Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY
(Decl. U/S 3 of UGC Act 1956)
DEPARTMENT OF MECHANICAL ENGINEERING

Semester: I
Theory:

Subject Code	Subject Title	C	L	T / S Lr.	P / R	Ty / Lb / ETL
BMA17005	Mathematics III for Mechanical and Civil Engineers	4	3	1	0	Ty
BCE17I05	Fluid Mechanics and Machinery	3	2	1	0	Ty
BME17003	Engineering Mechanics	4	3	1	0	Ty
BME17002	Manufacturing Technology - I	3	3	0	0	Ty
BCE17IL4	Fluid Mechanics and Machinery Lab.	1	0	0	3	Lb

Credits Sub Total: 15

Semester: II
Theory:

Subject Code	Subject Title	C	L	T / S Lr.	P / R	Ty / Lb / ETL
BMA17010	Numerical Methods for Mechanical and Civil Engineers	4	3	1	0	Ty
BEE17I01	Electrical and Electronics Engineering	3	3	0	0	Ty
BME17ET2	Manufacturing Technology-II	3	2	0/2	2/1	ETL
BME17006	Strength of Materials	4	3	1	0	Ty
BME17001	Engineering Thermodynamics	4	3	1	0	Ty

Credits Sub Total: 18

Semester: III
Theory:

Subject Code	Subject Title	C	L	T / S Lr.	P / R	Ty / Lb / ETL
BCS17 I03	C++ and Data Structures	3	3	0	0	Ty
BME17004	Thermal Engineering	4	3	1	0	Ty
BME17008	Mechanics Of Machines -I	4	3	1	0	Ty
BME17ET3	Engineering Metrology	3	3	0	0	ETL
BME17L08	Dynamics Lab.	1	0	0	3	Lb

Credits Sub Total: 15

Semester: IV

Theory:

Subject Code	Subject Title	C	L	T / S Lr.	P / R	Ty / Lb / ETL
BME17010	Industrial Automation	3	3	0	0	Ty
BME17011	Mechanics Of Machines -II	4	3	1	0	**Ty**
BME17005	Engineering Metallurgy	3	3	0	0	**Ty**
BME17Exx	Elective 1 (Industrial)	3	3	0	0	**Ty**
BME17L09	Heat Transfer Lab	1	0	0	3	**Lb**

Credits Sub Total: 14

Semester: V
Theory:

Subject Code	Subject Title	C	L	T / S Lr.	P / R	Ty / Lb / ETL
BME17014	Design of Machine Elements -I	4	3	1	0	Ty
BME17012	Heat and Mass Transfer	4	3	1	0	**Ty**
BMG17007	Statistical Quality Control and Reliability Engineering	3	2	1	0	Ty
BME17Exx	Elective 2 (Design)	3	3	0	0	Ty
BME17L10	Industrial Automation Lab	1	0	0	3	Ty

Credits Sub Total: 15

Semester: VI
Theory:

Subject Code	Subject Title	C	L	T / S Lr.	P / R	Ty / Lb / ETL
BME17014	Design of Machine Elements -II	4	3	1	0	Ty
BMG17004	Project Management	3	2	1	0	Ty
BME17Exx	Elective 3 (Manufacturing)	3	3	0	0	**Ty**
BME17013	CAD,CAM and CIM	3	3	0	0	Ty
BME17L13	Project Phase – I	2	0	0	6	Lb

Credits Sub Total: 15

Subject Code	Subject Title	C	L	T / S Lr.	P / R	Ty / Lb / ETL
BME17Exx	Elective 4 (Manufacturing)	3	3	0	0	**Ty**
BME17L14	Project Phase – II	10	0	0	20	Lb

Credits Sub Total: 13

Note :

C : Credits L : Lecture T : Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research

Ty / Lb / ETL : Theory / Lab / Embedded Theory and Lab

* Internal evaluation (Departmental level Refer Annexure for evaluation methodology)

4 Credit papers should compulsorily have either P/R component.

Credit Summary:

Semester : I	:	15
Semester : II	:	18
Semester: III	:	15
Semester : IV	:	14
Semester : V	:	15
Semester : VI	:	15
Semester: VII	:	13
Total Credits	**:**	**105**

LIST OF ELECTIVES						
Subject Code	**Subject Title**	**C**	**L**	**T / S Lr.**	**P / R**	**Ty / Lb / ETL**
	Elective: Thermal Engineering					
BME17E01	Advanced I.C Engines	3	3	0	0	Ty
BME17E02	Renewable Energy	3	3	0	0	Ty
BME17E03	Turbo machines	3	3	0	0	Ty
BME17E04	Refrigeration and Air Conditioning	3	3	0	0	Ty
BME17E05	Computational Fluid Dynamics	3	3	0	0	Ty
	Elective: Design Engineering					
BME17E06	Mechanical Vibrations	3	3	0	0	Ty
BME17E07	Finite element Analysis	3	3	0	0	Ty
BME17E08	Design of Production Tools	3	3	0	0	Ty
BME17E09	Design of Material Handling Equipment	3	3	0	0	Ty
BME17E10	Tribology	3	3	0	0	Ty
BME17E11	Design for Manufacture and Assembly	3	3	0	0	Ty
BME17E12	Mechanics of Fracture	3	3	0	0	Ty
	Elective: Manufacturing Engineering					
BME17E13	Industrial Robotics	3	3	0	0	Ty
BME17E14	Non-Conventional Machining Techniques	3	3	0	0	Ty
BME17E15	Process Planning and Cost Estimation	3	3	0	0	Ty
BME17E16	Flexible Manufacturing Systems	3	3	0	0	Ty
BME17E17	Powder Metallurgy	3	3	0	0	Ty
	Elective: Industrial Engineering Elective					
BME17E18	Enterprise Resource Planning	3	3	0	0	Ty
BME17E19	Industrial Engineering	3	3	0	0	Ty
BME17E20	Total Quality Management	3	3	0	0	Ty
BME17E21	Resource Management Techniques	3	3	0	0	Ty
BME17E22	Supply Chain Management	3	3	0	0	Ty

SEMESTER-I

Subject Code:	**Subject Name : MATHEMATICS III FOR MECHANICAL AND CIVIL ENGINEERS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BMA17005	Prerequisite: Mathematics I & II	T	3	1	0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Basic mathematical tools and techniques which emphasize the development of rigorous logical thinking and analytical skills.
- Theory and applications of partial differential equation, its applications, Fourier series, transforms and Laplace transformation.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the Basic concepts in Partial Differential equations
CO2	To understand the Basic concepts in Fourier series
CO3	To understand the Basic concepts in One & Two dimensional Heat and Wave equations
CO4	To understand the Basic concepts in Laplace Transforms
CO5	To understand the Basic concepts in Fourier Transforms

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	M	L	L	L	L	L	L	L	L
CO2	H	H	M	M	L	L	L	L	L	L	L	L
CO3	H	H	M	M	L	L	L	L	L	L	L	L
CO4	H	H	M	M	L	L	L	L	L	L	L	L
CO5	H	H	M	M	L	L	L	L	L	L	L	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	L	L	H	L			
CO2	M	L	L	H	L			
CO3	M	L	L	H	L			
CO4	M	L	L	H	L			
CO5	M	L	L	H	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
	✓											

Approval	**27th meeting of Academic council, June2017**

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

Formation of PDE by eliminating arbitrary constants and eliminating arbitrary functions – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second and higher order with constant coefficients.

UNIT- II: FOURIER SERIES **12** Hrs

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT- III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12** Hrs

Classification of second order linear partial differential equations – Solutions of one dimensional wave equation, one-dimensional heat equation – Steady state solution of two dimensional heat equations (Cartesian coordinates only) – Fourier series solutions.

UNIT- IV: LAPLACE TRANSFORMS **12** Hrs

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals – Periodic functions – Initial and final value theorems – Convolution theorem – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients and Linear simultaneous differential equations of first order with constant coefficients.

UNIT- V: FOURIER TRANSFORMS **12** Hrs

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem.

Total No. of Hrs : 60

TEXT BOOKS

1) Veerarajan T. (2007), *Engineering Mathematics (for first year)*, Tata McGrawHill Publishing Co.,
2) Veerarajan T. (2005), *Engineering Mathematics (for semester III)*, Tata McGraw Hill Publishing Co.,

REFERENCES

1) Singaravelu (2009), *Transforms and Partial Differential Equations*, Meenakshi Agency.
2) Kreyszig E. (2011), *Advanced Engineering Mathematics (9th ed.)*, John Wiley & Sons.
3) Grewal B.S. (2012), *Higher Engineering Mathematics*, Khanna Publishers.

Subject Code: BCE17I05	**Subject Name : FLUID MECHANICS AND MACHINERY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Engineering Physics & Mathematics	Ty	2	1	0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The students will learn
- The basic properties of fluids.
- Flow behaviour in various sections with basic equations
- Working principles of hydraulic pumps and turbines

COURSE OUTCOMES (COs) : (3- 5)

CO1	**CO1:** The basic properties of fluids.
CO2	**CO2:** Flow behaviour in various sections with basic equations.
CO3	**CO3:** Working principles of hydraulic pumps and turbines.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		H	M									
CO3			H	M								
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H											
CO2			M									
CO3					L		M					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								√				

Approval	**27th meeting of Academic council, June2017**

UNIT- I: PROPERTIES OF FLUIDS **7** Hrs

UNIT-s & Dimensions, Properties of fluids – density, specific Gravity, specific weight, viscosity. Surface tension and Capillarity, Compressibility & Bulk modulus, Vapour pressure, Measurement of pressure-Manometers, Mechanical gauges.

UNIT- II: FLUID FLOW CONCEPTS AND BASIC EQUATIONS **8** Hrs

Flow Characteristics, Concepts of System and Control Volume, Continuity, Energy equation- Euler equation- Bernoulli equation, Impulse momentum equation-applications.

UNIT- III: FLOW THROUGH CIRCULAR CONDUITS **8** Hrs

Laminar flow through circular tubes – Boundary layer thickness -Darcy equation on pipe roughness – Friction factor – Minor losses – Flow through pipes in series and in parallel, Equivalent pipes.

UNIT- IV: HYDRAULIC TURBINES **10** Hrs

Impact of free jets-work done and efficiency calculation, Classification of hydraulic turbines, Elementary working principles of Pelton, Francis, Kaplan turbine, Work done, Governing of turbines, Draft tube, Specific Speed.

UNIT- V: HYDRAULIC PUMPS **12** Hrs

Reciprocating pumps : Classification, Working, Single acting and Double acting, Slip, Indicator diagram, Air vessels. Centrifugal pumps :Classification, Components, Working, Velocity triangles, Losses & Efficiency of a centrifugal pump, Pumps in series & parallel, Specific speed, Separation, Cavitations, Priming.

Total No. of Hrs : 45

TEXT BOOKS

1) Bansal S.K. (2012) *"Fluid Mechanics and Hydraulic Machines"*, Laxmi Publications (P) Ltd., New Delhi.
2) R.K.Rajput. (1998) *"Fluid Mechanics and Hydraulic Machines"*, S.Chand & Company Ltd., New Delhi.

REFERENCES

1) L.Kumar. (2002), *"Engineering Fluid Mechanics"*, Eurasia Publishing House (P) Ltd., New Delhi.
2) Roberson J.A. & Crowe C.T. (2001), *"Engineering Fluid Mechanics"*, M/s Jaico Publishing Co., 9th edition
3) Streeter V.L. and Wylie E.B. (1983), *"Fluid Mechanics"*, McGraw Hill.
4) Ramamirtham S. (1988), *"Fluid Mechanics, Hydraulics and Fluid Machines"*, Dhanpat Rai & Sons, Delhi.
5) Yunus.A.Cengel, Robert H.Turner., *"Thermal-Fluid Sciences"*, Tata McGraw Hill.

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Subject Code:	**Subject Name : ENGINEERING MECHANICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17003	Prerequisite: 1.Basic concepts of force and its effect on bodies (PHYSIS) Basic knowledge of differential calculus and integral calculus(MATHEMATICS)	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Basic principles of stress, strain and elastic constants.
- To draw shear force and bending moment diagram
- To find deflection of beams.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The vector and scalar representation of forces and moments
CO2	Static equilibrium of particles and rigid bodies both in two dimensions and in three dimensions
CO3	The principle of work and energy.
CO4	The effects of friction on equilibriums ,the laws of motion, the kinematics of motion and the inter-relationship
CO5	To calculate the centre of gravity and moment of inertia

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H		M								H
CO2	M	H										H
CO3	M	H		M								H
CO4	M	H										H
CO5	M	H		M								H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H		M				
CO2	M	H						
CO3	M	H						
CO4	M	H						
CO5	M	H						

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										

Approval	**27th meeting of Academic council, June2017**

UNIT- I: STATICS **12** Hrs

STATICS OF PARTICLE: Introduction – units and Dimensions – Laws of mechanics – concurrent forces in a plane-resolution and Composition of forces – equilibrium of the particle-resultant force. Forces in space – Equilibrium of a particle in space

STATICS OF RIGID BODY **:** Free body diagram – Types of supports and their reactions – Moments and Couples – Moment of a force about a point and about an axis – Varignon's theorem – equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT- II: PROPERTIES OF SURFACE AND SOLIDS **12** Hrs

Determination of Area and volume – Determination and derivation of First moment of area(Centroid), Second moment of area(Moment of Inertia) of Regular as well as irregular geometrical area – Centroid of line elements. Mass moment of inertia and polar moment of inertia. Principal moments of inertia of plane areas – Principal axes of inertia-Product of Inertia.

UNIT- III: FRICTION **12** Hrs

Introduction – Laws of Dry Friction – Coefficient of friction – friction of a body lying on an inclined plane. Application of friction-Ladder friction-Wedge friction-Screw friction.

UNIT- IV: DYNAMICS OF PARTICLES **12** Hrs

KINEMATICS**:** Displacement, Velocity-Constant and variable Acceleration, their relationship – linear and curvilinear motion- Projectile motion, relative motion.

KINETICS**:** Linear and Curvilinear motion-Work-Energy method, Impulse and Momentum, Impact-collision of Elastic bodies. Newton's law-D'Alemberts principle.

UNIT- V: DYNAMICS OF RIGID BODIES **12** Hrs

KINEMATICS**:** Introduction-Rotation-Linear and Angular Velocity as well as acceleration. General plane motion-Absolute and Relative velocity in plane motion. Instantaneous centre of Rotation in plane motion-Location.

KINETICS**:** Relation between Translatory and Rotary motion of the body-Work energy equation of particles –D'Alemberts principle.

Total No. of Hrs : 60

TEXT BOOKS

1) R.S.Khurmi. (2008), "*A Textbook of Engineering Mechanics"*, S.Chand & co Ltd.
2) S.Rajasekaran et.al. (2009), "*Fundamentals of Engineering Mechanics",*Vikas Publishing House Pvt Ltd., 3rd Edition.

REFERENCES

1) Arthur.P.Boresi,Richard.J.Schmidt, "*Engineering Mechanics : Statics &Dynamics",* Thomson Brooks/Cole,Chennai.
2) Palanichamy M.S, Nagan.S, (2001), "*Engineering Mechanics – Statics and Dynamics*" Tata Mc Graw Hill.
3) Beer & Johnson et.al, (2010) *"Vector Mechanics for Engineers (Statics and Dynamics)",* Tata Mc Graw Hill.

Subject Code: BME17002	**Subject Name : MANUFACTURING TECHNOLOGY - I**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Basic Mechanical and Civil Engineering	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:
To impart knowledge in basics of manufacturing processes for metals and polymers
.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Various metal forming and joining processes
CO2	Basic machine tools - lathe and drilling machine**.**
CO3	Various methods of processing plastics.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		H			L			L			L
CO2	M		H			L			L			L
CO3	M					L	H					L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		H	H					
CO2		H	H					
CO3			M	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: METAL CASTING PROCESSES **9** Hrs

Introduction to Pattern making - Moulding sand - Melting furnaces - Special casting processes - Shell, Investment, Die casting, Full mould process - Defects in casting. Computers in casting processes.

UNIT- II: METAL FORMING PROCESSES **9** Hrs

Cold and hot working - Forging, Rolling, Extrusion, Drawing. . Introduction to sheet metal forming processes. High energy rate forming - Explosive forming, Electro-hydraulic, Electro magnetic forming, Dynapac machine, petro forge machines. Super plastic forming

UNIT- III: METAL JOINING PROCESSES **10** Hrs

Classification - Arc Welding –Sheet metal arc welding , Gas metal welding- - Submerged Arc , TIG, MIG, - Resistance welding -Electrode types – Specification- Special Types - Laser, Electron beam, Plasma Arc, Ultrasonic, Electro slag, Explosive welding and Friction welding - Thermit welding –inspection of welding- Defects in weld- Brazing and soldering

UNIT- IV: METAL CUTTING PROCESSES **9** Hrs

Lathe: Specification - Types - Mechanisms - Operations - Calculations - Capstan and turret lathe - Tooling with examples - Copy turning lathe. Drilling: Specification - Types - Feed Mechanism - Operations - Drill tool nomenclature - Mounting – Reamer and tap tools - Calculations.

UNIT- V: PROCESSING OF PLASTIC MATERIALS **8** Hrs

Types of Plastics - Types of moulding - Compression moulding - Transfer molding - Injection molding - Blow Moulding – Rota moulding - Film and sheet forming - Thermo forming - Reinforced plastic - Laminated plastics.

Total No. of Hrs : 45

TEXT BOOKS

1) Sharma P.C. (2008), *"A Text Book of Production Technology"*, S.Chand & Company Ltd., New Delhi.
2) Serope Kalpakjian (2013), *"Manufacturing Engineering and Technology"*, Addison-wesley Pub.Co ,7th edition.

REFERENCES

1) Rao P.N. (2007), *"Manufacturing Technology - Foundry Forging & Welding"*, Tata McGraw Hill Publishing Co., New Delhi, 2nd edition.
2) R.K. Jain, (2001) *"Production Technology"*, Khanna publisher.
3) O.P. Khanna, (1993), *"Welding Technology"*, Dhanpat Rai & sons.
4) S. K. Hajra Choudry, S. K. Bose, (2010) *"Elements of Workshop Technology -Volume I & II"*. Media promoters.

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Subject Code:	**Subject Name :** **FLUID MECHANICS AND MACHINERY LAB**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BCE 17IL4	Prerequisite: Thermodynamics	T	0	0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Different Methods of flow measurements
- To study the characteristics of hydraulic pumps.
- To study the characteristics of hydraulic turbines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Study the Different Methods of flow measurements
CO2	Study the performance characteristics of hydraulic pumps.
CO3	Study the performance characteristics of hydraulic turbines.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M			M	L					
CO2	H	L		M				M	L			
CO3	M		L	H			L					

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H		M		
CO2	H		M		
CO3	M		H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval	**27th meeting of Academic council, June2017**											

LIST OF EXPERIMENTS:

1. EXPERIMENTS ON FLOW MEASUREMENTS
   Venturimeter, Orifice Meter, Mouthpiece.

2. EXPERIMENT TO DETERMINE FRICTION FACTOR IN PIPES

3. EXPERIMENTS TO DRAW THE CHARACTERISTIC CURVES OF PUMPS
   Centrifugal pump, Reciprocating pump, Gear pump and Jet pump

4. EXPERIMENTS TO DRAW THE CHARACTERISTIC CURVES OF HYDRAULIC TURBINES
   Pelton Wheel, Francis Turbine.

SEMESTER - II

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Subject Code:	**Subject Name : NUMERICAL METHODS FOR MECHANICAL AND CIVIL ENGINEERS** (I yr. / II Sem. - Mechanical, II yr. / III Sem. - Civil - B.Tech (Part Time))	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BMA17010	Prerequisite: Mathematics I & II	T	3	1	0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Methods of solution of algebraic equations
- Basic principles of numerical interpolation methods.
- Solution methods for ordinary and partial differential equations.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the Basic concepts in Solution of Algebraic and Transcendental equations
CO2	To understand the Basic concepts in Interpolation
CO3	To understand the Basic concepts in Numerical Differentiation and Integration
CO4	To understand the Basic concepts in Numerical solutions of ODE
CO5	To understand the Basic concepts in Numerical solutions of PDE

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	M	L	L	L	L	L	L	L	L
CO2	H	H	M	M	L	L	L	L	L	L	L	L
CO3	H	H	M	M	L	L	L	L	L	L	L	L
CO4	H	H	M	M	L	L	L	L	L	L	L	L
CO5	H	H	M	M	L	L	L	L	L	L	L	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	L	L	H	L			
CO2	M	L	L	H	L			
CO3	M	L	L	H	L			
CO4	M	L	L	H	L			
CO5	M	L	L	H	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
	√											
Approval	**27th meeting of Academic council, June2017**											

UNIT- I: SOLUTION OF EQUATIONS **12** Hrs

Solution of Algebraic and Transcendental equations – Method of false position – Iteration method – Newton-Raphson method – Solution of Linear system of equations – Gauss Elimination method – Gauss-Jordan method – Iterative methods – Gauss-Jacobi method – Gauss-Seidel method – Matrix Inversion by Gauss-Jordan method.

UNIT- II: INTERPOLATION **12** Hrs

Newton forward and backward differences – Central differences – Stirling's and Bessel's formulae – Interpolation with Newton's divided differences – Lagrange's method.

UNIT- III: NUMERICAL DIFFERENTIATION AND INTEGRATION **12** Hrs

Numerical Differentiation with interpolation polynomials – Numerical Integration by Trapezoidal and Simpson's (both 1/3 rd & 3/8 th) rules – Two and three point Gaussian Quadrature formulae – Double integrals using Trapezoidal and Simpson's rules.

UNIT- IV: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS **12** Hrs

Taylor's series – Euler's & Modified Euler's method – Runge Kutta method of fourth order for first & second order differential equations – Milne's predictor-corrector method – Adam-Bashforth's predictor-corrector method.

UNIT- V: NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12** Hrs

Finite difference solutions for one dimensional heat equation (both implicit & explicit) – Bender-Schmidt method – Crank-Nicolson method – One dimensional wave equation – Two dimensional Laplace and Poisson equations – Liebmann's method.

Total No. of Hrs : 60

TEXT BOOK

1) Veerarajan T. (2005), *"Numerical Methods*", Tata McGraw Hill Publishing Co.

REFERENCES

1) Sastry S.S. (2003), *"Introductory Methods of Numerical Analysis*", Prentice Hall of India.
2) Kandasamy P., Thilagavathy, Gunavathy K. (2008), *"Numerical Methods" (Vol.IV),* S.Chand & Co.,
3) Grewal B.S. (2012), *"Higher Engineering Mathematics*", Khanna Publishers.

Subject Code:	**Subject Name :** **ELECTRICAL AND ELECTRONICS ENGINEERING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BEE17I01	Prerequisite: Thermodynamics	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Working principle of Electrical Machines
- Electronic engineering principles and digital electronics fundamentals.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Working principle of Electrical Machines
CO2	Working Principles of transformers and induction motors
CO3	Principles and digital electronics fundamentals

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H										
CO3		H	H	H	M	H	L					
Cos / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1							H					
CO2							H					
CO3							H					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	**27th meeting of Academic council, June2017**

NIT- I: DC MACHINES **9** Hrs

Construction details of DC machines – principle of operation of DC generator – EMF equation – Characteristics of DC generators – Principle of DC motor –Back EMF – Torque equation – Characteristics shunt, series and compound motors - Losses and efficiency – Starters – Speed control – applications.

UNIT- II: TRANSFORMERS **9** Hrs

Principle of ideal transformer – constructional details – EMF equation – Equivalent circuit – Voltage regulation – losses and efficiency – OC and SC tests on transformer – Autotransformer – Power supplies - basic principle of SMPS and UPS.

UNIT- III: SYNCHRONOUS MACHINES AND INDUCTION MOTORS **9** Hrs

Construction details – principle of alternator – EMF equation – Voltage regulation – Starting of synchronous motor – effect of field excitation – Induction motor – principle of operation – torque equation – torque-slip characteristics – Starting methods and speed control – principle of single -phase induction motor - applications. (Qualitative Treatment only)

UNIT- IV: DIGITAL ELECTRONICS **9** Hrs

Number systems-Binary, Octal, hexadecimal, Binary arithmetic-complement arithmetic-Binary coded decimal-Boolean Algebra-De Morgan's Laws-Logic gates-AND, OR, NOT, NAND, NOR, XOR-half & full adders-Multiplexers-De-multiplexers-Encoder-Decoder.

UNIT- V: FLIP FLOPS **9** Hrs

Flip Flops-RS-JK-D&T-Asynchronous & Synchronous counters-shift registers (brief explanation only)

Total No. of Hrs : 45

TEXT BOOKS

1) S.K Bhattacharya, (2008) *"Electrical Machines"*, Tata Mc Graw Hill Publications, 2nd Edition, 109098.
2) B.L.Theraja., (2012) *"Electrical Techonology"*,S.Chandhan Publication, 23rd edition.
3) M.Morris mano., (2008) *"Digital Design"*, Prentice-Hall of India,4th edition.

REFERENCES

1) I.J. Nagrath & D.P. Kothari, (2010) *"Electrical Machines"*, TMH Publications, 4th edition.
2) I Mckenzie Smith , (2012) *"Hughes Electrical Technology*", Revised, Low price Edition, Pearson Education, eleventh edition.

Subject Code: BME17ET2	**Subject Name : MANUFACTURING TECHNOLOGY - II**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Manufacturing Technology - I	ETL	2	0	2/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:
To impart knowledge and skill in metal cutting process and basics of powder metallurgy
.

COURSE OUTCOMES (COs) : (3- 5)

CO1	**Basic concepts of metal cutting**
CO2	**Various types of machine tools for metal cutting**
CO3	Basics of powder metallurgy techniques
CO4	Practical skill in various manufacturing processes in special purpose machines
CO5	

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H										L
CO2	M	M	H									L
CO3	L		H									L
CO4	M			H					H			H
CO5												

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		M	H					
CO2		H	H					
CO3		H		M				
CO4		M	H	M				
CO5								

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: THEORY OF METAL CUTTING **9** Hrs

Metal cutting types - Mechanism of metal cutting - Cutting forces - Chip formation - Merchant's circle diagram - Calculations – Tool geometry - Machinability - Tool wear - Tool life - Cutting tool materials - Cutting fluids.

UNIT- II: SPECIAL PURPOSE MACHINES-I **10** Hrs

Automats – Classification, cam controlled automats, single and multi spindle automats.
Shaper, Planer, slotter: Specification - Types - Mechanism – Calculations
Milling: Specification - Types - Cutter nomenclature - Types of cutter - Milling processes - Indexing - Cam and thread milling

Lab Components

SHAPING, AND SLOTTING PRACTICE: Cutting key ways and dove tail hexagonal machining using Shaper, Internal keyway using slotter
MILLING PRACTICE: Hexagonal milling, Contour milling

UNIT- III: SPECIAL PURPOSE MACHINES-II **10** Hrs

Broaching: Specification - Types - Tool nomenclature - Broaching process.
Boring: Specification - Types - Operations - Boring tool - Jig Boring machine.
Grinding: Types of grinding machine - Designation and selection of grinding wheel - Bonds - Reconditioning of grinding wheel – Lapping, honing and super finishing.

Lab Components

GRINDING PRACTICE: Cylindrical grinding, Surface grinding.

UNIT- IV: GEAR CUTTING MACHINES **8** Hrs

Kinematics of gear shaping and gear hobbing - Gear generation principles specifications - Cutters - Bevel gear generator - Gear finishing methods.

Lab Components

Machining of helical gear using hobbing machine**,** Spur gear milling

UNIT- V: POWDER METALLURGY AND PRECISION ENGINEERING **8** Hrs

Powder metallurgy – production of metal powders, compaction, sintering, selective laser sintering, finishing of sintered parts. Precision machining and micro machining – diamond turning of parts to nanometer accuracy, stereo microlithography, machining of microzied components

Total No. of Hrs : 45

TEXT BOOKS

1) S. K. Hajra Choudry, S. K. Bose, (2010) *"Elements of Workshop Technology -Volume I & II"*. Media promoters.
2) P. C. Sharma, (2008) *"A text book of Production Engineering"*, S. Chand and Co. Ltd., IV Edition.

REFERENCES

1) H.M.T, (1990) *"Production Technology – Handbook"*, TMH.
2) Richara R. Kibbe, John E. Neely, Roland O. Meyer and Warrent T. White, (2009) *"Machine Tool Practices"*, VI Edition, Prentice Hall of India.
3) N. K. Mehta, (2012) *"Machine Tool Design and NC"*, Tata McGraw Hill Publishing Co. Ltd.
4) Jaeger R.C, (1988) *"Introduction to microelectronics fabrication"*, Addison Wesley pub. Co.,
5) C. Elanchezian, M. Vijayan, (2004) *"Machine Tools"* Anuradha Publications.

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Subject Code:	**Subject Name : STRENGTH OF MATERIALS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17006	Prerequisite: Engineering Mechanics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Basic principles of stress, strain and elastic constants
- To draw shear force and bending moment diagrams
- to find deflection of beams

COURSE OUTCOMES (COs) : (3- 5)

CO1	Basic principles of stress, strain and elastic constants
CO2	To draw shear force and bending moment diagrams
CO3	To find deflection of beams.
CO4	To learn fundamental principles of equilibrium, compatibility, and force and deformation relationship
CO5	To learn fundamental principles of planes and cylindrical and spherical shells

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H		M		M						
CO2	M	H										
CO3	M	H		M		M						
CO4	M	H										
CO5	M	H		M								

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H						
CO2	H			M				
CO3	M	H						
CO4	H							
CO5	M	H						

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: STRESS, STRAIN DEFORMATION OF SOLIDS **9** Hrs

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 and their relationship – strain energy due to axial load – stress due to suddenly applied load and impact load.

UNIT- II: BEAMS - LOADS AND STRESSES **9** Hrs

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported beams and Overhanging beams Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stress distribution in beams of different sections.

UNIT- III: TORSION OF SHAFTS AND SPRINGS **9** Hrs

Theory of pure torsion- Torsion of circular and hollow shafts –Stepped shafts – Composite shaft – Stress due to combined bending and torsion. Type of springs - Stiffness- Springs in series-Springs in parallel - Stresses and deflections in helical springs and leaf springs – Design of helical springs- design of buffer Springs - leaf springs.

UNIT- IV: DEFLECTION OF BEAMS **9** Hrs

Double integration method- Macaulay's Method- Area Moment Theorems for Computations of slope and deflection in Beams. 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** Hrs

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point-Stress as Tension. Stresses on inclined plane – Principal planes and Principal stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy and Strain Energy Density.

Total No. of Hrs : 45

TEXT BOOKS

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2010.
2. S.Ramamruthum and R. Narayan, *"Strength of Materials"*, Dhanpat Rai & Sons,

REFERENCES:

1. Beer F. P. and Johnston R, (2002) "*Mechanics of Materials"*, McGraw-Hill Book Co, Third Edition

Egor P. Popov, *"Engineering Mechanics of Solids"*, Prentice Hall of India, New Delhi.

Subject Code: BME17001	**Subject Name : ENGINEERING THERMODYNAMICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Engineering Physics & Engineering Mathematics	Ty	3	1	0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: OBJECTIVE: The students will learn

- The fundamentals of thermodynamics and thermodynamic relations
- Properties of Steam and its applications.
- Different thermodynamic cycles

COURSE OUTCOMES (COs) : (3- 5)

CO1	Fundamentals concepts and laws of thermodynamics
CO2	Various properties steam and its applications
CO3	Various power cycles and their applications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		H	M	M								
CO3			M	M								
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H											
CO2	M											
CO3	M											

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS **12 Hrs**

Thermodynamics systems, Concepts of continuum, Thermodynamic properties, Equilibrium, Process, Cycle, Work, Heat, Temperature, and Zeroth law of thermo dynamics. First law of thermodynamics– Applications to closed and open systems, Internal energy, Specific heats, Enthalpy, Steady flow conditions.

UNIT- II: SECOND LAW OF THERMODYNAMICS **12 Hrs**

Statements, Reversibility, Causes of irreversibility, Carnot cycle, Reversed Carnot cycle, Heat engines, Refrigerators, Heat pumps. Clausius inequality, Concept of Entropy, Principles of increase of entropy, Carnot theorem, Available energy, Availability, Introduction to exergy.

UNIT- III: WORKING FLUIDS **12 Hrs**

Thermodynamic properties of pure substance, Property diagrams. PVT surface of water and other substances, calculation of properties. Applications of First law and second law analysis using tables and charts.

Properties of ideal and real gases, Equation of state, Gas laws. Van der-waal's equation of state, Compressibility. Daltons law of partial pressures, Internal Energy, enthalpy, Specific heat and molecular weight of gas mixtures.

UNIT- IV: POWER CYCLES **12 Hrs**

Gas power cycles - Carnot, Otto, Diesel, Dual, Brayton Cycles. Vapour Power Cycles – Rankine, Modified Rankine, Reheat, Ideal Regenerative cycle.

UNIT- V: THERMODYNAMIC RELATIONS **12 Hrs**

Exact differentials, Maxwell relations, Tds relations, Difference and ratio of Heat Capacities, Energy Equation, Clausius - Clapeyron equations, Joule-Thomson coefficient.

Total No. of Hrs : 60

Note: Standard and approved Steam Table, Mollier Chart are permitted in examination.

TEXT BOOKS

1) P.K.Nag, (2014) *"Engineering Thermodynamics" (Fifth Edition),* Tata McGraw Hill Education Publishing Company Ltd., New Delhi.
2) Yunus A.Cengel, (2014) *"Thermodynamics-An Engineering. Approach"*, Tata McGraw Hill Education, 8th edition.

REFERENCES

1) Spalding & Cole, (1973) "*Engineering Thermodynamics"*, ELBS, 6th edition.
2) J.P.Holman, (2011) "*Thermodynamics",* McGraw Hill 109095, 10th edition,
3) Van Wylen & Sonntag, (1998) "*Fundamentals of Classical Thermodynamics",* Wiley Eastern, 5th Edition.
4) Rogers & Mathew, (1992) *"Engineering Thermodynamics"*, Adison Wesley 1090909, 4th edition.
5) Michael Saad, (1966) *"Thermodynamics",* Prentice Hall 109097.

SEMESTER-III

Subject Code: BCS17I03	**Subject Name : C++ and Data Structures**	**Ty / Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

Master the implementation of linked data structures such as linked lists and binary trees

- with Be familiar with advanced data structures such as AVL trees and hash tables.
- Be familiar with several sub-quadratic sorting algorithms including quicksort, mergesort and heapsort
- Be familiar some graph algorithms such as shortest path and minimum spanning tree
- Master the standard data structure library of a major programming language(C++)

COURSE OUTCOMES (COs) : (3- 5)

CO1	Student will be able to understand the object oriented programming using C++ concepts.
CO2	Student will be able to handle operations like searching, insertion, deletion, traversing mechanism on various data structures.
CO3	Students will be able to implement the learned concept of data structures using C++.
CO4	Students will be able to use linear and non-linear data structures like stacks, queues , linked list etc

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	L	H	M	L	L	L	L	L	M	M
CO2	H	H	H	L	M	L	M	M	H	L	M	M
CO3	H	M	H	H	H	M	L	M	H	L	M	M
CO4	H	H	H	H	M	L	M	M	H	L	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		PSO6	
CO1	H	H	L	L	H	M	M	L
CO2	H	H	M	L	H	M	M	L
CO3	H	M	L	L	H	M	M	L
CO4	H	H	L	L	H	H	L	L

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Interdisciplinary subject		
										✓		
Approval	**27th meeting of Academic council, June2017**											

UNIT- I: INTRODUCTION TO OOPS **9 Hrs**

Object Oriented Concepts – Basics of C++ Environment. Definition – Data Members – Function Members – Control Statements-Overloading Operators – Functions – Friends – Class derivation – Virtual Functions – Abstract Base Classes.

UNIT – II: CLASSES, INHERITANCE & TEMPLATES **10 Hrs**

Constructor – Default constructors – Copy Constructors – Destructors – Static members –Constant Members – Free Store Operators- Multiple Inheritances- Exception Handling – Streams - Class Templates – Function Templates

UNIT - III: LINEAR DATA STRUCTURES **9 Hrs**

Stacks, Queues & Lists Implementation and Application Singly linked list – Doubly linked lists

UNIT - IV: NON LINEAR DATA STRUCTURES **9 Hrs**

Trees – Binary Trees – Binary Search Tree – Tree Traversals – AVL Trees

UNIT V: SEARCHING AND SORTING **8 Hrs**

Searching – Linear search-Binary Search. Sorting- Insertion sort, Bucket sort, Heap sort, Merge sort, Quick sort.

Total Hours: 45

Text Books :

1. E.Horowitz, S.Sahani & S.Rajasekharan, "Fundamentals of data structure in C++", Computer science press.
2. Balagurusamy.E, "*Object oriented programming with C++*", Tata McGraw-Hill publishing company limited, Addison Wesley.
3. Stanley B.Lippman, "The C++ Primer", Addison Wesley Publishers, 4th Edition, 2005.

Reference Books:

1. Weiss Mark Allen. "Data Structures and Algorithms Analysis in C", Pearson Education, 2/e, 1997
2. E.Horowitz, S.Sahani & S.Rajasekharan, "Computer Algorithms", Galgotia 1999.
3. Gary J. Bronson, "Object Oriented Program Development using C++", Thomson Learning, 4th Edition 2005. Brett D. McLaughlin, Gary Pollice, David West" Head First Object-Oriented Analysis & Design" O'Reilly Media, 2007.
4. Gilberg & Forugan, "Data Structures: A Pseudo Code Approach using C++ ", Thomson Learning 1st Edition, 2002.
5. Gary J. Bronson, "*Object oriented program development using Java*, Thomson Learning , 2nd Revised Edition 2005.

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	**Subject Name : THERMAL ENGINEERING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17004	Prerequisite: Engineering Thermodynamics	T	3	1	0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into the analysis of cyclic process.
- To apply the thermodynamic concepts into various thermal applications like, IC engines Steam turbines, Gas Turbines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge of various types of boilers, Condensers and nozzles
CO2	Knowledge of air compressors and working principles of gas turbines
CO3	Knowledge of working of steam turbines and it compounding
CO4	Knowledge of Working principles of I.C engines and testing
CO5	Knowledge of refrigeration and air conditioning

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M			M	L					
CO2	H	L		M				M	L			
CO3	M		L	H			L					
CO4	H	M	M			M	L					
CO5	H	L		M				M	L			

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H		M					
CO2	H		M					
CO3	M		H					
CO4	H		M					
CO5	H		M					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: STEAM GENERATORS, CONDENSERS AND NOZZLE **12** Hrs

Types and Classifications, high pressure boilers – Benson, Lamont and Babcock-Wilcox Boiler- mountings and Accessories – Criteria for selection of a boiler. Steam Condensers-Classifications – Evaporative and surface condensers-
Steam nozzles–isentropic flow through nozzles-convergent, convergent divergent nozzles-critical pressure ratio- effect of friction.

UNIT- I: AIR COMPRESSORS AND GAS TURBINES **12** Hrs

Reciprocating Compressor – Single Stage and Multi-stage operations, Effect of clearance, Volumetric efficiency. Rotary Compressor –Construction & Working of centrifugal compressor.
Gas turbines- classifications-Methods for improvement of Thermal efficiency –Inter-cooling, Reheating, Regeneration, Gas turbine fuels-Applications.

UNIT- III: STEAM TURBINES **12** Hrs

Impulse and Reaction Principles – Compounding-velocity and pressure compounding- Velocity diagrams for single stage turbines, Speed regulations – Governing.

UNIT- IV: INTERNAL COMBUSTION ENGINES **12** Hrs

Working principles of IC Engines- Cetane and Octane numbers of fuels, Knocking and Detonation, Scavenging and Supercharging, Valve and port timing diagrams, Fuel supply, Ignition, Cooling and Lubrication System.– Performance & Testing–Heat balance calculations.

UNIT- V: REFRIGERATION AND AIR-CONDITIONING **12** Hrs

Working principles of Vapour Compression refrigeration cycle –P-H & T-S diagrams, Calculation of COP, effect of subcooling and superheating, Vapour absorption refrigeration cycles – Refrigerants – Properties.
Introduction to Psychrometry – Psychrometric charts – Psychrometric processes - Principles of air-conditioning – Types of a/c systems – Summer, Winter comfort and Year round air-conditioning.

Total No. of Hrs : 60

***NOTE:** Use of approved Steam Tables, Refrigeration Tables and Psychrometric Charts are permitted in Examination.

TEXT BOOKS

1) Rajput R. K., (2012) *"Thermal Engineering"*, Laxmi Publications (P) Ltd.
2) C. P. Kothandaraman and S. Domkundwar, (2004) *"Thermodynamics and Thermal Engineering"* Dhanpat Rai & Co. (P) Ltd.

REFERENCES

1) P. L. Ballaney, (1994) *"Thermal Engineering"*, Khanna Publishers, New Delhi.
2) W.P.Stoecker and J. W. Jones, *"Refrigeration and Air Conditioning*", Tata McGraw Hill Co. Ltd.,
Ganesan V., (2012) "*Internal Combustion Engines"*, Tata McGraw Hill New Delhi, 4th edition

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Subject Code:	**Subject Name :** **MECHANICS OF MACHINES -I**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17008	Prerequisite: Engineering Mechanics, Strength of Materials	**T**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To understand the basic components and layout of linkages in the assembly of a system /machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components

.

COURSE OUTCOMES (COs) : (3- 5)	
CO1	Fundamental concepts of mechanisms and kinematic analysis of simple mechanisms.
CO2	Theory and application of friction in transmission drives
CO3	Fundamental concepts of gears and gear trains
CO4	Knowledge of different cams and their profiles

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	H									
CO2	H	L	H									
CO3	H	L	H									
CO4	H	L	H									

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		H						
CO2		H						
CO3		H						
CO4		H						

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								

Approval	**27th meeting of Academic council, June2017**

UNIT I BASICS OF MECHANISMS 12 Hrs

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle.

UNIT II KINEMATIC ANALYSIS OF MECHANISMS 12Hrs

Displacement, velocity and acceleration analysis of simple mechanisms –Velocity and acceleration polygons – analytical method and Kliens construction . Coincident points – Coriolis component of Acceleration.

UNIT III KINEMATICS OF CAM MECHANISMS 12Hrs

Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, uniform acceleration and retardation, simple harmonic motions – Derivatives of follower motions – Layout of plate cam profiles.

UNIT IV GEARS AND GEAR TRAINS 12Hrs

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions–Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Simple Epicyclic Gear Trains.

UNIT V FRICTION IN MACHINE ELEMENTS 12Hrs

Bearings and lubrication – Pivot and collar bearings, Friction clutches – Belt and rope drives – Friction in brakes- Shoe brakes, Band brakes and band and block brakes-braking torque.

Total No of Hrs: 60

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.
3.Khurmi R. S, (2012) *"Theory of Machines"*, S.Chand Publications,.

REFERENCES

1) Thomas Bevan, (2005) "*Theory of Machines"*,CBS Publishers and Distributors ,5th Edition.
2) Shigley J.E and Uicker J.J., (1995) *"Theory of Machines and Mechanisms"*, McGraw Hill Inc.
3) Rattan S.S., (2009) "*Theory of Machines"*, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4) Dr.V.P.Singh. (2005) "*Theory of Machines"*, Dhanpat Rai and Co Private Limited.

Subject Code:	**Subject Name : ENGINEERING METROLOGY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17ET3	Prerequisite: Engineering Sciences	ETL	2	0	2/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:
To gain knowledge and skill in precision measuring instruments
.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand and apply the various measuring and inspection methods in metrology.
CO2	Recent advances in metrology
CO3	Practical skill in handling precision instruments

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L		M	H							L
CO2	M				H							L
CO3	M			H	M				H			H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		M	H	M				
CO2		M	H	H				
CO3			H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: BASIC CONCEPTS OF MEASUREMENTS **7 Hrs**

Need for measurement - Precision and Accuracy - Reliability - Errors in Measurements – Types – Causes.

UNIT- II: LINEAR AND ANGULAR MEASUREMENTS **9** Hrs

Measurement of Engineering Components: Comparators (Mechanical, Optical, Electrical) - Slip Gauges - Limit Gauges - Auto Collimator - Angle Decker - Alignment Telescope - Sine Bar - Bevel Protractor**.**

Lab Components:

1.Angular Measurement using Sine Bar, Slip Gauge and Dial Gauge,
2.Measurement of Dimensions using Vernier Height Gauge
3.Measurement of Dimensions using Vernier Depth Micrometer
4.Angular Measurement using Vernier Height Gauge and Sine Bar
5.Angular measurement using Bevel Protractor
6.Calibration of Dial Gauge using Slip Gauge
7.Flatness of given work piece using Autocollimator

UNIT- III: FORM MEASUREMENTS **10** Hrs

Measurement of: Screw Thread – Gears - Radius - Surface Finish – Straightness - Flatness – Roundness.

Lab Components:

1.Measurement of Gear Nomenclature using Gear Tooth Vernier
2.Thread Measurement using Profile Projector

UNIT- IV: LASER METROLOGY **10** Hrs

Precision instrument based on Laser: Use of Lasers - Principle - Laser Interferometer - Application in Linear and Angular measurements - Testing of machine tools using Laser Interferometer**.**

UNIT- V: ADVANCES IN METROLOGY **9** Hrs

Co-ordinate Measuring Machine (CMM) - Constructional features - Types - Applications of CMM – CNC applications - Computer Aided Inspection (CAI) - Machine Vision - Applications in Metrology.

Lab Components:

1.Measurement of Dimensions using Tool Makers Microscope

Total No. of Hrs : 45

TEXT BOOK

1) R.K. Jain, (1994) *"Engineering Metrology"*, Khanna publishers, 109094.

REFERENCES

1) I.C. Gupta, *"A TEXT BOOK of Engineering Metrology"*, Dhanpat Rai & sons, 109096.
2) G.N. Galyer and C.R. Shotbolt, *"Metrology for Engineers"*, ELBS edition, 109090.
3) Thomas *"Engineering Metrology"*, Butthinson & co, 10984.

Subject Code:	**Subject Name :** **DYNAMICS LAB**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17L08	Prerequisite: Theory of Machines	T	0	0	3	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- Working of simple mechanisms
- Dynamic analysis of machine elements
- To find natural frequency of vibrating system at different models

.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Working of universal governors and their applications
CO2	Working of gyroscope and its applications
CO3	Working principles of vibrating systems

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M			M	L					
CO2	H	L		M				M	L			
CO3	M		L	H			L					
Cos / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H				M							
CO2	H				M							
CO3	M				H							

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval	**27th meeting of Academic council, June2017**											

KINEMATICS (Demonstration only)

1. Kinematics of four bar mechanisms - Slider Crank, Crank Rocker Mechanism.
2. Kinematics of Gears - Spur, Helical, Bevel, Worm.
3. Kinematics of Gear trains - Simple, Compound, Epicyclic & differential gear trains.

1. DYNAMICS

a. Motorized Gyroscope - Verification of Laws.
b. Connecting Rod and Flywheel - Determination of M.I. by oscillation.
c. Governors - Watts, Porter, Proell and Hartnell – Study of characteristics and determination of Sensitivity, effort etc.
d. Cam-profile of the cam-study of Jump phenomenon - Determination of Critical Speeds.

2. VIBRATING SYSTEMS

a. Helical Spring – Determination of natural frequency
b. Compound Pendulum - Determination of natural frequencies - moment of inertia.
c. Torsional vibration - Determination of natural frequencies – Single rotor system – Two rotor system
d. Flywheel - Determination of torsional natural frequencies – moment of inertia.
e. Whirling of shaft - Determination of critical speed of shaft.

3. BALANCING

Static and dynamic balancing of rotating masses

Total No. of Hrs : 45

SEMESTER-IV

Subject Code:	**Subject Name : INDUSTRIAL AUTOMATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17010	Prerequisite:	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:
To impart knowledge in hydraulic, pneumatic and mechatronics system in Automation.
.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand Pneumatic and hydraulic components and functions
CO2	Design of Pneumatic and hydraulic circuits for automation.
CO3	Understand Components of mechatronics system

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	M		H							M
CO2	L	H	H		H							M
CO3	L	H	H		H							M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		H		H				
CO2		H		H				
CO3		H		H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I BASIC PRINCIPLES OF HYDRAULICS AND PNEUMATICS **8** Hrs

Hydraulic principles – Hydraulic pumps – pumping circuits - Hydraulic actuators – Characteristics – Hydraulic valves types and Applications – Hydraulic Fluids. Fundamentals of pneumatics – Control elements – logic circuits – position – pressure sensing – switching – Electro-pneumatic – Electro-hydraulic circuits. Symbols of hydraulic and pneumatic circuits.

UNIT- II DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS **10** Hrs

Hydraulic circuits – Reciprocating – Quick-return – sequencing – synchronizing –Accumulators circuits – Safety circuits – Industrial circuits. Pneumatic circuits – classic – cascade – step counter – combination methods.
Design of Hydraulic and pneumatic circuits - Selection of components – Installation and Maintenance of Hydraulic and Pneumatic power packs.

UNIT- III MECHATRONICS, SENSORS AND TRANSDUCERS **8** Hrs

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

UNIT- IV ACTUATION SYSTEM AND SYSTEM MODELS **8** Hrs

Hydraulic, Pneumatic and electrical actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – D.C Motors – A.C Motors – Stepper Motors. Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Translational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems.

UNIT- V CONTROLLERS AND DESIGN OF MECHATRONICS SYSTEMS **11 Hrs**

Continuous and discrete process Controllers –PID Controllers – Digital Controllers, Digital Logic Control – Micro Processors Control. Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls. Stages in designing Mechatronics Systems -Case Studies of Mechatronics Systems, Pick and place robot – automatic Car Park Systems – Engine Management Systems.

Total No. of Hrs: **45**

TEXT BOOKS

1) S.Ilango and V.soundarrajan ,(2011) "*Introduction to Hydraulics and Pneumatics"*,Prentice hall india,2nd Edition.
2) K.Shanmugasundaram(2006) "*Hydraulic and Pneumatic control*"S.Chand &Co.
3) W. Bolton, "Mechatronics", Pearson Education, Second Edition, 1999.

REFERENCES

1) Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.
2) Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993.
3) Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering", An Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
4) Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, 2003
5) Anthony Esposito, (2008) *"Fluid power with applications"*, Pearson education Pvt. Ltd, 7th edition.
6) W.Bolton, (2012) *"Pneumatic and Hydraulic Systems"*, Butterworth, 3rd edition.

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: **BME17011**	**Subject Name :** **MECHANICS OF MACHINES –II**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Engineering Mechanics, Strength of Material	0	3	1	0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

To understand the method of static force analysis and dynamic force analysis of mechanisms

- To study the undesirable effects of unbalances in rotors and engines.
- To understand the concept of vibratory systems and their analysis
- To understand the principles of governors and gyroscopes.

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COURSE OUTCOMES (COs) : (3- 5)

CO1	Static and dynamic analysis of force.
CO2	Balancing of rotating and Reciprocating masses
CO3	Fundamental concepts of different vibratory systems.
CO4	Working principles of Speed controlling governors
CO5	Gyroscopic principle and its effects

Mapping of Course Outcomes with Program Outcomes (Pos)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M									
CO2	H	H	M									
CO3	H	H	M									
CO4	H	H	M									
CO5	H	H	M									

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO 5			
CO1		H						
CO2		H						
CO3		H						
CO4		H						
CO5		H						

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								

Approval	**27th meeting of Academic council, June2017**

UNIT I FORCE ANALYSIS AND FLYWHEELS 12 Hrs

Static force analysis of mechanisms – D ' Alemberts principle - Inertia force and Inertia torque – Dynamic force analysis - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses -Bearing loads - Crank shaft Torque– Engine shakingforces - Turning moment diagrams - Flywheels of engines and punch press.

UNIT II BALANCING 12 Hrs

Static and dynamic balancing - Balancing of rotating masses in several planes - Partial Balancing of a single cylinder Engine –Primary and secondary unbalanced forces.

UNIT III FREE VIBRATION 12 Hrs

Basic features of vibratory systems - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom – Longitudinal and transverse Free vibration - Equations of motion - natural frequency - Types of Damping -Damped free vibration –Whirling of shafts and critical speed -Torsional systems; Natural frequency of two and three rotor systems – torsionally equivalent shaft system.

UNIT IV FORCED VIBRATION 12 Hrs

Response to periodic forcing - Harmonic Forcing – Forced vibration caused by unbalance -Support motion – Force transmissibility and amplitude transmissibility - Vibration isolation

UNIT V MECHANISMS FOR CONTROL 12 Hrs

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors – Characteristics - Effect of friction - Controlling Force – Quality of governors – effect of friction.
Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in aero plane, automobiles and ships.

Total No. of Hrs : 60

TEXT BOOKS:

1. Ambedkar A. G., Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East- Press Pvt.Ltd., New Delhi, 1988.
3. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.
4. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory ", Wiley-Eastern Limited, New Delhi, 1992.
5. John Hannah and Stephens R.C., "Mechanics of Machines", Viva low-Priced Student Edition, 1999.
6. Sadhu Singh "Theory of Machines" Pearson Education, 2002.

Subject Code:	**Subject Name : ENGINEERING METALLURGY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17005	Prerequisite: Material Science	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:
To understand different materials and their metallurgical properties
.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Fundamental of metal structures and strengthening mechanisms
CO2	Properties and applications of metals, nonmetals and newer materials.
CO3	Heat treatment and testing of materials

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L		H		M	M					L
CO2	M	L		H		M	M					L
CO3	M	H		M		M	M					L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1			H	H				
CO2			H	H				
CO3		M	H	M				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: CRYSTALLOGRAPHY AND STRENGTHENING MECHANISMS **9 Hrs**

Crystalline and amorphous solids - UNIT- cell and primitive cell - Miller indices BCC, FCC and HCP crystal structures and their packing factors –Crystalisation- Crystal defects - Effect of crystal imperfections in mechanical properties- Dislocations- strengthening mechanisms for the improvement of mechanical properties.

UNIT- II: FERROUS AND NON FERROUS METALS **9** Hrs

Significance of Phase diagram-(Eutectic and Eutectoid alloy system)-Equilibrium and Non- Equilibrium cooling-Allotrophy of Iron-iron carbon phase diagram.

Classification of Steels and Cast Iron-Microstructure of Iron and Steel- Cast Irons - Grey, White malleable, spheroidal – Effect of alloying elements on steel - stainless and tool steels. Copper and Copper alloys - Brass, Bronze and Cupronickel – Aluminum and Al-Cu alloy

UNIT- III: HEAT TREATMENT AND TESTING **9** Hrs

Definition - Classification of heat treatment process - Purpose of heat treatment -Principles (fundamentals) of heat treatment - Annealing –Re-crystallization- Normalizing - Hardening-TTT-CCT Cooling curves- Tempering - Interrupted quenching - Testing of materials - Destructive testing - Tensile, Compression, Hardness, Impact, Torsion, Fatigue. Non-destructive testing - Visual inspection, Hammer test, Radiography, Ultrasonic inspection.

UNIT- IV: FAILURE MODES AND ITS PREVENTIONS **9** Hrs

Plastic deformation-Fracture - Mechanism of brittle fracture (Griffith's theory) and ductile fracture -Difference between brittle and ductile fractures - Fatigue failure and its prevention - Creep - different stages in creep curve - Factors affecting creep resistant materials -Mechanism of creep fracture.

UNIT- V: NON METALLIC AND NEWER MATERIALS **9** Hrs

Types, Properties and Application: Polymers, Ceramics and Metal matrix Composites –Super alloys, Nano-materials-carbon and metal based materials, Smart materials and their properties

Total No. of Hrs : 45

TEXT BOOKS

1) Avner, (1997) *"Introduction to Physical Metallurgy"*, McGraw Hill International Book., second edition.
2) Williams D Callister, (2007) *"Material Science and Engineering",* Wiley India Pvt Ltd, Revised Indian Edition.

REFERENCES

1) Raghavan, V., (2006) *"Materials Science and Engineering"*, Prentice Hall of India Pvt., Ltd.," 5 th edition.
2) Muralidhara. M.K. (1998) *"Material science and Process"*, Danpat Rai Publishing.
3) Nayak, S.P., (1985) *"Engineering Metallurgy and Material Science"*, Character Publishing House, Anand, India.
4) Van Vlack, (1970) *"Material Science for Engineers"*, Addison Wesley, 10985,
5) Arumugam, M., (1997) *"Material Science"*, Anuradha Publishers.
6) O.P. Kanna (1999) *"Material Science and Metallurgy"*, Prentice Hall of India Pvt., Ltd.

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	**Subject Name : HEAT TRANSFER LAB**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17L09	Prerequisite: Thermodynamics	T	0	0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To evaluate the performance of air compressor, air blower and refrigeration and air conditioning systems.
- To determine the properties of different liquid fuels.
- To study the different modes of heat transfer.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Study the performance of air compressor, air blower and refrigeration and air conditioning systems**.**
CO2	To study the properties of different liquid fuels.
CO3	To study the different modes of heat transfer.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M			M	L					
CO2	H	L		M				M	L			
CO3	M		L	H			L					

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H		M					
CO2	H		M					
CO3	M		H					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval	**27th meeting of Academic council, June2017**											

LIST OF EXPERIMENTS:

1. Performance test on reciprocating air compressor.
2. Performance test on a constant speed air blower.
3. Viscosity measurement using Redwood apparatus.
4. Viscosity measurement using Say bolt apparatus.
5. Determination of COP of a refrigeration system.
6. Determination of COP of air conditioning system.
7. Determination of flash point and fire point of the given lubricating oil sample**.**
8. Determination of thermal conductivity of an insulating material.
9. Determination of efficiency of a pin fin using natural and forced convection methods.
10. Determination of emissivity of a gray body using emissivity apparatus.
11. Determination of Stefan Boltzmann Constant.
12. Determination of effectiveness of a parallel flow and counter flow heat exchanger.
13. Determination of Heat Transfer in Drop and Film wise Condensation
14. Overall Heat Transfer Coefficient of Composite wall..

Total No. of Hrs : 45

SEMESTER-V

Subject Code: **BME17014**	**Subject Name : DESIGN OF MACHINE ELEMENTS - I**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Engineering Mechanics, Strength of Materials, Mechanics of Machines -I	T	3	1	0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- Design principles of various components in mechanical engineering application.
- To familiarize the various steps involved in the Design Process to satisfy functional and strength requirements.
- To use standard practices and standard data.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Design principles of various components in mechanical engineering application.
CO2	To familiarize the various steps involved in the design process to satisfy functional and strength requirements.
CO3	To use standard practices and standard data.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	H	M						L		
CO2	L		M							L		
CO3	L											

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H			
CO2		M			
CO3		M	M		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: INTRODUCTION TO DESIGN OF MACHINE ELEMENTS **10 Hrs**

Mechanical Engineering Design – Design considerations – Material selection – Modes of failure – Theories of failure – Stress concentration – Factor of safety.

UNIT- II: SHAFTS AND COUPLINGS **14** Hrs

Design of shafts and couplings – Design of cotter and knuckle joints

UNIT- III: DESIGN OF SPRINGS **10** Hrs

Design of Helical and Leaf springs

UNIT- IV: FASTENERS AND KEYS **14** Hrs

Design of welded joints – Fillet and butt welds – Design of riveted joints.

UNIT- V: BEARINGS **12** Hrs

Design of sliding contact bearings – Selection of rolling contact bearings

Total No. of Hrs : 60

***NOTE:** Use of PSG Design Data book is permitted in Examination

TEXT BOOKS

1) Shigley J.E and Mischke C. R., (2008) *"Mechanical Engineering Design"*, Sixth Edition, Tata McGraw Hill.
2) Bhandari V.B, (2010) *"Design of Machine Elements"*, Second Edition, Tata McGraw-Hill Book Co.

REFERENCE BOOK:

1. Sundararajamoorthy, T.V. and Shanmugan, Machine Design, Anuradha Agencies, 2003.
2. Shigley, J.E., Charles, R.M. and Richard, G.B., Mechanical Engineering Design, 7th ed., McGraw-Hill, 2004.

Subject Code:	**Subject Name : HEAT AND MASS TRANSFER**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17012	Prerequisite: Engineering Physics & Mathematics	Ty	3	1	0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Concept and modes of heat and mass transfer.
- Concept of various heat transfer correlations and their engineering calculations.
- Concept and types of heat exchangers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Concept of Conduction and Convection heat transfer and their correlations.
CO2	Concept of radiation and phase change heat transfer and applications
CO3	Concept of heat exchangers classifications and its applications
CO4	Concept of Mass transfer correlations and its applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M									
CO2		M	M									
CO3		M	M									
CO4		M	M									

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M						
CO2		M						
CO3		M	M					
CO4		M						

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: CONDUCTION **13** Hrs

Introduction of heat transfer – Mode of Heat Transfer- Fourier' Law of Conduction - General Differential equation of Heat Conduction- Heat conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems - Critical thickness of insulation - Extended surfaces (Fins).

UNIT- II: CONVECTION **13** Hrs

Basic Concepts – Boundary Layer Concept – Types of Convection – Forced Convection-External Flow- Flow over flat plates, Cylinders and Spheres- Internal Flow–Laminar and Turbulent Flow– Combined Laminar and Turbulent –Free Convection – Flow over Vertical Plate, Horizontal Plate and long horizontal cylinder.

UNIT- III: RADIATION **12** Hrs

Basic Laws of Radiation, Radiation shape factor, shape factor algebra for radiant heat exchange between black and gray bodies and Radiation shield-, Introduction to Radiosity and Irradiation.

UNIT- IV: PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER **12** Hrs

Boiling heat transfer phenomenon – modes of boiling, pool boiling regime-flow boiling thro horizontal pipes.-boiling empirical correlations. Condensation-film and drop wise condensation-Nusselt theory of condensation over vertical surface - governing equations-empirical correlations. Heat exchangers- types-Description only.

UNIT- V: MASS TRANSFER **10** Hrs

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Convective Mass Transfer Correlations.

Total No. of Hrs : 60

***NOTE:** Use of approved HMT data book is permitted in the University Examination.

TEXT BOOKS

1) C.P.Kothandaraman, (2005) "*Fundamentals of Heat and Mass Transfer"*, New age International (p) Ltd-109098.
2) R.C.Sachdeva (2010). "*Fundamentals of Heat and Mass Transfer"*, New age International (p) Ltd -109098, 4th edition.
3) R.K.Rajput (2007) "*Heat and Mass transfer"*, Chand Publishers

REFERENCES

1) J.P.Holman (2001) *"Heat transfer"*, McGraw Hill Book Company, 9th edition.
2) Ozisik.N.M. (1998) "*Heat transfer"*, McGraw Hill Book Company.
3) Michael A. Boles and Yunus A. Cengel (2002), "*Thermodynamics: An Engineering Approach*", McGraw-Hill.

Subject Code:	**Subject Name : STATISTICAL QUALITY CONTROL & RELIABILITY ENGINEERING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BMG17007	Prerequisite: Basic Knowledge as Statistical Techniques and Probability Theory	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: The student will learn:

- Concepts, principles, techniques and implementation of Quality Control and Reliability

COURSE OUTCOMES (COs) :

CO1	Concepts Quality Control and Reliability
CO2	Principles and Techniques of quality control
CO3	Reliability improvement

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	H	M	M	M	L				M		M
CO2	M	H	M	M	M	L				M		M
CO3	M				L	M		M	H	H	M	M

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1			M	L
CO2			M	
CO3			M	

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: STATISTICAL QUALITY CONTROL **9** Hrs

Quality, quality control, factors affecting quality, methods of control, chance causes, assignable causes. Quality control and quality assurance, economics of quality, organization for quality, statistical tools for quality control, quality circles**.**

UNIT- II: CONTROL CHARTS **9** Hrs

Control charts, control charts for variables X bar and R charts , standard deviation Charts, process and machine capabilities, control charts for attributes, fraction defective and number of defectives charts, control charts for non-conformities, special control charts, statistical process control.

UNIT- III: ACCEPTANCE SAMPLING **9** Hrs

Types of sampling, sampling inspection, inspection by Attributes and Variables, role of acceptance sampling, procedure for sampling, single, double, multiple sequential sampling plans, O.C.curves, quality indices for acceptance sampling plans, Dodge-Romig sampling for lot by lot, acceptance sampling by attributes, AQL, LTPD, AOQL- sampling plans, numerical problems on the above**.**

UNIT- IV: RELIABILITY **9** Hrs

Definition, mean fracture rate, mean time to failure, mean time between failure, hazard rate ,hazard models. Weibull model, system reliability, series , parallel and mixed configuration , simple problems.

UNIT- V: RELIABILITY IMPROVEMENT **9** Hrs

Reliability improvement, redundancy, element , UNIT- and stand by redundancy , reliability allocation for a series system , maintainability and availability. System down time , reliability and maintainability trade off , simple problems.

Total No. of Hrs : 45

Note: Approved SQC table to be permitted for University examination.

TEXT BOOKS

1) Grantt, "*Statistical Quality Control"*, Tata McGraw Hill.
2) L.S.Srinath, *"Reliability Engineering*", Affiliated East West Press, New Delhi, 10975.

REFERENCES

1) Jerry Banks, "*Principles of Quality Control"*, John Willey, 109090
2) Dr. E. Balagurusamy, *"Reliability Engineering"*

Subject Code:	**Subject Name : INDUSTRIAL AUTOMATION LAB**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17L10	Prerequisite:	L	0	0	3/0	1

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To get practical knowledge through intensive practice on CNC Machines and related software.¬
- To practice simple programs on microprocessors and micro controllers.¬
- To design and implement pneumatic and hydraulic circuits with automation studio software and with¬ kits.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Write Simple programs on microprocessors and micro controllers.
CO2	Design and implement pneumatic and hydraulic circuits with automation studio software and with kits
CO3	Knowledge of industrial robots

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L		H		H							H
CO2	L		H		H							H
CO3	L		L		M							H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		H		H				
CO2		H		H				
CO3		H	M	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	**27th meeting of Academic council, June2017**

LIST OF EXPERIMENTS:

1. Exercises in PLC Trainer Kit.
2. Exercises in Pneumatic / Hydraulic Trainer Kit.
3. Exercises in Industrial Robot.
4. Exercises in microprocessors and micro controllers.
5. Design of pneumatic and hydraulic circuits using Automation Studio software.

Total No. of Hrs: 45

SEMESTER -VI

Subject Code:	**Subject Name : DESIGN OF MACHINE ELEMENTS - II**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17014	Prerequisite: Engineering Mechanics, Strength of Materials, Mechanics of Machines – I, Design of Machine Elements - I	T	3	1	0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Design principles and design procedure of various mechanical power transmission systems.
- Use of standard design data books and catalogues.

OURSE OUTCOMES (COs) :

CO1	**Design principles and design procedure of various mechanical power transmission systems.**
CO2	Design principles and design procedure of simple mechanism.
CO3	Use of standard design data books and catalogues

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		H							L		L
CO2	L		M									L
CO3			M	L								

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	L					
CO2	L	H	M					
CO3	L	M	L					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	**27th meeting of Academic council, June2017**

UNIT- I: DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS **14** Hrs

Selection of V belts and pulleys – selection of Flat belts and pulleys – Wire ropes and pulleys –Selection of Transmission chains and Sprockets.

UNIT- II: DESIGN OF SIMPLE GEARS **12** Hrs

Design of gears – Spur gear, Helical gear and Herringbone gears.

UNIT- III: DESIGN OF SPECIAL GEARS **12** Hrs

Design of Bevel gears – Straight and Spiral Bevel types. Design of Worm gears .

UNIT- IV: DESIGN OF SPEED REDUCERS **14** Hrs

Design of speed reducers –Geometric Progression – Standard Step ratio- Ray diagram – Kinematic arrangement of Gears - Number of teeth on gears.

UNIT- V: DESIGN OF SIMPLE MECHANISMS **8** Hrs

Design of Ratchet and pawl mechanism, Geneva mechanism.

Total No. of Hrs : 60

***NOTE:** Use of P.S.G Design Data Book is permitted in the University examination

TEXT BOOKS

1) Shigley J.E and Mischke C. R., (2003) *"Mechanical Engineering Design"*, Sixth Edition, Tata McGraw Hill.
2) Sundararajamoorthy T. V and Shanmugam .N, (2003) *"Machine Design"*, Anuradha Publications, Chennai.

REFERENCES

1) Maitra G.M. and Prasad L.V., *"Hand book of Mechanical Design"*, II Edition, Tata McGraw Hill 10985.
2) Bhandari, V.B., *"Design of Machine Elements"*, Tata McGraw Hill Publishing Company Ltd., 109094.
3) Prabhu. T.J., (2000) *"Design of Transmission Elements"*, Mani Offset, Chennai.
4) Hamrock B.J., Jacobson B. and Schmid S.R., *"Fundamentals of Machine Elements"*, Tata McGraw-Hill Book Co., 1090909.
5) Ugural A,C, (2003) *"Mechanical Design, An Integrated Approach"*, Tata McGraw-Hill.

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code:	**Subject Name : PROJECT MANAGEMENT**		**L**	**T**	**P**	**C**
BMG17004	Prerequisite: Basic Knowledge as Management Concepts		3	0	0	3

L : Lecture T : Tutorial P : Project C: Credits

OBJECTIVE: The student will learn:

- To increasing involvement of students in decision making,
- To achieve optimum utilization of various resources.
- To have co-ordination between various department in the organization for completion of project

COURSE OUTCOMES (COs) :

CO1	Understand the basics of Project management
CO2	Explain the process of project planning with standards
CO3	Describe Project financing and investment institutions
CO4	Understand the stages of Project implementation and evaluation
CO5	Outline a Project feasibility study

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	M	H	M	M	M	L	
CO2		H	M	M	M	L	
CO3	M				L	M	M
CO4			M			M	
CO5			L	L	M		M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Management Science		
										✓		

Approval	**27th meeting of Academic council, June2017**

UNIT I Project Management **9 Hrs**

Project management – Concept of a Project – Categories of Project - Project life cycle Definition of project management - The project as a conversion Process - project environment - complexity of projects - the relationship between project Management and line management - current issues in project management- system approach to project management - Roles and responsibilities of project manager.

UNIT II Project planning **9 Hrs**

Project planning - project planning as a value adding activity - process of project planning -managing the planning process - communicating project plans - dealing with increased complexity through net work diagrams - Analyzing the network- Critical Path Analysis -Activity on Nodes diagramming- Dealing with the uncertainty Programme Evaluation and Review Technique- Computerized Project Management - planning with standards.

UNIT III Project Financing **9 Hrs**

Project financing and development banks - Development banking and western world - debt Equity ratio-Equity and Preference Share Capital- Internal Generation of Funds- Leasing Financing - Public sector bonds-Debentures- Assistance from International financial- Short Ten Rupee Funds for Working capital- All India Development Corporation- Specialized Institution - Investment Institution - means of financing - project financing package -procuring funds.

UNIT IV Project Implementation **9 Hrs**

Project implementation - stages - Bottlenecks in project implementation -Guidelines for effective implementation - Management techniques for project management - project monitoring - essentials - roles - tools and techniques Project management performance indicators performance improvement - project management environment -management reporting - report designing - project evaluation - project review.

UNIT V Project Feasibility **9 Hrs**

Project feasibility study- Market Feasibility- Technical Feasibility-Financial Feasibility - Economic Feasibility-Critical Success factors- Demand forecasting techniques.

TOTAL NO OF PERIODS: 45 Hrs

Text Books:

1. S. Choudhury, Project Management, Tata McGraw Hill publishing ISBN-10: 0074600680 ISBN-13: 978-0074600689
2. B.B. Goel, Project Management Principles & Techniques, Deep & Deep publications Pvt Ltd. Reprint ISBN NO 8171007880, 9788171007882

REFERENCE BOOKS:

1. Harvey Maylor, Project Management, Macmillan India Ltd. 4th Edition.
2.Prasanna Chandra Project Planning, Analysis, Selection, implementation and Review- Tata McGraw Hill Publishing Company Ltd 8th edition
3. Harold Kerzner, Project Management A systems Approach to Planning Scheduling and Controlling

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Subject Code:	**Subject Name :** **CAD,CAM AND CIM**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17013	Prerequisite: Design of Machine Elements, Manufacturing Technology	**T**	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To provide an overview of how computers are being used in design, development of Manufacturing plans and manufacture
- To understand the need for integration of CAD,CAM and CIM

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COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the use of various CAD devices.
CO2	Learning various CAD modeling techniques
CO3	Learning CAD/CAM integration and study of CNC Machines
CO4	Learning group Technology and process planning methods
CO5	Learning the FMS concept and functions.

Mapping of Course with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M		H							
CO2	H	H	M		H							
CO3	H	H	M		H							
CO4	H	H	M		H							
CO5	H	H	M		H							

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		H	H	M				
CO2		H	H	M				
CO3		H	H	M				
CO4		H	H	M				
CO5		H	H	M				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				√								

Approval	**27th meeting of Academic council, June2017**

UNIT- I INTRODUCTION **12 Hrs**

A typical product cycle, CAD tools for the design process of product cycle, CAD / CAM system evaluation criteria, Input / Output devices;

Graphics Displays: Refresh display, DVST, Raster display, pixel value and lookup table, estimation of graphical memory, LCD, LED fundamentals. Concept of Coordinate Systems: Working Coordinate System, Model Coordinate System, Screen Coordinate System. Graphics exchange standards.

UNIT- II GEOMETRIC TRANSFORMATIONS AND MODELING **12 Hrs**

Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D;. Window to View-port transformation. Geometry and Topology, Comparison of wireframe, surface and solid models, Properties of solid model, properties of representation schemes, Concept of Half-spaces, Boolean operations. Schemes: B-rep, CSG, Sweep representation, ASM, Primitive instancing, Cell Decomposition and Octree encoding

UNIT- III COMPUTER AIDED MANUFACTURING **12 Hrs**

CAM Concepts, Objectives & scope, Nature & Type of manufacturing system, Evolution, Benefits of CAM, Role of management in CAM, Concepts of Computer Integrated Manufacturing, Impact of CIM on personnel, Role of manufacturing engineers, CIM Wheel to understand basic functions.

NC and CNC Technology: Types, Classification, Specification and components, Construction Details-Axis designation, NC/CNC tooling. Fundamentals of Part programming, Types of format, Part Programming for drilling, lathe and milling machine operations.

UNIT- IV GROUP TECHNOLOGY AND CAPP **12 Hrs**

Introduction, part families, part classification and coding systems: OPITZ, PFA, FFA, Cell design, rank order clustering, composite part concepts, Benefits of group technology. Approaches to Process Planning, Different CAPP system, application and benefits

UNIT- V FLEXIBLE MANUFACTURING SYSTEM **12 Hrs**

Introduction & Component of FMS, Needs of FMS, general FMS consideration, Objectives, Types of flexibility and FMS, FMS lay out and advantages. Automated material handling system: Types and Application, Automated Storage and Retrieval System, Automated Guided Vehicles, Cellular manufacturing, Tool Management, Tool supply system, Tool Monitoring System, Flexible Fixturing, Flexible Assembly Systems.

Total No. of Hrs : 60

TEXT BOOKS

1) Chris McMohan and Jimmie Browne, *"CAD/CAM"*, Addison Wesley Publications, 2nd Ed.
2) HMT, (2000) *"Mechatronics"*, Tata McGraw –Hill Ed.
3) Mikkel. P.Groover, (2007) *"Automation, Production and Computer Integrated Manufacturing"*, PHI., Pvt Ltd.

REFERENCE BOOKS

1. Mikell P Groover, "*Automation, Production Systems and Computer Integrated Manufacturing"* , Pearson Education
2. Rao, Tewari, Kundra, "*Computer Aided Manufacturing*", McGraw Hill
3. P. Radhakrishnan , "*Computer Numerical Control*", New Central Book Agency
4. Ibrahim Zeid, "*Introduction to CAD/CAM*", Tata McGraw Hill

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Subject Code: **BME17L14**	**Subject Name : Project Phase - I**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: NIL	Lb	0	0	3	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	H	L	M	M	H	H
CO2	H	H	H	H	H	H	H	M	M	M	H	H
CO3	H	H	H	H	H	H	H	M	M	H	H	M
CO4	H	M	H	H	H	H	M	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1								
CO2								

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval	**27th meeting of Academic council, June2017**											

Students should identify the topic of the Project and should collect the literatures and datas, at the end of the semester the students should submit their Project Phase - I report to the Department and Viva -Voce examination will be conducted with external examiners and this carries 3 credits.

SEMESTER-VII

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Subject Code:	**Subject Name : Project Phase - II**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BME17L15	Prerequisite: NIL	Lb	0	0	20	10

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	`	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	CO1	H	CO1	H	CO1	H	CO1	H	CO1	H	CO1
CO2	H	CO2	H	CO2	H	CO2	H	CO2	H	CO2	H	CO2
CO3	H	CO3	H	CO3	H	CO3	H	CO3	H	CO3	H	CO3
CO4	H	CO4	H	CO4	H	CO4	H	CO4	H	CO4	H	CO4
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1												
CO2												

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	**27th meeting of Academic council, June2017**

Students are expected to do a Project work either in an Industry or at the University in the field of Mechanical Engineering in group, not exceeding 4 students in a group. Each group will be allotted a guide based on the area of Project work. Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.50% weight age will be given for the internal assessment and 50% weight age for the Project viva a voce examination.

ELECTIVE SUBJECTS

ELECTIVE:
THERMAL ENGINEERING

Subject Code: BME17E01	**Subject Name : ADVANCED IC ENGINES**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Thermodynamics and Thermal Engineering	Ty	3	0	0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Recent advancements of I.C Engines
- Various alternative fuels for I.C engines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	**Basics IC engine combustion and combustion chambers**
CO2	**Pollutions formation and control methods.**
CO3	Various alternate fuels to adopt in IC engines.
CO4	Recent developments IC engine technology

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		M					H					
CO3			M				H					
CO4				H			H					
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H											
CO2			M									
CO3					M		M					
CO4												

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: SPARK IGNITION ENGINES **9** Hrs

Spark Ignition Engine Mixture Requirements - Fuel- Injection Systems-Monopoint and Multi point Injection –Stages of Combustion-Normal and Abnormal Combustion-factors Affecting Knock-Combustion Chambers.

UNIT- II: COMPRESSION IGNITION ENGINES **9** Hrs

States of Combustion in C.I.Engine – Direct and Indirect Injection Systems - Combustion Chambers – Fuel Spray Behavior and Structure-Spray Penetration and Evaporation-Air Motion - Turbo charging.

UNIT- III: POLLUTANT FORMATION AND CONTROL 9 Hrs

Pollutant –Global warming- Sources and Types –Formation of NOx - Hydro-Carbon Emission Mechanism - Carbon Monoxide. Formation-Particulate Emissions-Methods of Controlling Emissions - Catalytic Converters and Particulate Traps-EGR technique.

UNIT- IV: ALTERNATIVE FUELS **9** Hrs

Bio-fuel – Vegetable oil – Bio diesel -Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas-Properties, Suitability, Engine Modifications, Merits and Demerits as Fuels.

UNIT- V: RECENT TRENDS **9** Hrs

Lean Burn Engines-Stratified Charge Engines-Gasoline Direct Injection Engine-Homogeneous Charge Compression Ignition –Plasma Ignition –Common rail direct injection engine.

Total No. of Hrs : 45

TEXT BOOK

1) V.Ganesan, (2008) "*Internal combustion engines"*, Tata McGraw Hill.

REFERENCES

1) Mathur and Sharma, (1990) "*Internal combustion engines"*.
2) John Heywood, (1988) "*Internal combustion engines fundamentals"*, Tata McGraw Hill Co.
3) Benson and White house (1983) "*Internal combustion engines Vol I & Vol II"*, pergamon press.
4) Domkundwar, "*Internal combustion engines"* Dhanpat Rai & Co. (P) Ltd.

Subject Code: BME17E02	**Subject Name : RENEWABLE ENERGY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Thermodynamics and Thermal Engineering		3	0	0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- The concept, principles and characteristics of different renewable energy systems.
- Energy conversion techniques

COURSE OUTCOMES (COs) : (3- 5)

CO1	**Concept and principles of different renewable energy systems like solar and wind energy and its applications.**
CO2	Biomass and bioenergy conversions, Ocean Thermal energy, Geothermal energy
CO3	**Direct energy conversions like Thermo electric generator, MHD and Fuel cells**

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		H	H									
CO3			M									
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H											
CO2			H		M							
CO3							M					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							

Approval	**27th meeting of Academic council, June2017**

UNIT- I PRINCIPLES OF SOLAR RADIATION: 9 **Hrs**

Role and Potential of new and renewable source, the solar energy option, Environmental impact of solar power,Solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT- II SOLAR ENERGY **9** Hrs

SOLAR ENERGY COLLECTION**:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

SOLAR ENERGY STORAGE**:** Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating/cooling techniques, solar distillation and drying, photovoltaic energy conversion.

UNIT- III WIND ENERGY AND BIOMASS **9 Hrs**

WIND ENERGY**:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics.

BIOMASS**:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-Gas digestors, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation, economic aspects.

UNIT- IV GEOTHERMAL,TIDAL AND WAVE ENERGY **9** Hrs

GEOTHERMAL ENERGY**:** Resources, types of wells, methods of harnessing

OTEC**:** Principles, utilization, setting of OTEC plants, thermodynamic cycles.

TIDAL AND WAVE ENERGY**:** Potential and conversion techniques, mini hydel power plants, and their economics.

UNIT- V:DIRECT ENERGY CONVERSION **9** Hrs

Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, MHD Power generators, principles, working.

Fuel cells: principle, working -types - Selection of fuels and operating conditions.

Total No. of Hrs : 45

TEXT BOOKS

1) G.D.Rai, (2004) *"Non-Conventional Energy Sources*" Khanna Publishers.
2) Ashok V Desai, (2003) "*Non-Conventional Energy"*, Wiley Eastern.
3) K.M.Mittal, (2007) "*Non-Conventional Energy Systems"*, Wheeler Publishing.
4) Ramesh & Kumar, (2007) "*Renewable Energy Technologies"*, Narosa Publishing House.

REFERENCES

1) Twidell & Weir, (2006) "*Energy Sources",* Taylor & Francis
2) Sukhame, (2009) "*Solar Energy"*.
3) B.S.Magal Frank Kreith, (2010) "Solar Power Engineering"

Subject Code: BME17E03	**Subject Name : TURBO MACHINES**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: GDJP, FLUID MECHANICS		3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The course aims at giving an overview of different types of turbo machinery used for energy transformation, such as pumps, fans, compressors, as well as hydraulic, steam and gas-turbines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Explain the working principles of turbo machines and apply it to various types of machines
CO2	Use design parameters for characterizing turbo machinery stages
CO3	Perform the preliminary design of turbo machines (pumps, compressors, turbines)
CO4	Recognize relations between choices made early in the turbo machinery design process and the final components and operability

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		H										
CO3			H									
CO4				M								
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H											
CO2												
CO3	L											
CO4												

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							

Approval	**27th meeting of Academic council, June2017**

UNIT- 1 INTRODUCTION **9Hrs**

Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Application of first and second laws of thermodynamics to turbo machines.

UNIT- 2 ENERGY EXCHANGE IN TURBOMACHINES **9Hrs**

Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor.

UNIT- 3 CENTRIFUGAL COMPRESSORS **9Hrs**

Construction details, types, impeller flow losses, slip factor, diffuser analysis losses and performance curves.

UNIT- 4 AXIAL AND RADIAL FLOW COMPRESSORS **9Hrs**

Axial and radial flow compressors and pumps– general analysis, Effect of blade discharge angle on performance, Theoretical head – capacity relationship.

UNIT- 5 AXIAL AND RADIAL FLOW TURBINES **9Hrs**

Velocity diagrams, losses and coefficients, blade design principles, testing and performance characteristics.

Total No. of Hrs : 45

TEXT BOOKS:

1. Gas Turbine, V.Ganesan, Tata McGraw Hill Co. Ltd., 3rd edition, 2010
2. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw HillCo. Ltd., 2nd edition, 2002

REFERENCE BOOKS:

1. D. G. Shepherd, "*Principals of Turbo machines*" , the Macmillan Company (1964).
2. , S. L.Dixon, "*Fluid Mechanics & Thermodynamics of Turbo machines"*, Elsevier (2005).
3. B.K.Venkanna, "*Turbomachine*", PHI, New Delhi 2009.
4. M. S. Govindgouda and A. M.Nagaraj, "*A Text Book of Turbomachines"*, , M. M. Publications, 4Th Ed, 2008.
5. V. Kadambi and Manohar Prasad, "*An Introduction to Energy Conversion, Volume III, Turbo machinery*", New Age International Publishers, reprint 2008.

Subject Code: BME17E04	**SUBJECT NAME :** REFRIGERATION AND AIR CONDITIONING	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Thermodynamics, Thermal Engineering		3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- The working principle of refrigerators and air conditioning systems.
- Different cycles used in refrigeration.
- Alternate refrigerants to reduce global warming **.**

COURSE OUTCOMES (COs) : (3- 5)

CO1	The working principle of refrigerators and air conditioners.
CO2	Different types of controlling and balancing of refrigerating system components
CO3	Alternate refrigerants to reduce global warming
CO4	Applications of cryogenic engineering in various Mechanical engineering fields

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2		M	M									
CO3			H			H	H					
CO4		M	M	M		H	H					
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H											
CO2	H		H		M							
CO3	H		M		M							
CO4			H		H							

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: REFRIGERATION CYCLES AND REFRIGERANTS **9** Hrs

Vapour Compression Réfrigération Cycle-Simple Saturated Vapour Compression Réfrigération Cycle. Thermodynamic Analysis of the above. Refrigerant Classification, Designation, Alternate Refrigerants, Global Warming Potential & Ozone Depleting Potential Aspects.

UNIT- II: SYSTEM COMPONENTS **9** Hrs

Refrigerant Compressors – Reciprocating Open & Hermetic Type, Screw Compressors and Scroll Compressors – Construction and Operation Characteristics. Evaporators – DX Coil, Flooded Type Chillers Expansion Devices - Automatic Expansion Valves, Capillary Tube & Thermostatic Expansion Valves. Condensing UNIT-s and Cooling Towers.

UNIT- III: CYCLING CONTROLS AND SYSTEM BALANCING **9** Hrs

Pressure and Temperature Controls. Range and Differential Settings. Selection and Balancing of System Components-Graphical Method.

UNIT- IV: PSYCHROMETRY & AIR CONDITIONING **9** Hrs

Moist Air Behavior, Psychrometric Chart, Different Psychrometric Process Analysis**.**
Summer and Winter Air-conditioning, Cooling Load Calculations, Air Distribution Patterns, Dynamic and Frictional Losses in Air Ducts, Equal Friction Method, Fan Characteristics in Duct Systems.

UNIT- V: INTRODUCTION TO CRYOGENIC ENGINEERING **9** Hrs

Introduction to cryogenic engineering-applications of cryogenics in various fields-low temperature properties of materials-mechanical, thermal, electrical and magnetic properties- properties of cryogenic fluids-cryogenic fluid storage and transfer systems- cryogenic insulation.

Total No. of Hrs : 45

TEXT BOOKS

1) W.F.Stocker and J.W.Jones, (2009) *"Refrigeration & Air Conditioning"*, McGraw Hill Book Company.
2) Randall F.Barron, (1985) *"Cryogenic systems"*, Oxford University press.

REFERENCES

1) R.J.Dossat, (2005) *"Principles of Refrigeration"*, John Wiley and Sons Inc., 6th edition.
2) Manohar Prasad, (2009) *"Refrigeration and Air Conditioning"*, Wiley Eastern Ltd.

Subject Code: BME17E05	**Subject Name : COMPUTATIONAL FLUID DYNAMICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Thermodynamics, Heat and Mass transfer and Fluid Mechanics		3	0	0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- Governing equation of fluid dynamics.
- Methods of solving the equations by Finite element and Finite Volume methods

COURSE OUTCOMES (COs) : (3- 5)

CO1	**Governing equation of fluid dynamics.**
CO2	Methods of solving the conduction problems by Finite element method
CO3	**Methods of solving the fluid flow problems by Finite Volume method**

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		H	M		H							
CO3			M	M	H							
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H											
CO2												
CO3												

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: GOVERNING EQUATIONS AND BOUNDARY CONDITIONS **8** Hrs

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT- II: FINITE DIFFERENCE METHOD **9** Hrs

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

UNIT- III: FINITE VOLUME METHOD (FVM) FOR DIFFUSION **9** Hrs

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT- IV: FINITE VOLUME METHOD FOR CONVECTION DIFFUSION **10** Hrs

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes-properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT- V: CALCULATION FLOW FIELD BY FVM **9** Hrs

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models

Total No. of Hrs : 45

TEXT BOOKS

1) Ghoshdastidar , P.S., (1998) "*Computer Simulation of flow and heat transfer"*, Tata McGraw Hill Publishing Company Ltd.
2) Versteeg, H.K., and Malalasekera, W., (1998) *"An Introduction to Computational Fluid Dynamics: The finite volume Method"*, Longman.

REFERENCES

1) Patankar, S.V. (2004) *"Numerical Heat Transfer and Fluid Flow"*, Hemisphere Publishing Corporation.
2) Muralidhar, K., and Sundararajan, T., (1995) "*Computations Fluid Flow and Heat Transfer"*, Narosa Publishing House, NewDelhi.

ELECTIVE:
DESIGN ENGINEERING

Subject Code: BME17E06	**Subject Name : MECHANICAL VIBRATIONS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Strength of Materials, Mechanics of Machines-II	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: Students will learn

- Multi degree of freedom system in different modes.
- Vibration measurement techniques.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Basic knowledge in vibrations
CO2	Multi-degree of freedom system in different modes.
CO3	Vibration measurement techniques

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			M			L					L
CO2	L	M	H	M								
CO3	M	M		H		L						L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	L	L	L				
CO2	M	H	M					
CO3	M	H		M				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval	**27th meeting of Academic council, June2017**											

UNIT- I:INTRODUCTION **9** Hrs

Relevance of and need for vibration Analysis- Mathematical Modelling of Vibrating Systems – Discrete and Continuous Systems – Review of Single degree of Freedom Systems – Free and Forced Vibrations, Various Damping Models

UNIT- II:TWO DEGREE-OF-FREEDOM SYSTEMS **9** Hrs

General Solution to Free vibration problem-Damped Free Vibration, Forced Vibration of un-damped System –Dynamic Vibration Absorbers-Technical Applications.

UNIT- III:MULTI-DEGREE OF FREEDOM SYSTEMS **9** Hrs

Free and Forced Vibrations of multi-degree of freedom systems in longitudinal, torsional and lateral modes – Matrix methods of solution – normal modes – orthogonal principle- energy methods, Introduction to vibration of plates.

UNIT- IV:CONTINOUS SYSTEMS **9** Hrs

Torsional vibrations – Longitudinal vibrations of rods – Transverse vibrations of beams- Governing equations of motion – Natural frequencies and normal modes – energy methods.

UNIT- V:VIBRATION MEASUREMENT **9** Hrs

Vibration monitoring-Data Acquisition- Vibration parameter selection – vibration sensors-accelerometers-Performance characteristics-sensor location-signal pre-amplification – vibration meters-vibration signatures-standards-vibration testing equipment-in-site, Balancing of rotors.

Total No. of Hrs : 45

TEXT BOOK

1) J.S.Rao and K.Gupta, (1999) *"Introductory Subject on Theory and Practice of Mechanical Vibrations"*, Wiley Eastern Ltd.

REFERENCES

1) P.Srinivasan, (1990) *"Mechanical Vibration Analysis"*, Tata-McGraw Hill, New Delhi.
2) G.K.Grover, (2006) *"Mechanical Vibrations"*, New Chand and Bros, Roorkey.

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Subject Code: BME17E07	**Subject Name : FINITE ELEMENT ANALYSIS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Strength of Materials, Design of Machine Elements-I	T	3	1	0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn
- Fundamentals of finite element analysis and their applications.
- Method of solving one, two and iso-parametric elements.

COURSE OUTCOMES (COs) :

CO1	Fundamentals of finite element analysis and their applications.
CO2	Use professional level finite element software to solve engineering problems in Solid Mechanics, Fluid Mechanics and Heat Transfer
CO3	Derive element matrix equation by different methods

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M								L		L
CO2			M		H					L		
CO3	L		M									L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M		L	
CO2	M	M	M	M	
CO3	L	L	L		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I INTRODUCTION **9Hrs**

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 – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT- II ONE-DIMENSIONAL PROBLEMS **9Hrs**

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of problems from solid mechanics including thermal stresses-heat transfer. Natural frequencies of longitudinal vibration and mode shapes. Fourth Order Beam Equation –Transverse deflections and Transverse Natural frequencies of beams.

UNIT- III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS **9Hrs**

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts.

UNIT- IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS **9Hrs**

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell elements.

UNIT- V ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS **9Hrs**

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software- Introduction to Non Linearity.

TOTAL No of Hrs :45

TEXT BOOKS:

1. J.N.Reddy, “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGrawHill,2005
2. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., NewDelhi, 2007.

REFERENCES:

1. Logan, D.L., “A first Subject in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002.
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2002.
3. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butter worth Heinemann, 2004.
4. Chandrupatla and Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition,

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Subject Code: BME17E08	**Subject Name : DESIGN OF PRODUCTION TOOLS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Material science, Engineering metallurgy, Engineering mechanics, Manufacturing Technology, Engineering Metrology, Design of machine elements	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: **OBJECTIVE**: Students will learn

- The design of jigs and fixtures.
- Different types of press tools and various elements of a press tools.
- To impart knowledge in basics, design and drawing of production tools

COURSE OUTCOMES (COs) : (3- 5)

CO1	Fundamentals of jigs, fixtures
CO2	Fundamentals of sheet metal forming
CO3	The design and drawing of jigs, fixtures and press tools
CO4	
CO5	

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H									L
CO2	M	H	H									L
CO3	M	H	H	H	H				H	H		H
CO4												
CO5												

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		H	H	H				
CO2		H	H	H				
CO3		H	H	H				
CO4								
CO5								

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: LOCATING AND CLAMPING PRINCIPLES **9** Hrs

OBJECTIVES of tool design- Function and advantages of Jigs and fixtures , Basic elements-principles of location .Locating methods and devices , Principles of clamping Mechanical actuation ,pneumatic and hydraulic actuation. Standard parts , Drill bushes and Jig buttons , Tolerances and materials used.

UNIT- II: JIGS **9** Hrs

Design and development of jigs and fixtures for given component- Types of Jigs -Post, Turnover, Channel, latch, box, pot, angular post jigs , Indexing jigs ,automatic drill jigs- rack and pinion operated air operated jigs - Design and drawing of channel, box, indexing and angular post jigs

UNIT- III: FIXTURES **9** Hrs

General principles of milling, Lathe, boring, broaching and grinding fixtures and shaping fixtures .Assembly, Inspection and Welding fixtures , Modular fixtures . Design and drawing of turning, milling and grinding fixtures

UNIT- IV: PRESS WORKING **9** Hrs

Press Working Terminologies - operations ,Types of presses , press accessories , Computation of press capacity , Strip layout , Material Utilization , Shearing action ,Clearances ,Press Work Materials , Center of pressure, recent trends in tool design- computer Aids for sheet metal forming Analysis

UNIT- V: ELEMENTS OF CUTTING, BENDING, FORMING AND DRAWING DIES **9** Hrs

Design of various elements of dies, Die Block, Punch holder, Die set, Stops, Strippers, Pilots - Selection of Standard parts. Design and drawing of simple blanking, piercing, compound and progressive dies.

Total No. of Hrs : 45

TEXT BOOKS

1) Joshi, P.H. (2004) *"Jigs and Fixtures"*, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
2) Donaldson, Lecain and Goold, (2000) "*Tool Design"*, III rd Edition, Tata McGraw Hill.

REFERENCES

1) K.Venkataraman, (2005) "*Design of Jigs Fixtures & Press Tools"*, Tata McGraw Hill, New Delhi.
2) Kempster, (1974) " *Jigs and Fixture Design"*, Hoddes and Stoughton " Third Edition.
3) Joshi, P.H. Press Tools (2006) *"Design and Construction"*, Wheels publishing, 2 edition
4) Hoffman, "*Jigs and Fixture Design"*, Thomson Delmar Learning, Singapore
5) *"Design Data Hand Book"*, PSG College of Technology, Coimbatore.

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Subject Code: BME17E09	**Subject Name :** **DESIGN OF MATERIAL HANDLING EQUIPMENTS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Design of Machine Elements.	**T**	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Design of different types of material handling systems used for engineering and process industries.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge of various material handling devices used in industries
CO2	Knowledge of hoists design and drives.
CO3	Knowledge of different types of cranes and their design
CO4	Knowledge of conveyor systems and elevators for material handling.

Mapping of Course with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M			M	M					
CO2	H	H	M			M	M					
CO3	H	H	M			M	M					
CO4	H	H	M			M	M					

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		H	H					
CO2		H	H					
CO3		H	H					
CO4		H	H					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: INTRODUCTION TO MATERIALS HANDLING EQUIPMENT **9 Hrs**

Overview - consideration in material handling system design, ten principles of material handling. Types of material handling equipments-trolleys, industrial trucks, AGV, monorails and other rail guided vehicles, conveyors, cranes, hoists and elevators.

UNIT- II: DESIGN OF HOISTS **9 Hrs**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

UNIT- III: DRIVES OF HOISTING GEAR **9 Hrs**

Hand and power drives - Travelling gear - Rail travelling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT- IV: CONVEYORS **9 Hrs**

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT- V: ELEVATORS **9 Hrs**

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

Total No. of Hrs : 45

***NOTE:** Use of Approved Data Book is permitted in examination

.

TEXT BOOKS:

1. Rudenko, N. (1970) *Materials handling equipment*. ELnvee Publishers
2. Mikell Groover, P. (2006) *Automation, Production system and computer integrated Manufacturing*. Second Edition, Prentice Hall of India Pvt. Ltd

REFERENCES

1. Alexandrov, M. (1981) *Materials Handling Equipments*. MIR Publishers
2. Boltzharol, A. (1958) *Materials Handling Handbook*. The Ronald Press Company
3. P.S.G. Tech, (2003) *Design Data Book*. Kalaikathir Achchagam
4. Lingaiah. K. and Narayana Iyengar, (1983) *Machine Design Data Hand Book*. Vol.1 & 2, Suma Publishers
5. Spivakovsy, A.O. and Dyachkov, V.K. (1985) *Conveying Machines*. Volumes I and II, MIR Publishers

Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY
(Decl. U/S 3 of UGC Act 1956)
DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BME17E10	**Subject Name : TRIBOLOGY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Engineering Mechanics, Fluid Mechanics and Machineries	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- To impart knowledge in the friction , wear and lubrication aspects of machine components.
- To understand the material properties which influence the tribological characteristics of surfaces.
- To understand the analytical behavior of different types bearings and design of bearings based on analytical /theoretical approach..

COURSE OUTCOMES (COs) : (3- 5)

CO1	To impart knowledge in the friction , wear and lubrication aspects of machine components.
CO2	To understand the material properties which influence the tribological characteristics of surfaces.
CO3	To understand the analytical behavior of different types bearings and design of bearings based on analytical /theoretical approach

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M									
CO2	L	M	L			L						
CO3	L	L	H	L								
Cos / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1			M		L		M					
CO2	L				L		L					
CO3	L		M		M							

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I - SURFACE INTERACTION AND FRICTION 9 **Hrs**

Topography of Surfaces – Surface features-Properties and measurement – Surface interaction –Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials.

UNIT- II WEAR AND SURFACE TREATMENT 9 **Hrs**

Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models-Wear of Metals and Non-metals – Surface treatments – Surface modifications – surface coatings methods

UNIT- III LUBRICANTS AND LUBRICATION REGIMES 9 **Hrs**

Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants-Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication
Regimes.

UNIT- IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION **9 Hrs**

Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Somerfield boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic and Hydrostatic bearings.

UNIT- V HIGH PRESSURE CONTACTS **9 Hrs**

Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication

Total No of Hrs: 45

TEXT BOOKS:

1. Rabinowicz.E, “Friction and Wear of materials”, John Willey &Sons ,UK,1995
2. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981

REFERENCES

1. Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984.
2. Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.
3. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005
4. G.W.Stachowiak & A.W .Batchelor , Engineering Tribology, Butterworth-Heinemann, UK, 2005

Subject Code: BME17E11	**Subject Name : DESIGN FOR MANUFACTURE AND ASSEMBLY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Manufacturing Technology-I	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- Rules and requirements of designing to ease manufacturing
- Rules and requirements of designing to ease assembly
- Methods for design and Assembly

COURSE OUTCOMES (COs) : (3- 5)

CO1	Rules and requirements of designing to ease manufacturing
CO2	Rules and requirements of designing to ease assembly
CO3	Methods for design and Assembly

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M							L		
CO2	M		M			L						L
CO3		M	H	L	L							

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1			H	L				
CO2	L	M	M	L				
CO3	L	L	H	M				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: INTRODUCTION **9Hrs**

General design principles for manufacturability - strength and mechanical factors, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

UNIT- II: FORM DESIGN - CASTING **9Hrs**

Production methods on form design - Casting considerations - Requirements and rules - Redesign of components for castings and Case studies.

UNIT- III: FORM DESIGN - FORGING **9Hrs**

Forging considerations - Requirements and rules - Redesign of components for forging and Case studies.

UNIT- IV: FORM DESIGN - MACHINING **9Hrs**

Machining considerations - Requirements and rules -Redesign of components for Machining and Case studies.

UNIT- V: DESIGN FOR ASSEMBLY METHODS **9Hrs**

Approaches to design for assembly - Qualitative evaluation procedures, knowledge based approach, Computer aided DFA methods. Assemblability measures. Boothroyd - Dewhurst DFA method - Redesign of a simple product - Case studies.

Total No. of Hrs : 45

TEXT BOOKS:

1. Harry Peck, (1983) Design *for Manufacture*. Pittman Publication
2. Alan Redford and Chal, (1994) *Design for Assembly - Principles and Procedures*. McGraw Hill International

REFERENCES

1. Robert Matousek, (1963) *Engineering Design - A Systematic Approach*. Blackie & Sons Ltd
2. James G. Bralla, (1986) *Hand Book of Product Design for Manufacturing*. McGraw Hill Co
3. Swift, K.G. (1987) *Knowledge Based Design for Manufacture*.

Subject Code: BME17E12	**Subject Name : MECHANICS OF FRACTURE**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Manufacturing Technology-I	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- To impart knowledge on solid mechanics of cracked components of different modes by which these components fail under static and fatigue load conditions.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on crack and crack growth on components at static and dynamic loading
CO2	Knowledge on fatigue crack growth
CO3	Applications of fracture mechanisms

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M							L		
CO2	M		M			L						L
CO3		M	H	L	L							

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1			H	L				
CO2	L	M	M	L				
CO3	L	L	H	M				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I ELEMENTS OF SOLID MECHANICS 9Hrs

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis – Airy's function – field equation for stress intensity factor.

UNIT- II STATIONARY CRACK UNDER STATIC LOADING 9Hrs

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement.

UNIT- III ENERGY BALANCE AND CRACK GROWTH 9Hrs

Griffith analysis – stable and unstable crack growth –Dynamic energy balance – crack arrest mechanism –K1c test methods - R curves - determination of collapse load.

UNIT- IV FATIGUE CRACK GROWTH CURVE 9Hrs

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum -- rain flow method– external factors affecting the K1c values.- leak before break analysis.

UNIT- V APPLICATIONS OF FRACTURE MECHANICS 9Hrs

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods

Total No. of Hrs: 45

TEXT BOOKS:

1. David Broek, "Elementary Engineering Fracture Mechanics ", Fifthoff and Noerdhoff International Publisher, 1978.
2. 2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.

REFERENCES:

1. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
2. John M.Barson and Stanely T.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood, 1977.
3. Tribikram Kundu, "Fundamentals of Fracture Mechanics", Ane Books Pvt. Ltd. New Delhi/ CRC Press, 2012

ELECTIVE:
MANUFACTURING ENGINEERING

Subject Code: BME17E13	**Subject Name : INDUSTRIAL ROBOTICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Industrial Automation	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: **OBJECTIVES:** Students will learn

- Basic components of an industrial robot and Sensors used in robots
- Robot programming methods and Robot applications

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COURSE OUTCOMES (COs) : (3- 5)

CO1	Expose to the basic components of robots used in industry
CO2	Knows the uses and applications of Sensors
CO3	Ability to write programming used in robots based on the applications

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	M	H							M
CO2	M	M	H	H	H	M	L		M			M
CO3	M	M	H	H	H	M	L		H			M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		M		H				
CO2		M	M	H				
CO3		H	H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I:INTRODUCTION **9** Hrs

Definition of a Robot – Basic Concepts –- Robot components –manipulator-configurations –joints- degree of freedom. Types of Robot Drives – Basic Robot Motion types – Point to Point Control – Continuous Path Control.

UNIT- II:COMPONENTS AND OPERATIONS **9** Hrs

Basic Control System Concepts – open loop and closed loop control-Control System Analysis – Robot Actuation and Feed Back, Manipulators – Direct and Inverse Kinematics, Co-ordinate Transformation – Brief Robot Dynamics, Types of Robot and Effectors – Grippers – Tools as End Effectors – Robot / End Effort Interface.

UNIT- III:SENSING AND MACHINE VISION **9** Hrs

Range Sensing – Proximity Sensing – Touch sensing – Force and Torque Sensing. Introduction to Machine Vision – functions and applications.

UNIT- IV:ROBOT PROGRAMMING **9** Hrs

Methods – Languages –programming for pick and place applications-palletizing. Capabilities and Limitation – Artificial Intelligence – Knowledge Representation – Search Techniques – AI and Robotics.

UNIT- V:ROBOT CELL DESIGN AND APPLICATIONS **9** Hrs

Robot cell design-types and control.

Applications of Robots –process applications in welding and painting – Assembly applications– Material Handling applications.

Total No. of Hrs : 45

TEXT BOOK

1) K. S. Fu, R. C. Gonalez, C.S.G. Lee, *"Robotics Control Sensing Vision and Intelligence"*, McGraw Hill International Edition, 10987.

REFERENCES

1) Mikell P. Groover, Mitchell Weiss, (2008) *"Industrial Robotics, Technology, Programming and Application",* Tata McGraw Hill International Editions, 10986.
2) Richard D. Klafter, Thomas A. Chonieleswski and Michael Negin, (1989) *"Robotic Engineering – An Integrated Approach"*, Prentice Hall Inc., Englewoods Cliffs, NJ, USA, 109809.

Subject Code: BME17E14	**Subject Name : NON CONVENTIONAL MACHINING TECHNIQUES**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Manufacturing Technology I & II	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:
To impart knowledge in different non- traditional manufacturing processes and their applications.
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COURSE OUTCOMES (COs) : (3- 5)

CO1	Need for non-conventional machining processes
CO2	Understand the process parameters and their effects in non-conventional machining processes
CO3	Applications of non-conventional machining techniques.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H		M	M						M
CO2	M	M	H		M	M	H		L			M
CO3	M	M	H		M	M	H		L			M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		H	H					
CO2	M	H	H	H				
CO3	L	M	M	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: INTRODUCTION, ELECTRICAL DISCHARGE MACHINING **10** Hrs

Need For Unconventional Processes – Classification - Electrical Discharge Machining Processes, Operating Principles – Dielectric – Electrode Material – Tool/Wear – Processes Parameters – Metal Removal Rate – Applications – Current Developments In EDM.

UNIT- II: ELECTRO CHEMICAL MACHINING **8** Hrs

Electro Chemical Machining Process – Principles – Equipments – Metal Removal Analysis - Tool Material – Insulation – Process Parameters – ECH,ECG Etc., – Applications.

UNIT- III: ELECTRON BEAM, LASER BEAM AND PLASMA ARC MACHINING **9** Hrs

EBM process - principle - Gun construction - vacuum and non-vacuum technique – applications. LBM process, principles, pumping processes, Types of Emission- Beam control – Applications.

UNIT- IV: ULTRASONIC MACHINING **8** Hrs

Ultrasonic Machining Processes – Working Principles – Transducers – Concentrators - Nodal Point Clamping - Feed Mechanism - Metal Removal Rate – Process Parameters – Applications.

UNIT- V: ABRASIVE, WATER JET AND HYBRID MACHINING **10** Hrs

AJM Processes – Principle – Equipment – Metal Removal Rate – Process Parameters – Applications. WJM Process – Principle – Equipment – Applications. Introduction to hybrid machining-Electro Chemical Discharge Machining, Abrasive electrical discharge grinding-Principle, advantages, limitations and applications.

Total No. of Hrs : 45

TEXT BOOKS

1) P.K.Mishra (1997) *"Non Conventional Machining"*. The Institution Of Engineers (India) text book Series
2) Vijay.K. Jain (2007) *"Advanced Machining Processes"* Allied Publishers Pvt. Ltd., New Delhi

REFERENCES

1) Benedict. G.F. (1987) *"Nontraditional Manufacturing Processes"* Marcel Dekker Inc., New York.
2) Pandey P.C. and Shan H.S. (2007) *"Modern Machining Processes"* Tata McGraw-Hill, New Delhi.
3) Mc Geough, (1998) *"Advanced Methods of Machining"* Chapman and Hall, London.
4) Paul De Garmo, J.T.Black, and Ronald.A.Kohser, (2001) *"Material and Processes in Manufacturing"*, Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition.
5) P.C.Sharma, (1995) "*TEXT BOOK of Production Engineering"*.

Subject Code: BME17E15	**Subject Name : PROCESS PLANNING AND COST ESTIMATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Manufacturing Technology I & II	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- Process planning activities
- Various elements of cost of a product.
- Methods of computer aided process planning.

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COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the method of planning the various machining processes
CO2	**Know the method of estimation of the cost of manufacturing a component**
CO3	Applications of computers in process planning

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M		H	M	M			M			M
CO2	M	M		H	M	M			M			M
CO3	M	M		H	H	M			M			M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H					
CO2	M	H	H	H				
CO3	L	M	M	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: PROCESS PLANNING **9** Hrs

Definition – OBJECTIVES – Scope – approaches to process planning- Process planning activities – Finished part requirements- operating sequences- machine selection –material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes.

UNIT- II: COMPUTER AIDED PROCESS PLANNING **9** Hrs

Variant process planning - Generative approach -Forward and Backward planning, Input format, Logical Design of a Process Planning - Implementation considerations. Application of computer softwares in process planning.

UNIT- III: ELEMENTS OF COST **9** Hrs

Introduction - Importance and aims of Cost estimation - Estimation procedure. Material Cost - Determination of Material Cost Labour Cost - Determination of Direct Labour Cost - Expenses - Cost of Product (Ladder of cost) - Illustrative examples. Analysis of overhead expenses - Factory expenses - Depreciation - Causes of depreciation - Methods of depreciation - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses.

UNIT- IV: PRODUCT COST ESTIMATION **9** Hrs

Estimation in forging shop - Losses in forging - Forging cost - Illustrative examples. Estimation in welding shop - Gas cutting - Electric welding - illustrative examples. Estimation in foundry shop - Estimation of pattern cost and casting cost - Illustrative examples.

UNIT- V: ESTIMATION OF MACHINING TIME AND COST **9** Hrs

Estimation of machining time and cost for Lathe operations - Estimation of machining time and cost for drilling, boring, shaping, planning, milling and grinding operations - Illustrative examples. Value engineering - cost reduction

Total No. of Hrs : 45

TEXT BOOKS

1) M.Adithan and B.S. Pabla, (1989) *"Estimating and Costing"*, Konark Publishers Pvt. Ltd.
2) V.Jayakumar (2012) *"Process Planning and Cost Estimation"*, Lakshmi Publication.

REFERENCES

1) Nanua Singh, (1996) *"System approach to Computer Integrated Design and Manufacturing"*,John Wiley & Sons, Inc.
2) Joseph G. Monks, (1982) *"Operations Management, Theory & Problems"*, McGraw Hill Book Company.
3) T.R. Banga and S.C. Sharma, (2011) *"Estimating and Costing"*, Khanna Publishers, 16thEdition
4) Sadhu singh, (2002) *"Computer aided Design and manufacturing*", Khanna publisher ,new delhi, second edition.

Subject Code: BME17E16	**Subject Name : FLEXIBLE MANUFACTURING SYSTEMS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Manufacturing Technology I & II; Industrial Automation; CAD/CAM	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- To understand the Modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the Modern manufacturing systems
CO2	Understand the concepts and applications of flexible manufacturing systems
CO3	Applications of Artificial Intelligence in manufacturing and future of the factory

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M		M	H	M			M			M
CO2	M	M	M	M	H	M			M	M		M
CO3	M	M	M	M	H	M			M	M		M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	H				
CO2	M	H	H	H				
CO3		H	H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9Hrs
Introduction to FMS - development of manufacturing systems - benefits - major elements of FMS - types of flexibility - FMS application and flexibility –single product, single batch, n - batch scheduling problem - knowledge based scheduling system.

UNIT- II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9Hrs
Introduction - composition of FMS - hierarchy of computer control - computer control of work center and assembly lines - FMS supervisory computer control - types of software specification and selection - trends.

UNIT- III FMS SIMULATION AND DATA BASE 9Hrs
Application of simulation - model of FMS - simulation software - limitation - manufacturing data systems - data flow - FMS database systems - planning for FMS database.

UNIT- IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS 9Hrs
Introduction - matrix formulation - mathematical programming formulation - graph formulation - knowledge based system for group technology - economic justification of FMS - application of possibility distributions in FMS systems justification.

UNIT- V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE 9Hrs
FMS application in machining, sheet metal fabrication, prismatic component production - aerospace application - FMS development towards factories of the future - artificial intelligence and expert systems in FMS - design philosophy and characteristics for future.

Total No. of Hrs: 45

TEXT BOOK:
1. Jha.N.K., “Handbook of flexible manufacturing systems”, Academic Press Inc., 1991.

REFERENCES:
1. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 2007.
2. Kalpakjian S., “Manufacturing Engineering and Technology”, Addison-Wesley Publishsing Co., 2013.
3. Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., 1994.
4. Raouf A. and Daya B.M., “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
5. Ohno T., “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd., 1992.

Subject Code: BME17E17	**Subject Name :POWDER METALLURGY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Materials Science; Engineering Metallurgy	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- To understand basics of powder metallurgy
- To expose various powder metallurgy techniques
- To know the application of powder metallurgy in various fields.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basics of powder metallurgy
CO2	Expose various powder metallurgy techniques
CO3	Know the application of powder metallurgy in various fields

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M		H		M					M
CO2	M	M	M		H		H					M
CO3	M	M	M		H		H					M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H					
CO2	H	M	H					
CO3		H	H	M				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I INTRODUCTION OF POWDER METALLURGY AND PRODUCTION OF METAL POWDERS 9Hrs

Historical and modern developments in Powder Metallurgy. Advantages, limitations, applications and basic steps involved in Powder Metallurgy. Manufacture of metal powders: Conventional methods and modern methods of metal powder manufacture. Purity of metal powders. Blending techniques.

UNIT- II POWDER CHARACTERIZATION 9Hrs

Powder characterization: problem of size determination. Method of size analysis and surface area assessment. Powder conditioning, fundamentals of powder compaction, density distribution
in green compacts, compressibility, green Strength, pyrophorocity and toxicity. Apparent density and flowability measurement.

UNIT- III POWDER COMPACTION 9Hrs

Powder compaction: Mechanical, thermal and thermomechanical compacting processes. Presses used for transmission. Die design and tooling for consolidation of powders. New methods of consolidation. E.g. Powder rolling, Powder forging, Isostatic pressing. Advantages and limitations of these methods.

UNIT- IV SINTERING PROCESS 9Hrs

Theories of sintering: Sintering mechanism, Roll of diffusion, Recrystallization, Por emigration, Pore-growth and coalescence. Liquid phase sintering and related processes. Effect of compacting pressure, sintering temperature and time on sintered properties. Type of sintering furnaces. Sintering atmospheres.

UNIT- V APPLICATIONS OF POWDER METALLURGY 9Hrs

Manufacturing and application of important P/M components: Porous bearing, Electrical contact materials, Metallic filters, Cemented carbides, magnets, Friction materials and Composites.
Total No. of Hrs: 45

Text Books:

1. A. K. Sinha, "*Introduction to Powder Metallurgy"*, Dhanpatrai Publication
2. P. C. Angelo and R. Subramanian, "*Powder Metallurgy: Science, Technology and Applications*",

Reference Books

1. Powder Metallurgy-ASM Vol. II
2. Powder Metallurgy-Sands and Shakespeare
3. Powder Metallurgy-Dixtor R.H. and Clayton.
4. Cemented Tungsten carbide Production, properties and testing-Gopal S. Upadhayay

ELECTIVE:
INDUSTRIAL ENGINEERING

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BME17E18	**Subject Name : ENTERPRISE RESOURCE PLANNING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: In depth Knowledge of Manufacturing Systems and Application of Computer Science and Engineering	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: Students will learn:

- Building of business model for resource planning
- Impact of IT in ERP

COURSE OUTCOMES (COs) :

CO1	Building of business model for resource planning
CO2	Impact of IT in ERP
CO3	Knowledge about supply chain management

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L		M	M	H	L				L		H
CO2				L	M	M			M	M		L
CO3						H	H	H	H	H	M	M
COs / PSOs	**PSO1**		**PSO2**		**PSO3**		**PSO4**					
CO1							L					
CO2							L					
CO3					M							

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: INTRODUCTION TO ERP **9** Hrs

Integrated Management Information, Seamless Integration - Supply Chain Management- Integrated Data Model- Benefits Of ERP - Business Engineering And ERP- Definition Of Business Engineering - Principle of business engineering - Business engineering with information technology.

UNIT- II: BUSINESS MODELING FOR ERP **9** Hrs

Building The Business model - ERP implementation – An Overview – Role Of Consultant, Vendors and Users, Customization – Precautions - ERP Post implementation options ERP Implementation Technology – Guidelines for ERP Implementation.

UNIT- III: INTRODUCTION TO ORGANIZATIONAL TRANSFORMATION **9** Hrs

Fundamental elements of organizational transformation - Principles-Methodology -Models (LMI CIP, DSMCQ & PMP) - Process improvements in models (Moen & Nolan strategy, NPRDC, LMI CIP) - Tools and Techniques.

UNIT- IV:GLOBAL INDUSTRIAL COMPETITION AND INFORMATION TECHNOLOGY **9** Hrs

Coping with competition – the impact and value of IT Systems – impact and value of IT – Value chain of a firm and strategic use of IT – development trends of IT. Introduction to SAP and its applications in ERP.

UNIT- V: SUPPLY CHAIN MANAGEMENT **9** Hrs

The concept of supply chain, logistics, customer and supply chain relation, role of IT in supply chain management – strategy and structure of supply chain – factors of supply chain – stages in supply chain progress.

Total No. of Hrs : 45

TEXT BOOKS

1) Leon, (2014) "*Enterprise Resource Planning*", McGraw Hill, New Delhi
2) P. N. Rastogi, *"Re-Engineering And Re-inventing the Enterprise*" , Wheeler Publishing
3) Dr. J. A. Edosomwan , (1995) "*Organizational transformation and Process Re-Engineering"* 1 edition.

REFERENCES

1. Jose Antonio Fernandz, (2005) *"The SAP R/3 Handbook*", TMH, 3 edition
2.Vinod Kumar Garg and N.K.Venkita Krishnan, (2004) "*Enterprise Resource Planning Concepts and Practice"*, PHI. Publishing Co.

Subject Code: BME17E19	**Subject Name : INDUSTRIAL ENGINEERING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Basics of Manufacturing System	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: Students will learn:

- Various techniques of work measurement
- Details of plant layout and material handling devices
- Basic concepts of ERP.

COURSE OUTCOMES (COs) :

CO1	Various techniques of Work Measurement
CO2	Details of Plant Layout and Material Handling devices
CO3	Basic concepts of ERP

Mapping of Course Outcomes(COs) with Program Outcomes (Pos) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	M		M		L			M	L		L
CO2	L	L	L			M	L		L	M	L	L
CO3	L				H	M			L	M	L	M

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1			L	L
CO2			M	L
CO3			M	L

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

UNIT- I:WORK STUDY & WORK MEASUREMENT 9 **Hrs**

Work study – Techniques – Productivity, Improving productivity by reducing work content- Human factors in work study. Method study – Basic procedure – Recording techniques - Micro–motion study, Threbligs, SIMO chart, Principles of motion economy.

Work Measurement – Techniques – Time study – Allowances – Work sampling – PMTS – MTM.

UNIT- II:SITE SELECTION, PLANT LAYOUT & MATERIAL HANDLING **9** Hrs

Site Selection: Importance of plant location – choice of site for location –State regulations on location – Industrial Estates. Plant layout: Types of factory buildings, OBJECTIVES of good plant layout, Principles, Techniques used, Types, Flow pattern, Line Balance, computerized plant layout. Material Handling: Functions, OBJECTIVES, principles, Devices used, Relation between plant layout and material handling.

UNIT- III:ERGONOMICS **9** Hrs

Techniques – Analysis – Equipment Design – Fatigue – Motivation theory of Fatigue – Fatigue tests-Duties of a human factor Engineer – Human effectiveness improvement through ergonomics**.**

UNIT- IV:WAGES & INCENTIVES **9** Hrs

Wages: Wage & salary policies, systems of wage payments, Principles of wage administration, National Wage Policy, Fair wage committee report, Need based minimum wage Incentives: Need, Incentive plans, Comparison of various Incentive plans, Administration of wage incentives.

UNIT- V:ENTERPRISE RESOURCE PLANNING (ERP) **9** Hrs

Need for optimal use of Resources, MRP I & II, Supply chain Management, Evolution of ERP, BPR, Lean Manufacturing, Popular ERP Packages, Implementation of ERP, Benefits of ERP.

Total No. of Hrs : 45

TEXT BOOKS

1) O.P. Khanna, (2005) *"Industrial Engineering and Management*", Khanna Publishers.
2) K.KAhuja, "*Industrial Management"*, Khanna Publishers.
3) Martand Telsang, "*Industrial Engineering and Production Management".*

REFERENCES

1) M.Mahajan, "*Industrial Engineering and Production Management"*, Dhanpat Rai &CO.,
2) B. Kumar, (2005) "*Industrial Engineering"*, Khanna Publishers.
3) International Labour Organization (ILO), (2004) *"Introduction to Work study"*, Universal Publishing Corporation.
4) H. B. Maynard, "*Industrial Engineering, Handbook"*, McGraw Hill Book Company, International Edition.
5) Marvin E. Mandel, *"Time & Motion study"*, Prentice Hall, Private Limited, International Edition.
6) James M Apple, "*Principles of Layout & Materials Handling"*, Ronalds Press, International Edition.
7) V. K. Garg & N.K. Venkatakrishnan, (2004) "*Enterprise Resource Planning, Concepts & Practice"*, Prentice Hall of India Private Limited.

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Subject Code: BME 17E20	**Subject Name : TOTAL QUALITY MANAGEMENT**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Basic Knowledge of Quality and Manufacturing Systems	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: Students will learn:

- Various Principles and Tools of TQM
- ISO Standards

COURSE OUTCOMES (COs) :

CO1	Various TQM Principles
CO2	Various Tools of TQM
CO3	ISO Standards 2008 and 14001

Mapping of Course Outcomes (COs) with Program Outcomes (Pos) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M				M	L		M	H	M	M	L
CO2	M				M	L		M	H	M	M	L
CO3	M				L	L		M	H	L	M	L

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1		M	L	L
CO2		M	L	L
CO3			L	L

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: INTRODUCTION **9** Hrs

Definition of Quality, Dimensions, Planning of quality, conformance to specification, Quality costs-. Basic concepts and evolution of Total Quality Management, Principles of TQM, Deming Philosophy Deming prize MBNQA. Barriers to TQM Implementation.

UNIT- II: TQM PRINCIPLES **9**Hrs

Customer satisfaction-Customer Perception of Quality, Customer Complaints. Service Quality, Customer Retention. Employee Involvement- Motivation, Empowerment, Teams. Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement-Juran Triology, PDSA Cycle,58,Kaizen.Supplier Partnership- Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures-Basic Concepts. Strategy, Performance Measure.

UNIT- III: SIX SIGMA **9** Hrs

The Seven Tools Of Quality, Statistical Fundamentals, Control Charts For Variables And Attributes, Process Capability, Concept Of Six Sigma, Phases And Defective UNIT-s Of Six Sigma .Overview Of GB,BB,MBB Leadership Characteristics ,Leadership Concept , Role Of Senior Management, Lean Management Principle, Strategic Planning New Seven Management Tools.

UNIT- IV: TQM TOOLS **9**Hrs

Benchmarking-Reasons to Benchmark, Benchmarking Process. Quality Function Deployment (QFD), pareto, process flow diagram, check sheets and histogram Taguchi Quality Loss Function. Total Productive Maintenance (TPM)-Concept, Improvement Needs, FMEA-Stages of FMEA.

UNIT- V: QUALITY SYSTEMS **9**Hrs

Need For ISO 09000 and Other Quality Systems, ISO 09000 – 2000 Quality System -Elements. Implementation Of Quality System, Documentation , Quality Auditing, Quality Council, Quality statements ,Quality Management System TS 1609409, ISO 14000 Concept, Requirements And Benefits. Introduction To Capability Material Management (CMM), People Capability Management (PCM).

Total No. of Hrs : 45

TEXT BOOK

1) Dale H Besterfied , "*Total Quality Management"*, Prentice Hall Publishing House

REFERENCES

1) S.Ramachandran,Dn.S.Jose, "*Total Quality Management"*, Airwalk Publications, First Edition, December.
2) Kulneet Suri, (2004 – 05) "*Total Quality Management: Priciples & Practce, Tools & Techniques"*, S.K. Kateria & sons, First Edition,
3) James R.Evans & William M.Lidsay, "*The Management and Control of Quality"*, (5th Edition), South Western(Thomson Learning),2002(ISBN 0-324-06680-5).
4) Feigenbaum.A.V. *"Total Quality Management"*, Tata Mcgraw-Hill, 109091.
5) Oakland.J.S. "*Total Quality Management"*, Butterworth-Heinemann Ltd.,Oxford,109809
6) R.S.Nagarajan,A.A.Arivalagar, "*Total Quality Management"*, New Age International(p) Ltd., Publishers, First Edition.

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Subject Code: BME17E21	**Subject Name : RESOURCE MANAGEMENT TECHNIQUES**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Knowledge of Management Science besides Quantitative Techniques	T	3	1	0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: The student will learn:

- Mathematical formulation of a real time problem
- Algorithms for optimal use of resources

COURSE OUTCOMES (COs) :

CO1	Mathematical formulation of a real time problem
CO2	Algorithms for optimal use of resources
CO3	Concept of queuing and replacement model

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H		H	H					L	L	M
CO2	M	H		H	H					L		L
CO3	M			M	M					M	M	
COs / PSOs	**PSO1**		**PSO2**		**PSO3**		**PSO4**					
CO1					M							
CO2					M							
CO3					M							

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: LINEAR PROGRAMMING **12** Hrs

Formulation of LPP – Standard form of LPP – Graphical method – Simplex method – Big M method – Two phase method.

UNIT- II: TRANSPORTATION AND ASSIGNMENT **12** Hrs

Formulation of Transportation problem – North West corner method – Least cost method – Vogel's approximation method – Optimality test – MODI method – Degeneracy – Assignment problem: Hungarian method – Travelling salesman problem.

UNIT- III: CPM, PERT AND SEQUENCING MODELS **12** Hrs

Network representation – Fulkerson's rule – Critical path method – Scheduling of activities – Earliest and Latest times – Float and Slack times – PERT – Probability for project duration – Sequencing Models: Introduction – Basic Terminologies – Processing n jobs on 2, 3, and machines – Johnson's method.

UNIT- IV: QUEUING MODELS **12** Hrs

Elementary concepts – Pure Birth and Death process – Single server Markovian models with infinite and finite capacity – Multi server Markovian models with infinite and finite capacity.

UNIT- V: SIMULATION AND REPLACEMENT MODELS **12** Hrs

Simulation: Introduction – Monte-Carlo Technique – Generation of Random numbers – Applications to Queuing models – Replacement Models: Introduction – Individual Replacement policy – Money value (not considered and considered) – Group Replacement policy – Comparison of Individual and Group Replacement policies.

Total No. of Hrs : 60

TEXT BOOKS

1) Sundaresan V. et.al. (2009), *"Resource Management Techniques*", A.R. Publications.

REFERENCES

1) Panneerselvam R. (2011), "*Operations Research"* (2nd ed.), Prentice Hall of India.
2) Hamdy A. Taha (2010), "*Operations Research: An Introduction" (09th ed.)*, Pearson.
3) Hillier, Lieberman (2005), *"Introduction to Operations Research"* (8th ed.) (IAE), Tata McGraw Hill Publishing Co.
4) Hira D.S., Gupta P.K., (2007) *"Operations Research"*, S.Chand & Co.

Subject Code: BME17E22	**Subject Name : SUPPLY CHAIN MANAGEMENT**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: In depth Knowledge of Manufacturing Systems, Material requirement planning and allied Procurement system	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: The student will learn:

- Basic conceptual idea of Supply Chain Management systems and its internal structural systems; also focused the theory and applications of SCM Networks with simple case study

COURSE OUTCOMES (COs) :

CO1	Knowledge of Logistic Management
CO2	Network design, sourcing and pricing in Supply chain
CO3	Information technology in Supply chain

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		M	L	L		L			M	M	H	M
CO2	L	L	M	M	H	L			L	M	M	L
CO3				M	M					M	M	M

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1			M	
CO2			M	
CO3			M	

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	**27th meeting of Academic council, June2017**

UNIT- I: INTRODUCTION **9 Hrs**

Definition of logistics and SCM: evolution, scope, importance& decision phases – drivers of SC performance and obstacles.

UNIT- II: LOGISTICS MANAGEMENT **9 Hrs**

Factors – Modes of Transportation - Design options for Transportation Networks-Routing and Scheduling – Inbound and outbound logistics- Reverse Logistics – 3PL- Integrated Logistics Concepts- Integrated Logistics Model – Activities - Measuring logistics cost and performance – Warehouse Management - Case Analysis

UNIT- III: SUPPLY CHAIN NETWORK DESIGN **9 Hrs**

Distribution in Supply Chain – Factors in Distribution network design –Design options-Network Design in Supply Chain – Framework for network Decisions - Managing cycle inventory and safety.

UNIT- IV: SOURCING AND PRICING IN SUPPLY CHAIN **9 Hrs**

Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain

UNIT- V: COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN **9 Hrs**

Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis

Total no. of Hrs : 45

REFERENCES

1. Sunil Chopra and Peter Meindl,(2007) "*Supply Chain Management, Strategy, Planning, and operation*", (2nd ed.), PHI
2. David J.Bloomberg, Stephen Lemay and Joe B.Hanna,(2002), " *Logistics*", PHI
3. Martin Christopher, "*Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service*", (2nd ed.), Pearson Education Asia
4. Jeremy F.Shapiro, Thomson Duxbury, (2002) " *Modeling the supply chain*"
5. James B.Ayers,(2000) "*Handbook of Supply chain management*", St.Lucle Press