Dr.M.G.R.
Educational and Research Institute
(DEEMED TO BE UNIVERSITY)
(An ISO Certified Institution)
University with Graded Autonomy Status
Maduravoyal , Chennai - 600 095

Department of Mechanical Engineering

B.Tech Mechanical Engineering (Part Time)
Curriculum and Syllabus
2018 Regulation

I SEMESTER							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ S.Lr	P/R	C
1	BMA18005	Mathematics III for Mechanical and Civil Engineers	Ty	3	1/0	0/0	4
2	BCE18I05	Fluid Mechanics and Machinery	Ty	3	0/0	0/0	3
3	BME18002	Manufacturing Technology - I	Ty	3	0/0	0/0	3
4	BME18003	Engineering Mechanics	Ty	3	1/0	0/0	4
5	BCE18IL4	Fluid Mechanics and Machinery Lab.	Lb	0	0/0	3/0	1

Credits Sub Total: 15

II SEMESTER							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BME18004	Mechanics of Machines -I	Ty	3	1/0	0/0	4
2	BEE18I01	Electrical and Electronics Engineering	Ty	3	0/0	0/0	3
3	BME18ET2	Engineering Metrology	Ty	1	0/1	3/0	3
4	BME18006	Strength of Materials	Ty	3	1/0	0/0	4
5	BME18001	Engineering Thermodynamics	Ty	3	1/0	0/0	4

Credits Sub Total: 18

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III SEMESTER							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BME18005	Thermal Engineering	Ty	3	1/0	0/0	4
2	BME18007	Engineering Metallurgy	Ty	3	0/0	0/0	3
3	BME18008	Mechanics of Machines -II	Ty	3	1/0	0/0	4
4	BME18ET3	Manufacturing Technology-II	ETL	1	0/1	3/0	3
5	BME18L04	Dynamics Lab	Lb	0	0/0	3/0	1

Credits Sub Total: 15

IV SEMESTER							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BME18009	Design of Machine Elements -I	Ty	3	1/0	0/0	4
2	BME18010	Industrial Automation	Ty	3	0/0	0/0	3
3	BME18013	Heat and Mass Transfer	Ty	3	1/0	0/0	4
4	BXX18EXX	Elective 1 (Thermal)	Ty	3	0/0	0/0	3
5	BME18L08	Thermal Engineering Lab-II	Lb	0	0/0	3/0	1

Credits Sub Total: 15

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V SEMESTER							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BME18011	Design of Machine Elements -II	Ty	3	1/0	0/0	4
2	BME18012	Automobile Engineering	Ty	3	0/0	0/0	3
3	BMG18008	Engineering Economics and Industrial	Ty	3	0/0	0/0	3
4	BXX18EXX	Elective 2 (Design)	Ty	3	0/0	0/0	3
5	BME18L03	Industrial Automation Lab	Lb	0	0/0	3/0	1

Credits Sub Total: 14

VI SEMESTER							
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BME18ET4	Finite Element Method	ETL	1	0/1	3/0	3
2	BXX18EXX	Elective 3 (Manufacturing)	Ty	3	0/0	0/0	3
3	BME18014	CAD,CAM & CIM	Ty	3	0/0	0/0	3
4	BME18L07	CAD/CAM Lab	Lb	0	0/0	3/0	1
5	BME18L09	Project Phase – I	Lb	0	0/0	3/3	2

Credits Sub Total: 12

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VII SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	**BXX18EXX**	**Elective 4 (Industrial)**	**Ty**	**3**	**0/0**	**0/0**	**3**
2	**BME18L10**	**Project Phase – II**	**Lb**	**0**	**0/0**	**12/12**	**8**

Credits Sub Total: 11

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 : 15

Semester: V : 14

Semester: VI : 12

Semester: VII: 11

Total Credits : 100 Credits

Department of Mechanical Engineering

ELECTIVE –I & V							
S.NO.	SUBJECT CODE	SUBJECT NAME Elective: Thermal Engineering	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BME18E01	Advanced IC Engines	Ty	3	0/0	0/0	3
2	BME18E02	Renewable Energy	Ty	3	0/0	0/0	3
3	BME18E03	Turbo machines	Ty	3	0/0	0/0	3
4	BME18E04	Refrigeration and Air Conditioning	Ty	3	0/0	0/0	3
5	BME18E05	Computational Fluid Dynamics	Ty	3	0/0	0/0	3
6	BME18E06	Gas Dynamics and Jet propulsion	Ty	3	0/0	0/0	3

ELECTIVE –II							
S.NO.	SUBJECT CODE	SUBJECT NAME Elective: Design Engineering	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BME18E07	Mechanical Vibrations	Ty	3	0/0	0/0	3
2	BME18E08	Design of production Tools	Ty	3	0/0	0/0	3
3	BME18E09	Design of Material Handling Equipments	Ty	3	0/0	0/0	3
4	BME18E10	Tribology	Ty	3	0/0	0/0	3
5	BME18E11	Design for Manufacture and Assembly	Ty	3	0/0	0/0	3
6	BME18E12	Mechanics of Fracture	Ty	3	0/0	0/0	3

ELECTIVE –III							
S.NO.	SUBJECT CODE	SUBJECT NAME Elective: Manufacturing Engineering	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BME18E13	Industrial Robotics	Ty	3	0/0	0/0	3
2	BME18E14	Non-Conventional Machining Techniques	Ty	3	0/0	0/0	3
3	BME18E15	Process Planning and Cost Estimation	Ty	3	0/0	0/0	3
4	BME18E16	Flexible Manufacturing Systems	Ty	3	0/0	0/0	3
5	BME18E17	Composite Materials	Ty	3	0/0	0/0	3

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ELECTIVE –IV							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME Elective: Industrial Engineering**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	**BME18E18**	**Enterprise Resource Planning**	**Ty**	**3**	**0/0**	**0/0**	**3**
2	**BME18E19**	**Industrial Engineering**	**Ty**	**3**	**0/0**	**0/0**	**3**
3	**BME18E20**	**Total Quality Management**	**Ty**	**3**	**0/0**	**0/0**	**3**
4	**BME18E21**	**Facilities Planning and Design**	**Ty**	**3**	**0/0**	**0/0**	**3**
5	**BME18E22**	**Supply Chain Management**	**Ty**	**3**	**0/0**	**0/0**	**3**
6	**BME18E23**	**Quality Engineering**	**Ty**	**3**	**0/0**	**0/0**	**3**

SEMESTER-I

Department of Mechanical Engineering

Subject Code:	Subject Name: MATHEMATICS III FOR MECHANICAL AND CIVIL ENGINEERS.	Ty/Lb/ ETL	L	T/ S.Lr	P/ R	C
BMA18005	Prerequisite: Mathematics I & II	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

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			
	✓											

Department of Mechanical Engineering

Subject Code: BMA18005	Subject Name: MATHEMATICS III FOR MECHANICAL AND CIVIL ENGINEERS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Mathematics I & II	Ty	3	1/0	0/0	4

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

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**

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**

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**

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**

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 Periods: 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 (9^{th} ed.), John Wiley & Sons.
3) Grewal B.S. (2012), Higher Engineering Mathematics, Khanna Publishers.

Department of Mechanical Engineering

Subject Code: BCE18I05	Subject Name : FLUID MECHANICS AND MACHINERY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Physics & Mathematics	**Ty**	**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: 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) :

CO1	The basic properties of fluids.
CO2	Flow behaviour in various sections with basic equations.
CO3	.Concept of boundary layer and flow through pipes
CO4	Working principles of hydraulic turbines and its types
CO5	Working principles of hydraulic pumps and its types

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

Department of Mechanical Engineering

Subject Code: BCE18I05	Subject Name: FLUID MECHANICS AND MACHINERY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Physics & Mathematics	Ty	3	0/0	0/0	3

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

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**

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**

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**

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**

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 Periods : 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.*

Department of Mechanical Engineering

Subject Code: BME18002	Subject Name: MANUFACTURING TECHNOLOGY - I	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Basic Mechanical and Civil Engineering	**Ty**	**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

OBJECTIVES: The student will learn

- To impart knowledge in basics of manufacturing processes for metals and polymers

COURSE OUTCOMES (COs) :

CO1	Knowledge of metal casting processes
CO2	Knowledge of basic and advanced metal forming processes
CO3	Knowledge of metal joining processes
CO4	Knowledge of basic metal cutting processes
CO5	Knowledge of different plastic materials processing

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	L	L	M	-	H	-	-	M
CO2	H	-	H	M	L	L	M	-	H	-	-	M
CO3	H	-	H	M	L	L	M	-	H	-	-	M
CO4	H	-	H	M	L	L	M	-	H	-	-	M
CO5	H	-	H	M	L	L	M	-	H	-	-	M

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

Department of Mechanical Engineering

Subject Code: BME18002	Subject Name: MANUFACTURING TECHNOLOGY - I	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Basic Mechanical and Civil Engineering	Ty	3	0/0	0/0	3

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

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**

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**

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**

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**

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 Periods : 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.*

Department of Mechanical Engineering

Subject Code:	Subject Name: ENGINEERING MECHANICS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18003	Prerequisite: Engineering Physics	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	To calculate the centre of gravity and moment of inertia
CO3	The effects of friction on equilibriums ,the laws of motion, the kinematics of motion and the inter-relationship
CO4	The principle of work and energy.
CO5	Static equilibrium of particles and rigid bodies both in two dimensions and in three dimensions

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			
				✓								

Department of Mechanical Engineering

Subject Code: BME18003	Subject Name: ENGINEERING MECHANICS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Physics	Ty	3	1/0	0/0	4

UNIT- I: STATICS **12**

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**

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**

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**

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**

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 Periods: 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.*

Department of Mechanical Engineering

Subject Code: BCE18IL4	Subject Name : FLUID MECHANICS AND MACHINERY LAB	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Fluid Mechanics and Machinery	**Lb**	**0**	**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) :

CO1	Knowledge on Different Methods of flow measurements
CO2	Knowledge on friction factor in pipes
CO3	Knowledge on centrifugal pumps
CO4	Knowledge on reciprocating pumps
CO5	Knowledge on 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					
CO4		H		M		M		M				
CO5		H		M		M		M				

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

Department of Mechanical Engineering

Subject Code:	Subject Name:	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BCE 18IL4	FLUID MECHANICS AND MACHINERY LAB					
	Prerequisite: Fluid Mechanics and Machinery	**Lb**	**0**	**0/0**	**3/0**	**1**

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.

Total No. of Periods : 45

SEMESTER - II

Department of Mechanical Engineering

Subject Code: BME18004	Subject Name: MECHANICS OF MACHINES -I	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Engineering Mechanics, Strength of Materials	**Ty**	**3**	**1/0**	**0/0**	**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

- 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

OURSE OUTCOMES (COs) :

CO1	Fundamental concepts of mechanism, types of mechanisms and their inversions
CO2	Velocity and acceleration of different links of a mechanism
CO3	Knowledge of different types of cams and their profiles
CO4	Fundamental concepts of gears and gear trains
CO5	Theory and application of friction in transmission drives

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**	**M**	**-**	**L**	**-**	**-**	**-**	**-**	**-**	**M**
CO2	**H**	**H**	**H**	**H**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**L**
CO3	**H**	**H**	**H**	**H**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**L**
CO4	**H**	**H**	**H**	**H**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**L**
CO5	**H**	**H**	**H**	**H**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**L**

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	-	**H**	**H**	-
CO2	-	**H**	**H**	-
CO3	-	**H**	**H**	-
CO4	-	**H**	**H**	-
CO5	-	**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			
				✓								

Department of Mechanical Engineering

Subject Code: BME18004	Subject Name: MECHANICS OF MACHINES -I	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials	Ty	3	1/0	0/0	4

UNIT I BASICS OF MECHANISMS 12

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 12

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 12

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 12

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 12

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 Periods: 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.*

Department of Mechanical Engineering

Subject Code: BEE18I01	Subject Name : ELECTRICAL AND ELECTRONICS ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Basic Electrical and Electronics Engineering	**Ty**	**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

OBJECTIVES:

- To analyse construction and working of DC machines and their characteristics
- To analyze the different types of transformers and different types of power supplies
- To construct different types of synchronous and induction motors.
- To design different types of logic gates and the combinational circuits.
- To design and analyse different types of flip flops and sequential circuits

COURSE OUTCOMES (COs) : Students will be able to

CO1	To analyse construction and working of DC machines and their characteristics
CO2	To analyze the different types of transformers and different types of power supplies
CO3	To construct different types of synchronous and induction motors.
CO4	To design different types of logic gates and the combinational circuits.
CO5	To design and analyse different types of flip flops and sequential circuits

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	L	L	L	L	L	L	M
CO2	H	H	H	H	M	L	L	L	L	L	L	M
CO3	H	H	H	H	M	L	L	L	L	L	L	M
CO4	H	H	H	H	M	L	L	L	L	L	L	M
CO5	H	H	H	H	M	L	L	L	L	L	L	M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
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	Interdisciplinary		
										✓		

Subject Code: BEE18I01	Subject Name: ELECTRICAL AND ELECTRONICS ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Basic Electrical and Electronics Engineering	Ty	3	0/0	0/0	3

UNIT- I: TRANSFORMERS **9**

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. (Qualitative Treatment only)

UNIT – II: SYNCHRONOUS MACHINES AND INDUCTION MOTORS **9**

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 – III: ELECTRICAL DRIVES **9**

Types of Electrical Drives - Factors Influencing the Choice of Electrical Drives, Heating and Cooling Curves - Loading Conditions and Classes of Duty -Determination of Power Rating - Drives for Textile mills, Steel rolling mills, Machine tools and Cranes & hoist drives. (Qualitative Treatment only)

UNIT-IV: FABRICATION OF IC's **9**

Thermal oxidation – Photolithography –Etching- Dopant Diffusion- Metal Evaporation- Electrical Testing- Steps of CMOS Fabrication Process(n-well,p-well and twin tub process).

UNIT-V: MICROPROCESSORS AND MICROCONTROLLERS **9**

Architecture of 8085,Functional Block Diagram of 8086,Archicture of 8051,Addressing mode of 8051,Instruction set of 8051,Interfacing of 8051 with Stepper motor, Interfacing of 8051 with LCD.

Total No. of Periods : 45

Text Books:

1. A Text book of Electrical Technology A.K.Theraja, S.Chand limited 2014.
2. Electric Drives By N. K. DE, P. K. SEN, Prentice – Hall of India Private Limited, 2006
3. Basic VLSI Design- Douglas A.Pucknell, Prentice Hall , 1994.
4. "Microprocessors and Interfacing, Programming and Hardware", Doughlas V.Hall, TMH,2012

References:-

1. Electrical Machines, S.K.Bhattacharya, Tata MC Graw Hill Publication.
2. Microprocessors and Interfaces, A.P.Godes, D.A.Godse, Technical Publications Pune.

Department of Mechanical Engineering

Subject Code:	Subject Name: ENGINEERING METROLOGY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18ET2	Prerequisite: Engineering Sciences	Ty	1	0/1	3/0	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: The student will learn

- Technique of measurement using different types of precision measuring instruments

OURSE OUTCOMES (COs) :

CO1	Understand the fundamentals of precision measurements
CO2	Gain theoretical and practical knowledge about the linear and angular measurements
CO3	Gain theoretical and practical knowledge about the form measurements
CO4	Gain knowledge in laser based precision measurements
CO5	Exposed to the recent advancement in metrology

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
CO2	H	-	-	-	M	-	-	-	M	M	-	M
CO3	H	-	-	-	M	-	-	-	M	M	-	M
CO4	H	-	-	-	H	-	-	-	M	M	-	M
CO5	H	-	-	-	H	-	-	-	M	M	-	M

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

Department of Mechanical Engineering

Subject Code: BME18ET2	Subject Name: ENGINEERING METROLOGY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Physics	Ty	1	0/1	3/0	3

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

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

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

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**

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**

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**

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 Periods: 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.*

Department of Mechanical Engineering

Subject Code: BME18006	Subject Name: STRENGTH OF MATERIALS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	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			
				✓								

Subject Code: BME18006	Subject Name: STRENGTH OF MATERIALS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Mechanics	Ty	3	1/0	0/0	4

UNIT- I: STRESS, STRAIN DEFORMATION OF SOLIDS **12**

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 **12**

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 **12**

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 **12**

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 **12**

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 Periods: 60

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.

Department of Mechanical Engineering

Subject Code: BME18001	Subject Name : ENGINEERING THERMODYNAMICS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Physics	**Ty**	**3**	**1/0**	**0/0**	**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) :

CO1	Fundamentals concepts and First laws of thermodynamics
CO2	Second law of thermodynamics and its application
CO3	Various properties steam and its applications
CO4	Various power cycles and their applications
CO5	Concept of thermodynamics relations, Joule Thomson effect.

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								
CO4		M				M						
CO5		M		M								

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

Department of Mechanical Engineering

Subject Code: BME18001	Subject Name: ENGINEERING THERMODYNAMICS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Physics	**Ty**	**3**	**1/0**	**0/0**	**4**

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

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**

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**

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**

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

UNIT- V: THERMODYNAMIC RELATIONS **12**

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

Total No. of Periods: 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

Department of Mechanical Engineering

Subject Code:	Subject Name: THERMAL ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18005	Prerequisite: Engineering Thermodynamics	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: 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			
				✓								

Subject Code: BME18005	Subject Name: THERMAL ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Thermodynamics	Ty	3	1/0	0/0	4

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

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**

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**

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

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

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**

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 Periods: 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

Department of Mechanical Engineering

Subject Code: BME18007	Subject Name : ENGINEERING METALLURGY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Material Science	Ty	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:
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 ferrous and non ferrous metals
CO3	Heat treatment and testing of materials
CO4	Basic failure modes of metals, mechanism and its preventions
CO5	Non metals and newer materials

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		H		M	M					L
CO2	M	L		H		M	M					L
CO3	M	H		M		M	M					L
CO4	M	H	M	M		L	M					L
CO5	M	H	M	M		M	M					L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1		M	H					
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			
				✓								

Department of Mechanical Engineering

Subject Code: BME18007	Subject Name: ENGINEERING METALLURGY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Material Science	Ty	3	0/0	0/0	3

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

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**

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**

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**

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**

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 Periods: 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.

Department of Mechanical Engineering

Subject Code: BME18008	Subject Name: MECHANICS OF MACHINES –II	Ty/Lb/ ETL	L	T/ S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics & Strength of Material	**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:

- 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.

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	PSO5			
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			
				√								

Department of Mechanical Engineering

Subject Code: BME18008	Subject Name: MECHANICS OF MACHINES –II	Ty/Lb / ETL	L	T/ S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics & Strength of Material	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT I FORCE ANALYSIS AND FLYWHEELS 12

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

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

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

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

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 Periods : 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.*

Department of Mechanical Engineering

Subject Code: BME18ET3	Subject Name: MANUFACTURING TECHNOLOGY - II	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology - I	**ETL**	**1**	**0/1**	**3/0**	**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	Knowledge of powder metallurgy and precision engineering

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			
				✓								

Department of Mechanical Engineering

Subject Code: BME18ET3	Subject Name: MANUFACTURING TECHNOLOGY - II	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology - I	ETL	1	0/1	3/0	3

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

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**

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**

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**

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**

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 micronized components

Total No. of Periods: 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.

Department of Mechanical Engineering

Subject Code: BME18L04	Subject Name: DYNAMICS LAB	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Mechanics of Machines-II	**Lb**	**0**	**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
- Working of simple mechanisms
- To find natural frequency of vibrating system at different models

COURSE OUTCOMES (COs) :

CO1	Gain knowledge in kinematics and Dynamics of Machinery
CO2	Working of gyroscope and its applications
CO3	Working principles of vibrating systems
CO4	Working of universal governors and their applications
CO5	Understand the knowledge on Static and dynamic balancing of rotating masses

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	L	M	M	M	M	M			M
CO2	H	M	M	L	M	M	M	M	M			M
CO3	H	M	M	L	M	M	M	M	M			M
CO4	H	M	M	L	M	M	M	M	M			M
CO5	H	M	M	L	M	M	M	M	M			M

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

Department of Mechanical Engineering

Subject Code:	Subject Name: DYNAMICS LAB	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18L04	Prerequisite: Mechanics of Machines-II	Lb	0	0/0	3/0	1

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 Periods: 45

SEMESTER IV

Department of Mechanical Engineering

Subject Code: BME18009	Subject Name: DESIGN OF MACHINE ELEMENTS - I	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials, Mechanics of Machines -I	**Ty**	**3**	**1/0**	**0/0**	**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

- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.

COURSE OUTCOMES (COs) :

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
CO4	To obtain an optimum design procedure
CO5	Students will learn to fabricate/do research using their knowledge attained

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	H	M	M	M	M			M
CO2	H	H	H	M	H	M	M	M	M			M
CO3	H	H	H	M	H	M	M	M	M			M
CO4	H	H	H	M	H	M	M	M	M			M
CO5	H	H	H	M	H	M	M	M	M			M

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

Department of Mechanical Engineering

Subject Code: BME18009	Subject Name: DESIGN OF MACHINE ELEMENTS - I	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials, Mechanics of Machines -I	**Ty**	**3**	**1/0**	**0/0**	**4**

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

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

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

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

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

Design of Helical and Leaf springs

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

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

UNIT- V: BEARINGS **12**

Design of sliding contact bearings – Selection of rolling contact bearings

Total No. of Periods: 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.

Department of Mechanical Engineering

Subject Code: BME18010	Subject Name: INDUSTRIAL AUTOMATION	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Manufacturing Technology-I & II, Electrical and Electronics Engineering and Fluid Mechanics	**Ty**	**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

OBJECTIVES: The student will gain

- knowledge in hydraulic, pneumatic and mechatronics system in Automation.

OURSE OUTCOMES (COs) :

CO1	Understand Pneumatic and hydraulic principles, components and functions
CO2	Design of Pneumatic and hydraulic circuits for automation.
CO3	Understand Components of mechatronics system
CO4	Understand Actuation System and System model in automation
CO5	Understand Controllers and Design of Mechatronic systems

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
CO4	L	H	H		H							M
CO5	L	H	H		H							M

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

Department of Mechanical Engineering

Subject Code:	Subject Name: INDUSTRIAL AUTOMATION	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18010	Pre requisite: Manufacturing Technology-I & II, Electrical and Electronics Engineering and Fluid Mechanics	Ty	3	0/0	0/0	3

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

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**

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 ANDTRANSDUCERS **8**

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-IVACTUATIONSYSTEMAND SYSTEM MODELS **8**

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**

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 Periods: **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.

Department of Mechanical Engineering

Subject Code: BME18013	Subject Name : HEAT AND MASS TRANSFER	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Thermodynamics	Ty	3	1/0	0/0	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 ,extended surfaces and their correlations.
CO2	Concept forced and free Convection heat transfer and their correlations
CO3	Concept of block body and laws of radiation
CO4	Concept of heat exchangers and phase change heat transfer and its applications
CO5	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	H	M	M									
CO2	H	M	M									
CO3		M	M									
CO4		M	M									
CO5		M	M									
COs / PSOs	PSO1		PSO2		PSO3		PSO4					
CO1	H		M		M							
CO2			M									
CO3			M									
CO4			M		M							
CO5			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			
				√								

Department of Mechanical Engineering

Subject Code: BME18013	Subject Name: HEAT AND MASS TRANSFER	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Thermodynamics	Ty	3	1/0	0/0	4

UNIT- I: CONDUCTION **13**

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**

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**

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**

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

Total No. of Periods: 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.*

Department of Mechanical Engineering

Subject Code: BME18L08	Subject Name : THERMAL ENGINEERING LAB-II	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermal Engineering and Heat and Mass Transfer	**Lb**	**0**	**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 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	Gain the knowledge of performance of air compressor and air blower and refrigeration and air conditioning systems**.**
CO2	Gain the knowledge of refrigeration and air conditioning systems.
CO3	Gain the knowledge of properties of different liquid fuels.
CO4	Gain the knowledge of modes of heat transfer.
CO5	Gain the knowledge of performance of heat exchangers.

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			L					
CO3	M		L	H		M	L					
CO4	H	M	M	M			L					
CO5	M	M	M	M		M	L					

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

Department of Mechanical Engineering

Subject Code: BME18L08	Subject Name: THERMAL ENGINEERING LAB-II	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermal Engineering and Heat and Mass Transfer	Lb	0	0/0	3/0	1

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 Periods: 45

SEMESTER-V

Department of Mechanical Engineering

Subject Code: BME18011	Subject Name: DESIGN OF MACHINE ELEMENTS - II	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials, Mechanics of Machines – I, Design of Machine Elements - I	**Ty**	**3**	**1/0**	**0/0**	**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

- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.

COURSE 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
CO4	Understand belt drives and chain drives
CO5	Learn calculation of speed reduction , kinematic and ray diagrams

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	M	H	M	M	M	M			M
CO2	H	H	H	M	H	M	M	M	M			M
CO3	H	H	H	M	H	M	M	M	M			M
CO4	H	H	H	M	H	M	M	M	M			M
CO5	H	H	H	M	H	M	M	M	M			M

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

Department of Mechanical Engineering

Subject Code: BME18011	Subject Name: DESIGN OF MACHINE ELEMENTS - II	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials, Mechanics of Machines – I, Design of Machine Elements - I	**Ty**	**3**	**1/0**	**0/0**	**4**

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

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**

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

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

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

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

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**

Design of Ratchet and pawl mechanism, Geneva mechanism.

Total No. of Periods: 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.*

Department of Mechanical Engineering

Subject Code: BME18012	Subject Name : AUTOMOBILE ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering-I	Ty	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: The student will learn

- Various automobile parts, power transmission from engine to various parts of the automobile, engine cooling, lubrication and also about various pollutants and its control.

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COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on I.C engine parts and different chassis and frames
CO2	Knowledge on Ignition, lubrication and cooling system..
CO3	Knowledge on Transmission systems like clutches and gear boxes.
CO4	Knowledge on Steering, brake and suspension system.
CO5	Knowledge on working of Hybrid Vehicles 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	H		M		L		H					
CO2		L		M								
CO3	H						M					
CO4	H		M		L		H					
CO5	H		M		L		H					
Cos / PSOs	PSO1		PSO2		PSO3		PSO4					
CO1	H				M							
CO2	M				M							
CO3	M		M		L							
CO4	M		M		L							
CO5	M		M		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			
					✓							

Department of Mechanical Engineering

Subject Code: BME18012	Subject Name: AUTOMOBILE ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT- I: VEHICLE STRUCTURE AND ENGINES **9**

Vehicle construction –types-chassis layout- body-integral and chassis mounted body- vehicle specifications-power and torque requirements- choice of engine for different applications. Engine types and construction – cylinder arrangement-piston- cylinder head connecting rod – crank shaft-valves- liners-manifolds.

UNIT- II: ENGINE AUXILIARY SYSTEMS AND POLLUTION CONTROL **9**

Fuel supply system to SI and CI engines–injection timing. Lubrication system-cooling system-ignition system-spark timing-firing order, electronic fuel injection system-types. Pollution from engines and their control-Indian emission standards-supercharging-turbo charging.

UNIT- III: TRANSMISSION SYSTEMS **9**

Clutches –need-types-single& multi plate –diaphragm-fluid coupling-torque converter Gear boxes-manual-sliding mesh-constant mesh-synchro mesh- epicyclic gear boxes-automatic transmission. Universal joint-propeller shaft-Hotchkiss drive-torque tube drive. Differential-need-types- construction. Four wheel drive-rear axle.

UNIT- IV: STEERING AND SUSPENSION SYSTEMS **9**

Principle of steering-steering geometry and wheel alignment-steering linkages-steering gear boxes-power steering. Wheel and tyre construction-type and specification-tyre wear and causes-front axles arrangements. Suspension system-need and types-independent systems-coil-leaf spring-torsion bar-shock absorbers-air suspension**.**

UNIT- V: BRAKE SYSTEMS **9**

Auto Electrical Components and Alternative Power Plants. Brake –need –types-mechanical-hydraulic-pneumatic-power brake-trouble shooting of brakes. Principles of modern electrical systems-battery-dynamo-starting motor- lighting- automobile conditioning. Electric hybrid vehicle and fuel cells.

Total No. of Periods: 45

TEXT BOOKS

1) K.K.Ramalingam, (2007) "*Automobile Engineering"*, SciTech Publications.
2) Kirpal Singh, (2012) *"Automobile Engineering vol-I&II".*
3) R.B.Gupta, (2013) "*Automobile Engineering"*, Satya Prakashan Publishing.

REFERENCES

1) *Joseph Heitner, "Automotive Mechanics", Affiliated East West Press Ltd.*
2) *"Newton and Steeds, Motor Vehicles", ELBS –13 EDITION.*
3) *William Crouse, (2007) "Automotive Mechanics", Tata McGraw Hill.*

Department of Mechanical Engineering

Subject Code: BMG18008	Subject Name : ENGINEERING ECONOMICS AND INDUSTRIAL MANAGEMENT	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Nil	**Ty**	**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: The student will learn:

- Concepts of industrial management and economics

COURSE OUTCOMES (COs) :

CO1	Gain the knowledge of administration and management
CO2	Gain the knowledge of concepts of organization behavior and management
CO3	Gain the knowledge of concepts of supply and demand and analysis
CO4	Gain the knowledge of theory of production and economic concepts
CO5	Gain the knowledge of macroeconomic Concepts like inflation, Monetary and fiscal policy.

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

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	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
CO4	M				L	M		M	H	H	M	M
CO5	M				L	M		M	H	H	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1			M	M
CO2			M	M
CO3			M	M
CO4			M	M
CO5			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			
		✓										

Department of Mechanical Engineering

Subject Code:	Subject Name: ENGINEERING ECONOMICS AND INDUSTRIAL MANAGEMENT	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BMG18008	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT - I Introduction to Management **9**

The Nature of Management –Management: Science or Art – Difference between administration and management - Evolution of management thought - Roles of managers– F.W.Taylor and Henri Fayol contribution to the management- Organization and the environmental factors.

UNIT - II Managing Organizational Behavior **9**

Definition- need and Importance of Organizational Behavior – Nature and Scope of Organizational Behavior - Role of managers – Contributing disciplines to Organizational Behavior - Frame work of Organizational Behavior.

UNIT – III Demand & Supply Analysis **9**

Meaning of demand, the demand curve, Elasticity of demand, types of elasticity of demand. **Supply** –Meaning, the supply curve, equilibrium with supply and demand curves.

UNIT IV Theory of Production **9**

Meaning of Production, Basic concepts- total, average, and marginal product, short run and long run production Function, Law of Variable Proportion. Production function with two variable inputs – Isoquants – Meaning, Properties, ISO cost Lines, All variable inputs – Returns to Scale, **Cost Analysis**: Determinants of Costs, types of Cost.

UNIT V Macro Economic Concepts **9**

National income concepts, Inflation, Balance of Payment, Circular flow of income Monetary and Fiscal Policy, Demonization, Exchange Rates

Total No. of Periods: 45

REFERENCE BOOKS:

1. *Meenakshi Gupta - Principles of Management - PHI Learning Pvt. Ltd.-2009.*
2. *L.M.Prasad - Principles and Practice of Management - Sultan Chand & Sons - 7th Edition - 2007.*
3. *Harold Koontz - Principles of Management - Tata McGraw Hill - 2004.*
4. *Mithani, D.M, Managerial Economics- Theory &applications, Himalaya pub.*
5. *Mehta, P, L, Managerial Economics. Analysis, problem & cases, Sultan Chand*

Department of Mechanical Engineering

Subject Code: BME18L03	Subject Name: INDUSTRIAL AUTOMATION LAB	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Manufacturing Technology – I & II, Electrical and Electronics Engineering	**Lb**	**0**	**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 practice simple programs on microprocessors and micro controllers.
- To design and implement pneumatic and hydraulic circuits with automation studio software and with kits

OURSE OUTCOMES (COs) :

CO1	Write Simple programs on microprocessors and micro controllers.
CO2	Design and implement hydraulic circuits with automation studio software and with kit
CO3	Design and implement pneumatic circuits with automation studio software and with kit
CO4	Knowledge of industrial robots
CO5	Knowledge in PLC trainer kit

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		H		H							H
CO4	L		L		L							H
CO5	L		L		M							H

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

Department of Mechanical Engineering

Subject Code: BME18L03	Subject Name: INDUSTRIAL AUTOMATION LAB	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Industrial Automation	Lb	0	0/0	3/0	1

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 Periods: 45

SEMESTER -VI

Department of Mechanical Engineering

Subject Code: BME18ET4	Subject Name: FINITE ELEMENT METHOD	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Strength of Materials, Design of Machine Elements-I	ETL	1	0/1	3/0	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: The student will learn

- Fundamentals of finite element analysis and their applications.
- Method of solving one, two and iso-parametric elements.

OURSE OUTCOMES (COs) :

CO1	To Impart Knowledge about Introduction to Finite Element Analysis
CO2	To impart knowledge about one-dimensional problems
CO3	To impart knowledge about two dimensional scalar variable problems
CO4	To impart knowledge about two dimensional vector variable problems
CO5	To impart knowledge about isoparametric formulation and advanced topics

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	H	H	M	L	L	L	M	L	M
CO2	M	H	H	H	H	M	L	L	L	M	L	M
CO3	M	H	H	H	H	M	L	L	L	M	L	M
CO4	M	H	H	H	H	M	L	L	L	M	L	M
CO5	M	H	H	H	H	M	L	L	L	M	L	M

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

Department of Mechanical Engineering

Subject Code: BME18ET4	Subject Name: FINITE ELEMENT METHOD	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Strength of Materials, Design of Machine Elements-I	ETL	1	0/1	3/0	3

UNIT- I INTRODUCTION **9**

Historical Background – Mathematical Modeling of field problems in Engineering –Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

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

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 **9**

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 **9**

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 **9**

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.

Lab Components

Design the following machine elements using CAD software, analyse using FEA software.

1. Shafts subjected to Bending Moment and Twisting Moment
2. Open and Closed coiled helical springs
3. Leaf Springs
4. Wire ropes for various loads
5. Connecting rod

Design and simulation of linkages.

1. Simulation of Single Slider Crank chain Mechanism for I.C. Engines.
2. Simulation of 4 bar mechanism.
3. Simulation of crank and slotted lever mechanism.

Total No. of Periods: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, Ibrahim Zeid, "Introduction to CAD/CAM", Tata McGraw Hill Co.*

Department of Mechanical Engineering

Subject Code: BME18014	Subject Name: CAD,CAM & CIM	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Design of Machine Elements, Manufacturing Technology	**Ty**	**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

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			
				√								

Department of Mechanical Engineering

Subject Code: BME18014	Subject Name: CAD,CAM & CIM	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Design of Machine Elements, Manufacturing Technology	Ty	3	0/0	0/0	3

UNIT- I INTRODUCTION **9**

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 **9**

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 **9**

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 **9**

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 **9**

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 Periods: 45

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

Department of Mechanical Engineering

Subject Code: BME18L07	Subject Name: CAD/CAM LAB	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: CAD,CAM&CIM, Machine drawing	**Lb**	**0**	**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

- Get practical knowledge through practice on CNC Machines and related software

OURSE OUTCOMES (COs) :

CO1	Gain the knowledge of Auto CAD/ Solid works or CATIA Software's
CO2	Gain the knowledge of drawing the machine parts drawing, assembly drawing, detailed drawing
CO3	Gain the knowledge of solid modeling features-Boolean operations.
CO4	Gain the knowledge of various machine parts of CNC Lathe and Milling Machine
CO5	Gain the knowledge of writing coding and operations of CNC Lathe and Milling Machines

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	H	-	L
CO2	M	-	-	-	H	-	-	-	H	H	-	L
CO3	M	M	-	-	H	-	-	-	H	H	-	L
CO4	M	M	-	-	H	-	-	-	H	H	-	L
CO5	M	M	-	-	H	-	-	-	H	H	-	L

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

Subject Code: BME18L07	Subject Name: CAD / CAM LAB	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: CAD,CAM&CIM, Machine drawing	**Lb**	**0**	**0/0**	**3/0**	**1**

Exercises

1. CAD LAB

Introduction to computer Aided Design and Drafting Packages.

2D – Drawing using Auto CAD/ Solid works or CATIA Software

2D sectional views, part drawing, assembly drawing, detailed drawing.

Dimensioning, annotations, symbols – Welding, Surface finish, threads, Text, Bill of Materials, Title Block.

Exercises – Knuckle joint, Gib & Cotter joint, Screw Jack, Foot step bearing.

Orthographic views, Isometric views.

Solid modeling features-Boolean operations**.**

CAM LAB

NC part programme with G and M codes should be generated, tool path simulation and execution to be done for the following machines.

1. Exercises in CNC lathe.
    1. Step Turning
    2. Taper Turning
    3. Thread Cutting
    4. Eccentric Turning

2. Exercises in CNC milling machines.
    1. Contour Milling
    2. Hexagonal Milling

Total No. of Periods: 45

Subject Code: BME18L09	Subject Name: PROJECT PHASE-I	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: All Courses	**Lb**	**0**	**0/0**	**3/3**	**2**

Department of Mechanical Engineering

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

- make use of the knowledge and skill developed during their four years of study and to apply them for making an innovative product/process for the development of society and industries.

COURSE OUTCOMES (COs) :

CO1	Generate, develop and evaluate ideas and information so as to apply the skills acquired to the project work
CO2	Ability to make links across different area of knowledge
CO3	Acquire skills to communicate effectively and present the ideas clearly
CO4	Acquire collaborative skills through working in team to achieve a common goal
CO5	Able to learn on their own, reflect on their learning and take appropriate actions to improve it.

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**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**
CO2	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**
CO3	**M**	**M**	**H**	**H**	**M**	**M**	**M**	**-**	**H**	**H**	**H**	**H**
CO4	**H**	**M**	**H**	**H**	**M**	**M**	**M**	**-**	**H**	**H**	**M**	**H**
CO5	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**-**	**H**	**H**	**M**	**H**

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

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

Department of Mechanical Engineering

Subject Code: BME18L10	Subject Name: PROJECT PHASE-II	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: All Courses, Project Phase-I	Lb	0	0/0	12/12	8

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

- make use of the knowledge and skill developed during their four years of study and to apply them for making an innovative product/process for the development of society and industries.

COURSE OUTCOMES (COs) :

CO1	Generate, develop and evaluate ideas and information so as to apply the skills acquired to the project work
CO2	Ability to make links across different area of knowledge
CO3	Acquire skills to communicate effectively and present the ideas clearly
CO4	Acquire collaborative skills through working in team to achieve a common goal
CO5	Able to learn on their own, reflect on their learning and take appropriate actions to improve it.

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	H	H	H	H	H	M	H	H
CO2	H	H	H	H	H	H	H	H	H	M	H	H
CO3	M	M	H	H	M	M	M	-	H	H	H	H
CO4	H	M	H	H	M	M	M	-	H	H	M	H
CO5	H	H	H	H	H	H	H	-	H	H	M	H

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

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

Department of Mechanical Engineering

Subject Code: BME18E01	Subject Name : ADVANCED IC ENGINES	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	Ty	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:

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

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on S.I engine combustion and combustion chambers
CO2	Knowledge on C.I engine combustion and combustion chambers
CO3	Knowledge on Pollutions formation and control methods.
CO4	Knowledge on Various alternate fuels to adopt in IC engines.
CO5	Knowledge on 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					M	H					
CO2						M	H					
CO3			M				H					
CO4				M			H					
CO5							H					
Cos / PSOs	PSO1		PSO2		PSO3		PSO4					
CO1	H											
CO2			M									
CO3					M		M					
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			
					√							

Department of Mechanical Engineering

Subject Code: BME18E01	Subject Name : ADVANCED IC ENGINES	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	Ty	3	0/0	0/0	3

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

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**

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**

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

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**

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

Total No. of Periods: 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.*

Department of Mechanical Engineering

Subject Code: BME18E02	Subject Name : RENEWABLE ENERGY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	**Ty**	**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

OBJECTIVES: Students will learn

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

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on principles of solar energy and its measurement.
CO2	Knowledge on Solar energy applications in various fields.
CO3	Knowledge on Biomass and bioenergy conversions and wind energy.
CO4	Knowledge on, Ocean Thermal energy, Geothermal energy
CO5	Knowledge on 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									
CO4			M	M		M	H			M	M	M
CO5			M	M		M	H			M	M	M

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

Department of Mechanical Engineering

Subject Code: BME18E02	Subject Name : RENEWABLE ENERGY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	**Ty**	**3**	**0/0**	**0/0**	**3**

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

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**

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**

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**

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**

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 Periods : 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*"

Department of Mechanical Engineering

Subject Code: BME18E03	Subject Name : TURBO MACHINES	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: GDJP, Fluid Mechanics, Thermal Engineering	Ty	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: 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	Knowledge on various parts of turbo machines and itsapplications.
CO2	Knowledge on Euler's equation and velocity triangles and degree of reaction
CO3	Knowledge on Performance and the preliminary design of centrifugal compressors
CO4	Knowledge on Performance and the preliminary design of Axial flow and radial flow compressors
CO5	Knowledge on Performance and the preliminary design of Axial flow and radial flow 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	H	M	M	M	L	M	L	M	M	M	L
CO2	M	H	M	M	M	L	M	L	M	M	M	L
CO3	M	H	M	M	M	L	M	L	M	M	M	L
CO4	M	H	M	M	M	L	M	L	M	M	M	L
CO5	M	H	M	M	M	L	M	L	M	M	M	L

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

Department of Mechanical Engineering

Subject Code:	Subject Name : TURBO MACHINES	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18E03	Prerequisite: GDJP, Fluid Mechanics Thermal Engineering	Ty	3	0/0	0/0	3

UNIT- 1 INTRODUCTION **9**

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 **9**

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 **9**

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

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

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 **9**

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

Total No. of Periods : 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.

Department of Mechanical Engineering

Subject Code: BME18E04	Subject Name : REFRIGERATION AND AIR CONDITIONING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics, Thermal Engineering	Ty	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

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	Knowledge on different type of refrigeration systems and properties of refrigerants.
CO2	Knowledge on different types of controlling and balancing of refrigerating system components
CO3	Knowledge on Pressure and temperature controlling and system balancing
CO4	Knowledge on Psychometric properties and A/C systems
CO5	Knowledge of 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	M	M	M		M	H	M		L		
CO2	H	M	M	M		M	H	M		L		
CO3	H	M	M	M		M	H	M		L		
CO4	H	M	M	M		M	H	M		L		
CO5												

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

Department of Mechanical Engineering

Subject Code: BME18E04	Subject Name : REFRIGERATION AND AIR CONDITIONING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics, Thermal Engineering	**Ty**	**3**	**0/0**	**0/0**	**3**

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

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**

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**

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

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

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**

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 Periods : 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.

Department of Mechanical Engineering

Subject Code: BME18E05	Subject Name : COMPUTATIONAL FLUID DYNAMICS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics, Heat and Mass transfer and Fluid Mechanics	**Ty**	**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

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	Knowledge on governing equations and boundary conditions.
CO2	Knowledge on methods of solving the conduction problems by Finite element method
CO3	Knowledge on solving the fluid flow problems by diffusion conduction by Finite Volume method
CO4	Knowledge on solving the fluid convection problems by Finite Volume method
CO5	Knowledge on calculation flow field by FVM

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	H	L						
CO2	M	H	M	M	H	L						
CO3	M	H	M	M	H	L						
CO4	M	H	M	M	H	L						
CO5	M	H	M	M	H	L						

COs / PSOs	PSO1	PSO2	PSO3	PSO4
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			
					√							

Subject Code: BME18E05	Subject Name : COMPUTATIONAL FLUID DYNAMICS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Thermodynamics, Heat and Mass transfer and Fluid Mechanics	**Ty**	**3**	**0/0**	**0/0**	**3**

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

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**

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**

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**

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**

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 Periods: 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*.

Department of Mechanical Engineering

Subject Code: BME18E06	Subject Name : GAS DYNAMICS AND JET PROPULSION	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Thermodynamics	**Ty**	**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

OBJECTIVES: The student will learn

- The basic difference between incompressible and compressible flow.
- The phenomenon of shock waves and its effect on flow.
- Basic knowledge about jet propulsion and Rocket Propulsion.

COURSE OUTCOMES (COs) :

CO1	Basic concept of incompressible and compressible flow.
CO2	Concept of variable area duct and its applications
CO3	Concept of constant area ducts and its applications
CO4	Phenomenon of various types of flows and shock waves and their effects.
CO5	Working principles of Jet propulsion and Rocket Propulsion

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	M	M								
CO3		M	M	M								
CO4		M	M	M								
CO5	H											

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

Subject Code: BME18E06	Subject Name : GAS DYNAMICS AND JET PROPULSION	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Thermodynamics	Ty	3	0/0	0/0	3

UNIT- I: COMPRESSIBLE FLOW – FUNDAMENTALS **9**

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states. Mach number, Critical Mach number, types of waves. Mach cone, Mach angle.

UNIT- II: FLOW THROUGH VARIABLE AREA DUCTS **9**

Isentropic flow through variable area ducts. T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

UNIT- III: FLOW THROUGH CONSTANT AREA DUCTS **9**

Flow in constant area ducts with friction (Fanno flow) – Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length.

Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, Maximum heat transfer - Isothermal flow.

UNIT- IV: NORMAL SHOCK **9**

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shocks. Prandtl Meyer equation, flow in convergent and divergent nozzle with shock

UNIT- V: PROPULSION **9**

Theory of jet propulsion –Types of Jet engines- principles and working of pulse jet, ram jet, turbojet, turbofan and turbo prop engines. Types of rocket engines –Liquid and Solid propellant rocket- Propellants-feeding systems –Cryogenic rocket engine.

Total No. of Periods: 45

***NOTE:** Use of approved Gas tables permitted in the University Examination

TEXT BOOK

1) Yahya S.M., (2005) "*Fundamental of Compressible flow"*, New Age International (P) Ltd., New Delhi. Third edition reprint.

REFERENCES

1) *Patrick & William, (1997) "Fundamentals Of Compressible Flow", McGraw Hill-Inc.*
2) *Ganesan.V, (2010) "Gas Turbines" , Tata McGraw Hill Publishing Company, New Delhi.*

ELECTIVE
DESIGN ENGINEERING

Department of Mechanical Engineering

Subject Code: BME18E07	Subject Name: MECHANICAL VIBRATIONS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Strength of materials; Mechanics of Machines- II.	Ty	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

OBJECTIVES: The student will learn

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

OURSE OUTCOMES (COs) :

CO1	To Impart Knowledge about Introduction to Mechanical Vibrations
CO2	To Impart Knowledge about Two degree of freedom systems
CO3	To Impart Knowledge about Multi degree of freedom systems
CO4	To Impart Knowledge about Continuous System
CO5	To Impart Knowledge about Vibration Measurement

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	M	H	M	M	L	M	M	L	M
CO2	H	H	H	M	H	M	M	L	M	M	L	M
CO3	H	H	H	M	H	M	M	L	M	M	L	M
CO4	H	H	H	M	H	M	M	L	M	M	L	M
CO5	H	H	H	M	H	M	M	L	M	M	L	M

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

Department of Mechanical Engineering

Subject Code: BME18E07	Subject Name : MECHANICAL VIBRATIONS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Strength of Materials, Mechanics of Machines-II	Ty	3	0/0	0/0	3

UNIT- I:INTRODUCTION **9**

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**

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**

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**

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**

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 Periods: 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.*

Department of Mechanical Engineering

Subject Code: BME18E08	Subject Name: DESIGN OF PRODUCTION TOOLS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology, Design of machine elements	**Ty**	**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

OBJECTIVES: The student 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) :

CO1	Understand the locating and clamping priniciples and elements
CO2	Design the various types of jigs
CO3	Design the various types of fixtures
CO4	Understand the sheet metal operation and die design aspects
CO5	Understand the various parts of the press tool and design the tool

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	L	L	H	M	L	M
CO2	H	H	H	H	H	M	L	L	H	M	M	M
CO3	H	H	H	H	H	M	L	L	H	M	M	M
CO4	H	H	H	H	H	M	L	L	H	M	L	M
CO5	H	H	H	H	H	M	L	L	H	M	M	M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
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			
					✓							

Department of Mechanical Engineering

Subject Code: BME18E08	Subject Name : DESIGN OF PRODUCTION TOOLS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology, Design of machine elements	Ty	3	0/0	0/0	3

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

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**

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**

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**

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**

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 Periods: 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.

Department of Mechanical Engineering

Subject Code:	Subject Name : DESIGN OF MATERIAL HANDLING EQUIPMENTS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18E09	Prerequisite: Design of Machine Elements.	Ty	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:

- 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.
CO5	Knowledge of elevators systems 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					
CO5	H	H	M			M	M					

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

Department of Mechanical Engineering

Subject Code:	Subject Name : DESIGN OF MATERIAL HANDLING EQUIPMENTS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18E09	Prerequisite: Design of Machine Elements.	Ty	3	0/0	0/0	3

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

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**

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**

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**

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

UNIT- V: ELEVATORS **9**

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 Periods: 45

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

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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*

Department of Mechanical Engineering

Subject Code: BME18E10	Subject Name : TRIBOLOGY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Mechanics, Fluid Mechanics and Machineries	Ty	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: 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) The student will able to

CO1	Understand Surface Interaction and Friction.
CO2	Understand Wear and Surface Treatment.
CO3	Understand Lubricants and Lubrication Regimes
CO4	Understand Theory of Hydrodynamic and Hydrostatic Lubrication
CO5	Understand High pressure contacts

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		L					L
CO2	M	L			M		L					L
CO3	M	L			M		L					L
CO4	M	L			M		L					L
CO5	M	L			M		L					L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	M	L	M	M				
CO2	M	L	M	M				
CO3	M	L	M	M				
CO4	M	L	M	M				
CO5	M	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			
					✓							

Department of Mechanical Engineering

Subject Code: BME18E10	Subject Name : TRIBOLOGY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Mechanics, Fluid Mechanics and Machineries	Ty	3	0/0	0/0	3

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

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**

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**

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**

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**

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 Periods: 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*

Department of Mechanical Engineering

Subject Code: BME18E11	Subject Name: DESIGN FOR MANUFACTURE AND ASSEMBLY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Manufacturing Technology-I	**Ty**	**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

OBJECTIVES: The student will learn

- General design Principles of Design for Manufacture and Assembly

.

COURSE OUTCOMES (COs) :

CO1	Knowledge of Rules and requirements of designing to ease manufacturing
CO2	Knowledge of Form Design in casting
CO3	Knowledge of Form Design in Forging
CO4	Knowledge of Form Design in Machining
CO5	Knowledge of Methods of design for Assembly

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	H			M	M					
CO2	H	M	H			M	M					
CO3	H	M	H			M	M					
CO4	H	M	H			M	M					
CO5	H	M	H			M	M					

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

Department of Mechanical Engineering

Subject Code: BME18E11	Subject Name : DESIGN FOR MANUFACTURE AND ASSEMBLY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology-I	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION **9**

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 **9**

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

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

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

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

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

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

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 Periods: 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.*

Department of Mechanical Engineering

Subject Code: BME18E12	Subject Name: MECHANICS OF FRACTURE	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Strength of Materials, Engineering Metallurgy	Ty	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

OBJECTIVES: The student will learn

- Solid mechanics of cracked components of different modes by which these components fail under static and fatigue load conditions.

OURSE OUTCOMES (COs) :

CO1	Knowledge about elements of solid mechanics
CO2	Understand about stationary crack under static loading
CO3	Expose to energy balance and crack growth
CO4	Knowledge about crack growth curve
CO5	Applications of fracture mechanics

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	H	M	H	M			M		M
CO2	H	H	M	H	M	H	M			M		M
CO3	H	H	M	H	M	H	M			M		M
CO4	H	H	M	H	M	H	M			M		M
CO5	H	H	M	H	M	H	M			M		M

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

Department of Mechanical Engineering

Subject Code:	Subject Name : MECHANICS OF FRACTURE	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME18E12	Prerequisite: Strength of Materials, Engineering Metallurgy	Ty	3	0/0	0/0	3

UNIT- I ELEMENTS OF SOLID MECHANICS **9**

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 **9**

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 **9**

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 **9**

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 **9**

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 Periods: 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

Department of Mechanical Engineering

Subject Code: BME18E13	Subject Name : INDUSTRIAL ROBOTICS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Industrial Automation	Ty	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

OBJECTIVES: To give an understanding to the student with respect to:

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

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COURSE OUTCOMES (COs) :

CO1	Knowledge of basic concepts of a robot.
CO2	Knowledge of different components and operation with respect to robot design.
CO3	Knowledge of aware of sensing and machine vision concepts and its applications.
CO4	Knowledge of writing programme for robot.
CO5	Knowledge of able to design robot cell and its applications.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	L	L	L	H	M	L	H
CO2	H	H	H	H	H	L	L	L	H	M	L	H
CO3	H	H	H	H	H	L	L	L	H	M	L	H
CO4	H	H	H	H	H	L	L	L	H	M	L	H
CO5	H	H	H	H	H	L	L	L	H	M	L	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO 4				
CO1	L	L	L	H				
CO2	L	L	L	H				
CO3	L	L	L	H				
CO4	L	L	L	H				
CO5	L	L	L	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			
					✓							

Department of Mechanical Engineering

Subject Code: BME18E13	Subject Name : INDUSTRIAL ROBOTICS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: **Industrial Automation**	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT- I:INTRODUCTION **9**

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**

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**

Range Sensing – Proximity Sensing – Touch sensing – Force and Torque Sensing. Introduction to Machine Vision – functions and applications.

UNIT- IV:ROBOT PROGRAMMING **9**

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**

Robot cell design-types and control.

Applications of Robots –process applications in welding and painting – Assembly applications– Material Handling applications.

Total No. of Periods : 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.*

Department of Mechanical Engineering

Subject Code: BME18E14	Subject Name: NON-CONVENTIONAL MACHINING TECHNIQUES	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology I & II	**Ty**	**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

OBJECTIVES: The student will learn

- To understand basics of Non conventional machining techniques
- To impart knowledge on various non conventional machining proces
- To know the applications of non conventional machining techniques in various fields

COURSE OUTCOMES (COs) :

CO1	Understand the Electrical Discharge Machining process and its applications
CO2	Knowledge of various non conventional chemical machining process and their applications
CO3	Understand the Electron beam , laser beam & plasma arch machining and their applications
CO4	Knowledge of Ultrasonic machining process and its applications
CO5	Knowledge of various abrasive machining techniques and hybrid machining process 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	M	M	M	H	H	M	M	L	L	L	M
CO2	H	M	M	M	H	H	M	M	L	L	L	M
CO3	H	M	M	M	H	H	M	M	L	L	L	M
CO4	H	M	M	M	H	H	M	M	L	L	L	M
CO5	H	M	M	M	H	H	M	M	L	L	L	M

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

Department of Mechanical Engineering

Subject Code: BME18E14	Subject Name : NON CONVENTIONAL MACHINING TECHNIQUES	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology I & II	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT- I: INTRODUCTION, ELECTRICAL DISCHARGE MACHINING **10**

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**

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**

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**

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**

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 Periods : 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".*

Department of Mechanical Engineering

Subject Code: BME18E15	Subject Name: PROCESS PLANNING AND COST ESTIMATION	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology- I & II	**Ty**	**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

OBJECTIVES: The student will learn

- Process planning activities
- Various elements of cost of a product.
- Methods of computer aided process planning

COURSE OUTCOMES (COs) :

CO1	Understand the method of planning the various machining processes
CO2	Application of computers in processes planning
CO3	Know the different element of cost
CO4	Know the estimation of cost of componets made in forging shop, welding shop and foundry shop
CO5	Know the estimation of time and cost of machining processes

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	M	M	-	-	M	M	-	M
CO2	M	M	M	H	H	M	-	-	M	M	-	M
CO3	M	M	-	H	M	M	-	-	M	M	-	M
CO4	M	M	H	H	M	M	-	-	M	M	-	M
CO5	M	M	H	H	M	M	-	-	M	M	-	M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	M	H	H	-
CO2	M	H	H	H
CO3	L	M	M	H
CO4	H	H	H	M
CO5	H	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			
					✓							

Department of Mechanical Engineering

Subject Code: BME18E15	Subject Name : PROCESS PLANNING AND COST ESTIMATION	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology- I & II	Ty	3	0/0	0/0	3

UNIT- I: PROCESS PLANNING **9**

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**

Variant process planning - Generative approach -Forward and Backward planning, Input format, Logical Design of a Process Planning - Implementation considerations. Application of computer software's in process planning.

UNIT- III: ELEMENTS OF COST **9**

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**

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**

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 Periods : 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.*

Department of Mechanical Engineering

Subject Code: BME18E16	Subject Name: FLEXIBLE MANUFACTURING SYSTEMS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology I & II; Industrial Automation; CAD/CAM	**Ty**	**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

OBJECTIVES: The student will learn

- To understand the Modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems

COURSE OUTCOMES (COs) :

CO1	Understand the concepts of flexible manufacturing systems (FMS)
CO2	Use of computers in FMS
CO3	Application of simulation and data base management in FMS
CO4	Methods of group technology and justication of FMS
CO5	Application of FMS and its future

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
CO4	M	M	-	M	H	M	-	-	M	-	-	M
CO5	M	M	-	M	H	M	-	-	M	-	-	M

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

Subject Code: BME18E16	Subject Name : FLEXIBLE MANUFACTURING SYSTEMS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology I & II; Industrial Automation; CAD/CAM	Ty	3	0/0	0/0	3

UNIT- I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9

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 9

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 9

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 9

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 9

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 Periods: 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.

Department of Mechanical Engineering

Subject Code: BME18E17	Subject Name : COMPOSITE MATERIALS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	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

OBJECTIVES: Students will learn

- Different composites and their manufacturing methods
- Design parameters of composites
- To gain knowledge in need and applications of composite materials

.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Aware of different composites and their manufacturing methods
CO2	Know the mechanics and performance of composite materials
CO3	Understand the design parameters of composites
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	M		H			H		H			M
CO2	M	M	M	H					H			M
CO3	M	M	M	H			H		H			M
CO4												
CO5												

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

Department of Mechanical Engineering

Subject Code: BME18E17	Subject Name : COMPOSITE MATERIALS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION **9**

Limitations of Conventional Materials- Definition of Composite Materials- Types and characteristics Applications.

UNIT- II: MATERIALS **9**

Fibers- Materials- Fiber Reinforced Plastics- Thermo set Polymers- Coupling Agents, Fillers and Additives- Metal Matrix and Ceramics Composites.

UNIT- III: MANUFACTURING **9**

Fundamentals- bag moulding- compression moulding pultrusion- filament winding- other manufacturing process- quality inspection and non-destructive testing.

UNIT- IV: MECHANICS AND PERFORMANCE **9**

Introduction to Micro-mechanics- Unidirectional Lamina-Laminates- Inter laminar Stress- Statics Mechanical Properties- Fatigue Properties- Impact Properties- Environmental Effects- Fracture Mechanics and Toughening mechanisms, Failure Modes

UNIT- V: DESIGN **9**

Failure Predictions- Design Considerations- Joint Design- Codes- Design Examples. Optimization of Laminated Composites- Application of FEM for Design.

Total No. of Periods:: 45

TEXT BOOKS

1.P.K.Mallick, (2006) “Fiber-Reinforced Composites”, Monal Deklatr Inc., New York.
2.B.D.Agrawal and L.J.Broutmam, (2006) “Analysis and Performance of Fiber Composites”, John Wiley and Sons, New York.

REFERENCES

1.Micael hyer, (1998) “Stress Analysis of Fiber- Reinforced Composite Materials”, Tata McGrawHill.
2.Ronald Gibson, (2007) “Principles of Composite Material Mechanics”, Tata McGraw Hill.

ELECTIVE
INDUSTRIAL ENGINEERING

Department of Mechanical Engineering

Subject Code: BME18E18	Subject Name: ENTERPRISE RESOURCE PLANNING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Manufacturing Technology I & II; Application of Computer Science Engineering	**Ty**	**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

OBJECTIVES: The student will learn:
Building of business model for resource planning; Impact of IT in ERP

OURSE OUTCOMES (COs) :

CO1	Concepts of ERP
CO2	Business Modeling for ERP
CO3	Introduction to Organizational Transformation
CO4	Global Industrial Competition and Information Technology
CO5	Concepts of Supply Chain Management

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	L	L	L		M	M	M	M
CO2	M	M	L	L	L	L	L		M	M	M	M
CO3	M	M	M	L	M	L	L		M	M	M	M
CO4	M	M	L	L	L	L	L		M	M	M	M
CO5	M	M	L	L	L	L	L		M	M	M	M

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

Department of Mechanical Engineering

Subject Code: BME18E18	Subject Name : ENTERPRISE RESOURCE PLANNING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION TO ERP **9**

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**

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**

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**

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**

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 Periods: 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.

Department of Mechanical Engineering

Subject Code: BME18E19	Subject Name: INDUSTRIAL ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Manufacturing Technology I & II, CAD/CAM	**Ty**	**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

OBJECTIVES: The student will learn:
Various Techniques of work measurement; Details of plant layout and material handling devices; Basic concepts of ERP

OURSE OUTCOMES (COs) :

CO1	Various techniques of Work Measurement
CO2	Details of Plant Layout and Material Handling devices
CO3	Human factor design
CO4	Understand wages and incentives
CO5	Basic concepts of ERP

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		M		L			M	L		L
CO2	L	L	M	M		M	L		L	M	L	L
CO3	L	L				M	L		L	M	L	M
CO4	L	L				M		M				L
CO5	L	L			H	M			L	M		L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1			L	L				
CO2		L	M	L				
CO3		L	M	L				
CO4				L				
CO5			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			
					✓							

Department of Mechanical Engineering

Subject Code: BME18E19	Subject Name : INDUSTRIAL ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology I & II, CAD/CAM	Ty	3	0/0	0/0	3

UNIT- I:WORK STUDY & WORK MEASUREMENT **9**

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**

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**

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**

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**

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 Periods : 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.*

Department of Mechanical Engineering

Subject Code: BME18E20	Subject Name: TOTAL QUALITY MANAGEMENT	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Manufacturing Technology I & II	**Ty**	**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

OBJECTIVES: The student will learn
Various Principles and Tools of TQM; ISO Standards

OURSE OUTCOMES (COs) :

CO1	Basic Idea of Quality
CO2	Principles of TQM
CO3	Tools of Quality and Role of senior Management
CO4	Various TQM Tools
CO5	Understand Quality Systems

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	M	M	M	M	M	M
CO2	L		L			M	M	M	M	M	M	M
CO3	M	M	M	M	M	M	M	M	M	M	M	M
CO4	L	M	M	L	M	L	L	L		L	M	M
CO5	L	L	L	L	L	L	L	L	L	L	L	L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1			M	L				
CO2			M	L				
CO3			M	L				
CO4			M	L				
CO5			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			
					✓							

Department of Mechanical Engineering

Subject Code:	Subject Name : TOTAL QUALITY MANAGEMENT	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
BME 18E20	Prerequisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION **9**

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**

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**

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**

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**

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 Periods : 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.*

Department of Mechanical Engineering

Subject Code: BME18E21	Subject Name : FACILITIES PLANNING AND DESIGN	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology-I& II	**Ty**	**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.

OBJECTIVES: The student will learn

- To explain project management for entrepreneurs

COURSE OUTCOMES (COs) :

CO1	Concept of facility planning and product scheduling
CO2	Concept of plant location and design and requirements
CO3	Concept of Line balancing and Material handling system
CO4	Concept of group technology and line balancing
CO5	Concept of material handling system

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	L	L	M	L	M	L	L	H	H	M	M
CO2	M	M	H	M	M	H	M	M		M	M	M
CO3	M	M	H	M	M	H	M	M		M	M	M
CO4	M	M	H	M	M	H	M	M		M	M	M
CO5	M	M	H	M	M	H	M	M		M	M	M

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

Department of Mechanical Engineering

Subject Code: BME18E21	Subject Name : FACILITIES PLANNING AND DESIGN	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology-I& II	Ty	3	0/0	0/0	3

UNIT I: INTRODUCTION **5**

Facilities planning, significance, objectives, requirement, process, product and schedule design, need for layout study – types of layout

UNIT II: PLANT LOCATION **10**

Plant location analysis – factors, costs, location decisions – single facility location models, multi facility location models- set covering problem – warehouse location problems

UNIT III: LAYOUT DESIGN **10**

Design cycle – SLP procedure, nadler's ideal approach, flow and activity analysis, computerized layout planning procedure – ALDEP, CORELAP, CRAFT

UNIT IV: GROUP TECHNOLOGY AND LINE BALANCING **10**

Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Line balancing, single, multi and mixed mode, parallel line and parallel station

UNIT V: MATERIAL HANDLING **10**

Principles, unit load concept, material handling system design, handling equipment types, selection and specification, handling cost, containers and packaging

Total No. of Periods: 45

REFERENCES

1. *Tompkins, J.A. and J.A.White,(2003) "Facilities planning", John Wiley*
2. *Richard Francis.L. and John A.White,(2002) "Facilities Layout and location - an analytical approach", PHI*
3. *James Apple.M,(1977) "Plant layout and Material Handling", John Wiley*
4. *Pannerselvam,R,(2007) "Production and Operations Management", PHI*

Department of Mechanical Engineering

Subject Code: BME18E22	Subject Name: SUPPLY CHAIN MANAGEMENT	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Pre requisite: Manufacturing Technology I & II	**Ty**	**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

OBJECTIVES: The student will learn:
Basic Conceptual idea of supply chain management system; Theory and application SCM networks with simple case study

OURSE OUTCOMES (COs) :

CO1	Basic Concepts of SCM
CO2	Knowledge of Logistics Management
CO3	Network Design
CO4	Sourcing and Pricing in supply chain
CO5	Information Technology in Supply Chain

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	L		L	L		M	M	H	M
CO2		M	L	L	L	L	L		M	M	H	M
CO3	L	L	M	L	L	L	L		L	L	L	L
CO4	L	L	M	L	L	L	L		L	L	L	L
CO5	L	L	M	L	L	L	L		L	L	L	L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4								
CO1			L	L								
CO2			L	L								
CO3			L	L								
CO4			L	L								
CO5			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			
					✓							

Department of Mechanical Engineering

Subject Code: BME18E22	Subject Name : SUPPLY CHAIN MANAGEMENT	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION **9**

Definition of logistics and SCM: evolution, scope, importance& decision phases – drivers of SC performance and obstacles.

UNIT- II: LOGISTICS MANAGEMENT **9**

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**

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**

Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain

UNIT- V: COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN **9**

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 Periods: 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*

Department of Mechanical Engineering

Subject Code: BME18E23	Subject Name : QUALITY ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Nil	Ty	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: 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 basic concepts of quality and control charts
CO2	Concept of process capability and control charts
CO3	Knowledge of sampling inspection and TQM concepts and principles
CO2	Concept of sampling methods and inspection
CO3	Concept of total quality management system

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
CO2				M	M					M	M	M
CO3				M	M					M	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1			M	
CO2			M	
CO3			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			
					✓							

Department of Mechanical Engineering

Subject Code: BME18E23	Subject Name : QUALITY ENGINEERING	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT I: QUALITY CONCEPTS **6**

Quality, History of Quality, Quality Control, Quality Assurance, Quality Costs, Optimum Quality, Opportunity Loss, Taguchi's Quality loss function

UNIT II: CONTROL CHARTS FOR VARIABLES & PROCESS CAPABILITY **10**

Statistical Process Control (SPC), Control Charts for Variables, Action & Warning Limits in Control Charts, Process Capability, Process Capability Indices, Process Capability Studies, Problems in Control Charts for Variables

UNIT III: OTHER CONTROL CHARTS **8**

Control Charts for Attributes, Special Control Charts – Group Control Chart, Moving Averages/Moving Range Control Charts, Difference Control Charts, Mid-Range and Median Control Charts & Cumulative Sum Control Charts

UNIT IV: SAMPLING ISPECTION **9**

Economics of Sampling, Sampling Methods, Sampling Plans, OC Curves, Quality Indices, Standard tables used in Sampling Inspection - Dodge-Romig & ABC Standard

UNIT V: TOTAL QUALITY MANAGEMENT (TQM) **12**

Main Concepts of TQM, Quality Dimensions, TQM concepts in depth - KAIZEN, POKA YOKE, Six Sigma, 5S & Kano's Model, TQM Tools – Benchmarking, QFD & FMEA

Total No. of Periods: 45

REFERENCES:

1. *Douglas C. Montgomery, (2007) "Introduction to Statistical Quality Control", John Wiley & Sons*
2. *Grant E.L. and Leavenworth R.S.,(2000), "Statistical Quality Control", TMH*
3. *Dale H. Besterfield, (2002) "Total Quality Management", Pearson Education Asia*