GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Mechanical Engineering

Program: B. Tech Mechanical Engineering

Scheme: 2017 – 2021

Date of BoS: 15.06.2019

Curriculum

Semester 1

							Assessment Pattern		
Sl. No.	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**	**IA**	**CAT I/II**	**ETE**
1	BCSE1002	Computer Programming and Problem Solving	0	0	4	2	50	-	50
2	BEEE1002	Basic Electrical and Electronics Engineering	3	0	0	3	20	50	100
3	BEEE1003	Basic Electrical and Electronics Engineering Lab	0	0	2	1	50	-	50
4	BTME1003	Product Manufacturing	0	0	2	1	50	-	50
5	BTME1001	Introduction to Mechanical Engineering	0	0	2	1	50	-	50
6	ENVS1001	Environmental Science	3	0	0	3	20	50	100
7	MATH1001	Multivariable Calculus	3	0	0	3	20	50	100
8	MATH1002	Exploration with CAS-I	0	0	2	1	50	-	50
9	SLBT1001	Basic English	0	0	4	2	50	-	50
10	JAPA1001	JAPANESE -I	0	0	2	1	50	-	50
	FREN1001	FRENCH -I							
	GERN1001	GERMAN –I							
11	PHYS1001	Engineering Physics	3	0	0	3	20	50	100
12	PHYS1002	Engineering Physics lab	0	0	2	1	50	-	50
13	PSSO1001	Psychology and Sociology	2	0	0	2	20	50	100
		Total	**14**	**0**	**20**	**24**			

Semester 2

							Assessment Pattern		
Sl. No.	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**	**IA**	**CAT I/II**	**ETE**
1	BCSE1003	Application Oriented Programming using Python	0	0	4	2	50	-	50
2	BTME1002	Product Design using Graphics	0	0	4	2	50	-	50
3	MATH1003	Matrices and Differential equations	3	0	0	3	20	50	100
4	MATH1004	Exploration with CAS-II	0	0	2	1	50	-	50
5	SLBT1002	English Proficiency and Aptitude Building - 1	0	0	4	2	50	-	50
6	JAPA1002	JAPANESE -II	0	0	2	1	50	-	50
	FREN1002	FRENCH -II							
	GERN1002	GERMAN -II							
7	CHEM1001	General Chemistry	3	0	0	3	20	50	100
8	CHEM1002	General Chemistry Lab	0	0	2	1	50	-	50
9	PHYS1003	Physics of Materials	3	0	0	3	20	50	100
10	PHYS1005	Advance Physics Lab	0	0	2	1	50	-	50

11	UHVE1001	Universal Human Values and Ethics	0	0	4	2	50	-	50
		Total	**9**	**0**	**24**	**21**			

Semester 3

							Assessment Pattern		
Sl. No.	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**	**IA**	**CAT I/II**	**ETE**
1	BTME2001	Engineering Mechanics	3	0	0	3	20	50	100
2	BTME2002	Engineering Thermodynamics	3	0	0	3	20	50	100
3	BTME2003	Manufacturing Processes I	3	0	0	3	20	50	100
4	MATH2001	Functions of complex variables and Transforms	3	0	0	3	20	50	100
5	SLBT2001	English Proficiency and Aptitude Building – 2	0	0	4	2	50	-	50
6	BTME2004	Manufacturing Processes I Laboratory	0	0	2	1	50	-	50
7	BTME2005	Machine Drawing Laboratory	0	0	2	1	50	-	50
8	BTME2006	SKILL-1 (Solid Works)	0	0	2	1	50	-	50
9	BTME2007	PBL-1 (Machine Drawing / Mechanics)	0	0	2	1	50	-	50
		Total	**12**	**0**	**12**	**18**			

Semester 4

							Assessment Pattern		
Sl. No.	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**	**IA**	**CAT I/II**	**ETE**
1	BTME2008	Mechanics of Material	3	0	0	3	20	50	100
2	BTME2009	Fluid Mechanics	3	0	0	3	20	50	100
3	BTME2010	Manufacturing Processes II and Metrology	3	0	0	3	20	50	100
4	MATH2003	Probability and Statistics	3	0	0	3	20	50	100
5	BBAD 1003	Microeconomics	3	0	0	3	20	50	100
6	UE1	Management Course (from basket)	3	0	0	3	20	50	100
7	SLBT2002	English Proficiency and Aptitude Building – 3	0	0	4	2	50	-	50
8	BTME2011	Fluid Mechanics Laboratory	0	0	2	1	50	-	50
9	BTME2012	Mechanics of Material Laboratory	0	0	2	1	50	-	50
10	BTME2013	Manufacturing Processes II and Metrology Laboratory	0	0	2	1	50	-	50
11	BTME2014	PBL-2 (Material microstructures)	0	0	2	1	50	-	50
		Total	**18**	**0**	**12**	**24**			

Semester 5

							Assessment Pattern		

Sl. No.	Course Code	Name of the Course	L	T	P	C	IA	MTE	ETE
1	BTME3001	Applied Thermodynamics I	3	0	0	3	20	50	100
2	BTME3002	Kinematics of Machines	3	0	0	3	20	50	100
3	BTME3003	Heat and Mass Transfer	3	0	0	3	20	50	100
4	BTME3013	Machine Design	3	0	0	3	20	50	100
5	PE01	Program Elective - 1	3	0	0	3	20	50	100
6	PE02	Program Elective - 2	3	0	0	3	20	50	100
7	SLBT3001	English Proficiency and Aptitude Building – 4	0	0	4	2	50	-	50
8	MATH2002	Numerical Methods	2	0	2	3	20	50	100
9	BTME3004	Applied Thermodynamics and HMT Lab	0	0	2	1	50	-	50
10	BTME3005	PBL-3 (Applied Thermodynamics)	0	0	2	1	50	-	50
		Total	**20**	**0**	**10**	**25**			

Semester 6

							Assessment Pattern		
Sl. No.	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BTME3006	Applied Thermodynamics II	3	0	0	3	20	50	100
2	BTME3008	Dynamics of Machines	3	0	0	3	20	50	100
3	BTME3009	CAM and Automation	3	0	0	3	20	50	100
4	PE03	Program Elective – 3 / PBL	4	0	0	4	20	50	100
5	PE04	Program Elective - 4	3	0	0	3	20	50	100
6	PE05	Program Elective - 5	3	0	0	3	20	50	100
7	SLBT3002	Soft Skill - 6 (Campus to Corporate)	0	0	4	2	50	-	50
8	BTME3010	Dynamics of Machines Laboratory	0	0	2	1	50	-	50
9	BTME3017	AI & Machine Learning using Python	0	0	4	2	50	-	50
		Total	**19**	**0**	**10**	**24**			

Semester 7

							Assessment Pattern		
Sl. No.	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BTME4001	Energy systems and Technologies	3	0	0	3	20	50	100
2	BTME4002	Operational Research	3	0	0	3	20	50	100
3	UE2	Science Course (from basket)	3	0	0	3	20	50	100
4	UE3	Humanities Course (from basket)	3	0	0	3	20	50	100
5	BTME9998	Project Work 1	-	-	-	3	50	-	50
6	BTME4004	Energy systems Laboratory	0	0	2	1	50	-	50
7	BTME4005	Comprehensive Examination	0	0	0	0			
8	UC28	Professional Ethics and Values	0	0	0	0			
		Total	**12**	**0**	**2**	**16**			

Semester 8

							Assessment Pattern		
Sl. No.	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BTME9999	Project Work 2	-	-	-	9	50	-	50
Total						**9**			

List of Electives

Elective 1

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BTME3054	Welding Technology	3	0	0	3	20	50	100
2	BTME3051	Automobile Engineering	3	0	0	3	20	50	100
3	BTME3055	Supply Chain Management	3	0	0	3	20	50	100
4	BTME3059	Project Management	3	0	0	3	20	50	100

Elective 2

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BTME3053	Computational Fluid Dynamics	3	0	0	3	20	50	100
2	BTME3057	Advance Machining Processes	3	0	0	3	20	50	100
3	BTME3058	Mechatronics	3	0	0	3	20	50	100
4	BTME3062	Mechanical Measurements	3	0	0	3	20	50	100

Elective 3

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BTME3052	Robotics	3	0	0	3	20	50	100
2	BTME3061	Finite Element Analysis	3	0	0	3	20	50	100
3	BTME3066	Renewable Energy Sources	3	0	0	3	20	50	100

Elective 4

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BTME3056	Product Design	3	0	0	3	20	50	100
2	BTME3067	Refrigeration and Air Conditioning	3	0	0	3	20	50	100
3	BTME3063	Design of Transmission Systems	3	0	0	3	20	50	100

Elective 5

Sl No	Course Code	Name of the Electives					Assessment Pattern	
			L	T	P	C	IA	MTE	ETE
1	BTME3060	Computer Aided Design	3	0	0	3	20	50	100
2	BTME3064	Fuels and Combustion	3	0	0	3	20	50	100
3	BTME3065	Metal Forming Theory and Practice	3	0	0	3	20	50	100

Detailed Syllabus

Name of The Course	Introduction to Mechanical Engineering				
Course Code	BTME1001				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

1. To introduce the discipline of Mechanical Engineering, its fundamentals, its sub disciplines and their interaction.
2. To introduce the key mechanical engineering components such as an internal combustion engine, refrigerators, power plant machinery and machine elements.

Course Outcomes

CO1	Relate various manufacturing techniques and joining process.
CO2	Illustrate the power transmitting elements.
CO3	Describe the working of internal combustion engine.
CO4	Compare the principles of various power plants.
CO5	Illustrate the working principle of thermal power cycles and refrigeration.

Text Book (s)

1. Kumar, Pravin, Basic Mechanical Engineering, 1st Edition, Pearson India, 2013,ISBN: 978-9-332-50575-9

Reference Book (s)

1. Manglik, V. K., Elements of Mechanical Engineering, 1st Edition, PHI, 2013, ISBN: 978-8-120-34629-1

Course Content:

Unit I: Manufacturing Techniques and Machine Elements **7 Hours**
Introduction to Lathe and its operations, Drilling; metal joining processes – shielded metal arc & gas welding, Brazing and soldering; Sheet metal working, Smithy.
Unit II: Machine Elements **7 Hours**
Helical and leaf springs; Cams - types of cams and followers; Gears - Spur, helical and bevel gears, gear trains; Belt drives – types; chain drives; Introduction to clutch.
Unit III: Internal combustion engine **8 Hours**
Introduction to Otto cycle, diesel cycle, Principle of internal and external combustion engines; two strokes and four strokes engines; emission control.
Unit IV: Power Plant Engineering **9 Hours**

Introduction and classification of power plants – thermal, hydroelectric, diesel, nuclear power plants, Tidal power plants, Geo-thermal power plant; introduction to steam and gas turbines.
Unit V: Refrigeration cycles **9 Hours**
Introduction to Refrigeration – Principle of vapour compression refrigeration system – Principle of vapour absorption refrigeration system, Air-conditioning – Layout of typical domestic refrigerator – window and split, centralized type air conditioner.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Product Design using Graphics			
Course Code	BTME1002			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	4	2

Course Objectives:

1. To introduce the concept of product design.
2. To establish the usage of basics of engineering graphics in product design.
3. To introduce graphics software and apply graphics software for devloping product model.

Course Outcomes

CO1	Understand the concept and principles of engineering graphics in product design.
CO2	Make isometric and orthographic projection of solids along with free hand sketching.
CO3	Develop a solid model using AutoCAD
CO4	Make a solid model for a given assembly using AutoCAD.
CO5	Apply the concepts and techniques learnt in the course to make hands-on project.

Text Book (s)

1. Asimow, M. (1962). Introduction to design. Englewood Cliffs: Prentice-Hall.
2. K C John (2009), Engineering Graphics for Degree, Prentice Hall of India. ISBN: 978-8-120-33788-3.
3. P N Rao (2010), CAD/CAM Principles and Applications, 3rd Edition, Tata McGraw-Hill Education, ISBN: 978-0-070-68193-4.

Reference Book (s)

1. Course material uploaded on LMS

Course Content:

Unit I: Introduction – Understanding the Concept of Product Design 10 lab hours
Fundamentals of Design : Design by Evolution and Design by Innovation, Principles that govern any design, Morphology and Process of Design, Application of Graphics in Design, Engineering Graphics: An Overview, Introduction to Computer Aided Drafting, Lettering, Numerals and Dimensioning.
Unit II: Projection of Solids 13 lab hours
Concept of Projection, Object in four quadrant, 2-D description of quadrants, Orthographic Projection of Solids, Isometric Projection of Solids, Free-hand sketching.
Unit III: Solid Modeling 12 lab hours
Division of Engineering Solids- Polyhedra, Regular and Irregular polyhedral, solids of revolution, Geometric Modeling – Wireframe, B-Rep and Solid Modeling, Solid Modelling using AutoCAD.

Unit IV: Introduction to Assembly **11 lab hours**
Types of assembly drawings, Accepted Norms for Assembly Drawings, Sequences of Preparing the Assembly Drawing, Solid Modeling of assembly.
Unit V: Application of Design Concepts for Product Design **10 lab hours**
Hands-on Project in Groups: Choose a specific objective for Product Design, Design the Product and Model it using AutoCAD, presentation.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	Product Manufacturing Lab				
Course Code	BTME1003				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

1. To learn to make a product using different basic processes.
2. To get acquainted with assembling of two or more components to obtain a product.
3. To be trained to make a product out of wood.

Course Outcomes

CO1	Develop a product using Welding Process.
CO2	Develop a product out of a given sheet.
CO3	Assemble a product of wood in carpentry shop.
CO4	Create a product using casting and then machining.
CO5	Assemble different components to get final product with the help of welding

Text Book (s)

1. Product Manufacturing Manual prepared by faculties of School of Mechanical Engineering.

Reference Book (s)

1. A.K. Hajra Choudhury, S.K. Hajra Choudhury and Nirjhar Roy (2009), Elements of Workshop Technology, Vol. – I, Media Promoters, ISBN: 978-8-185-09914-9.
2. A.K. Hajra Choudhury, S.K. Hajra Choudhury and Nirjhar Roy (2010), Elements of Workshop Technology, Vol. – II, Media Promoters, ISBN: 978-8-185-09915-6.

List of Exercises

1. To prepare a given product using the knowledge gained in Product Manufacturing Lab while working in the lab. (To be submitted at the end of the session and evaluated in the external examination)

2. Welding Shop

Any two of the following

a. Prepare a Lap joint as per drawing using Oxy-Acetylene Gas welding
b. Prepare a T-joint as per drawing using Oxy-Acetylene Gas welding
c. Prepare a Butt-joint as per drawing using Oxy-Acetylene Gas welding
d. Prepare L- joint as per drawing using Oxy-Acetylene Gas welding
e. Prepare a Lap joint as per drawing using Electric Arc welding
f. Prepare a T-joint as per drawing using Electric Arc welding
g. Prepare a Butt-joint as per drawing using Electric Arc welding
h. Prepare L- joint as per drawing using Electric Arc welding

3. Fitting Shop

a. Prepare a Male/Female Parts as per drawing
4. Lathe Machine Shop
a. Preparation of Job as per drawing.
5. Sheet metal Shop
a. Preparation of funnel of given dimension. Use soldering to join lower part with upper and use riveting to join cylinder
6. Foundry Shop
a. Preparation of Job of aluminium as per drawing through casting.
7. Carpentry Shop
Any one of the following a) Preparation of T-Joint of given dimension. b) Preparation of Lap Joint of given dimension. c) Preparation of Cross Joint of given dimension. d) Preparation of Dove Tail Joint of given dimension.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	Engineering Mechanics			
Course Code	BTME2001			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To calculate the reactive forces and analyse the structures.
2. To know the geometric properties of the different shapes.
3. To learn energy and momentum methods.

Course Outcomes

CO1	Solve the engineering problems involving equilibrium of paritcles and rigid bodies.
CO2	Solve the problems involving dry friction and virtual work.
CO3	Determine the centroid, centre of gravity and moment of inertia of various surfaces and solids.
CO4	Solve problems related to kinematics and kinetics of rigid body.
CO5	Solve problems using energy-momentum priniciple for a particle and rigid bodies in plane motion.

Text Book (s)

1. J. V. Rao, D. H. Young, S. Timoshenko, Sukumar Pati (2013), Engineering Mechanics, Tata McGraw Hill Education. ISBN: 978-1-259-06266-7.

Reference Book (s)

1. P. Ferdinand, E. Beer and J. Russell (2010), Vector Mechanics for Engineers, 9th Edition, McGraw-Hill International Edition. ISBN: 978-0-079-12637-5
2. Irving H. Shames (2012), Engineering Mechanics – Statics and Dynamics, 4th Edition, Prentice-Hall of India Private limited. ISBN: 978-8-131-72883-3

Course Content

Unit I: Equilibrium of Particle, Rigid body and Trusses 9 Hour
Introduction to Mechanics – Fundamental Principles – Coplanar forces – Equilibrium of particles – Free body diagram – Equilibrium of particle in space – Single equivalent force - - Equilibrium of rigid bodies in two dimensions. Analysis of plane trusses – Method of joints – Method of sections – Zero-force member.
Unit II: Friction and Virtual work 7 Hours
Characteristics of dry friction – Problems involving dry friction – Ladder – Wedges – Square threaded screws. Definition of virtual work – Principle of virtual work – System of connected rigid bodies – Degrees of freedom – Conservative forces – Potential energy – Potential energy criteria for equilibrium.
Unit III: Properties of Surfaces and Solids 6 Hours

Centroid – First moment of area – Theorems of Pappus and Guldinus – Second moment of area – Moment and Product of inertia of plane areas – Transfer Theorems – Polar moment of inertia – Principal axes – Mass moment of inertia.
Unit IV: Kinematic and Kinetics **9 Hours**
Position, Velocity and Acceleration – Rectilinear motion – Curvilinear motion of a particle – Tangential and Normal components – Radial and Transverse components – Rotation of rigid bodies about a fixed axis – General plane motion – Absolute and relative motion method – Instantaneous centre of rotation in plane motion. Linear momentum – Equation of motion – Angular momentum of a particle and rigid body in plane motion – D'Alembert's principle.
Unit V: Energy and Momentum Methods **9 Hours**
Principle of work and energy for a particle and a rigid body in plane motion – Conservation of energy - Principle of impulse and momentum for a particle and a rigid bodies in plane motion – Conservation of momentum – System of rigid bodies – Impact - direct and central impact – coefficient of restitution.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Engineering Thermodynamics			
Course Code	BTME2002			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To learn the basic principles of classical thermodynamics.
2. To study the laws of thermodynamics to various systems and analyze the significance of the results.
3. To analyze the performance of thermodynamic gas and vapour power cycles.

Course Outcomes

CO1	Outline the thermodynamic properties for different types of system.
CO2	Apply the first law of thermodynamics for a system undergoing a cycle.
CO3	Demonstrate basic understanding of the second law of thermodynamics and its application to open and closed systems.
CO4	Demonstrate basic understanding of entropy and its application to engineering systems.
CO5	Practice the basic thermal analysis of thermodynamic cycles.

Text Book (s)

1. P. K. Nag (2010), Basic and Applied Thermodynamics, Tata McGraw-Hill Publishing Company Ltd., ISBN 978-0-070-15131-4
2. R. K. Rajput, A Textbook of Engineering Thermodynamics, Laxmi Publications; Fifth edition, ISBN-13**:** 978-8131800584

Reference Book (s)

1. Yunus A. Cengel and Michael A. Boles, Thermodynamics, An Engineering Approach, 8th Ed., McGraw Hill, 20015, ISBN: 978-9-339-22165-2.
2. Jean-Philippe Ansermet, Sylvain D. Brechet, Principles of Thermodynamics, Ist Ed., Cambridge University Press; ISBN-13: 978-1108426091

Course Content:

Unit I: Basic Concepts of Thermodynamics **6 Hours**
Thermodynamics and Energy, Macroscopic and microscopic viewpoint, Closed and open systems, Thermodynamic properties of a system, State and equilibrium, Processes and cycles, Forms of energy , Temperature and its measurement, Zeroth law of thermodynamics.
Unit II: First Law of Thermodynamics **9 Hours**
Work transfer, pdV work, Types of work transfer, Net work done by a system, heat transfer, path function, Specific heat and latent heat, First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy – a property of the system, enthalpy, specific heat at constant pressure and volume, PMM-I, Control volume, First law applied to steady flow process, Mass and energy balance.

Unit III: Second Law of Thermodynamics **9 Hours**
Limitations of the first law of Thermodynamics, Kelvin-Planck statement of the second law of thermodynamics, Clausius statement, Equivalence of Kelvin- Planck and Clausius statements, Heat engine, Refrigerators, Heat Pump, COP, Carnot's theorem, Corollary of Carnot's theorem, Reversible and Irreversible process, Efficiency of Reversible Heat engine, PMM-II, Carnot cycle.
Unit IV: Entropy and properties of pure sustances **8 Hours**
Introduction, Clausius theorem, Entropy – property of the system, Clausius inequality, Entropy change in irreversible process, Entropy principle, Reversible adiabatic work in steady flow system, Availability and irreversibility, Second law efficiency, p-v, p-T and T-s diagrams for a pure substance, Quality, Introduction to steam tables.
Unit V: Thermodynamic Cycles **8 Hours**
Carnot cycle, Otto cycle, Diesel and Dual cycles, Brayton and reversed Brayton Cycle, Rankine cycle.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Manufacturing Processes I				
Course Code	BTME2003				
Prerequisite	BTME1003 Product Manufacturing				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1.To acquire basic knowledge about the behaviour and manufacturing properties of engineering materials and concepts of foundry and casting processes.
2. To acquire knowledge about various methods of welding, cold and hot working, and forming process.
3. To understand forging, moulding and powder metallurgy processes in detail and application of these in manufacture of a product.

Course Outcomes

CO1	Develop a simple shape of castings by using different casting methods.
CO2	Prepare the weld joints by using different welding methods.
CO3	Develop a product by using metal forming processes.
CO4	Demonstrate the powder metallurgy process for making a component.
CO5	Apply the knowledge in manufacturing a product from plastic or composite materials.

Text Book (s)

1. Manufacturing Technology – Foundry, Forging and Welding (Vol-1), P.N.Rao. (2008), 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 978-0-070-08798-9.

Reference Book (s)

1. A.K. Hajra Choudhury, S.K. Hajra Choudhury and Nirjhar Roy (2009), Elements of Workshop Technology, Vol. – I, Media Promoters, ISBN: 978-8-185-09914-9.
2. W.A.J.Chapman (2001), Workshop Technology, Vol 1, 5th Edition, CBS Publishers, ISBN: 978-8-123-90401-6.

Course Content:

Unit I: Metal Casting Processes **12 Hours**.
Manufacturing- selecting manufacturing process –Fundamentals of metal casting – Fluidity of molten metal – Solidification time – Sand casting – Shell mold casting - Investment casting - Plaster mold casting – Ceramic mold casting – Die casting - Centrifugal casting – Melting practice and furnaces - Defects in sand casting – Testing and inspection of casting.
Unit II: Joining Processes **10 Hours**
Metal fusion welding processes – Oxyfuel gas welding – Arc welding processes – Consumable electrode: SMAW- SAW – GMAW – FCAW – Non-consumable Electrode: GTAW- AHW- PAW – EBM – LBM – Solid state welding processes: Ultrasonic welding – Friction welding – Friction stir welding -Resistance welding – Weld quality – Testing welded joints.
Unit III: Metal Forming Processes **8 Hours**

Cold and Hot working: Rolling – Forging – Extrusion – Drawing – Sheet metal forming processes – High Energy Rate Forming Processes: Explosive Forming – Electro Hydraulic Forming – Electro Magnetic Forming.
Unit IV: Processing of Metal Powders, Ceramics and Glass 5 Hours
Production of metal powders: Compaction – Sintering and Finishing – Design considerations for powder metallurgy and Process capability Shaping of ceramics – Forming and shaping of glass – Design considerations for ceramics and glass – Processing of superconductors.
Unit V: Processing of Plastics and Composite Materials 5 Hours
Types of Plastics – Types of Molding: Injection molding – Blow molding – Compression molding – Transfer molding – Thermoforming – Reinforced plastics – Metal Matrix Composites – Ceramic Matrix Composites.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Functions of complex variables and transform Calculus			
Course Code	**MATH 2001**			
Prerequisite	MATH 1001			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

In modern world, Functions of complex variables and transform Calculus has become an important tool extensively used in many fields such as science, engineering, business, industry. The objective of the course is familiarizing the prospective engineers with techniques in Transform Calculus and differentiation and integration of Complex variable. It aims to equip the students with standard concepts and tools to advance level that will serve them well towards tackling more advanced level of Mathematics and application that they would find useful in their discipline.

Course Outcomes

CO1	To understand the behavior of complex valued functions such as continuity/differentiability and analyticity.
CO2	To evaluate complex integral, singularities, residue of an analytic function, contour integral and an integral over the real line.
CO3	To apply Laplace transforms for solving initial value problems
CO4	To apply Fourier transforms for solving one dimensional heat and wave equations.
CO5	To apply Z-transforms for solving difference equations.

Text Book (s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley &Sons.
2. J W Brown and R V Churchill, Complex Variables and Applications ,7th Ed., Mc-GrawHill,2004

Reference Book (s)

1. Michael D. Greenberg, Advanced Engineering Mathematics, 2nd Edition, PearsonEducation
2. Peter V. O'Neil,Advanced Engineering Mathematics, 6th Edition, CengageLearning.
3. R. K. Jain and S. R. K. IyengarAdvanced Engineering Mathematics, 4th Edition, NarosaPublishers

Course Content:

Unit I: Complex Differentiation **12 Hours**
Complex number system(A review), Limit, Continuity, Differentiability of function, Cauchy-Riemann Equations in Cartesian and Polar coordinates, Analytic function, elementary analytic functions (exponential, trigonometric, logarithm),Harmonic functions, harmonic conjugate, Conformal mappings and mobius transformations with their properties.
Unit II: Complex Integration **10 Hours**

Contour integral, Cauchy theorem (without proof), Cauchy Integral formula (withoutproof), Maximum-Modulus theorem (without proof), Taylor's and Laurent's series: radius and circle of convergence, Zeroes and singularities of analytic functions, Residues, Residue theorem (without proof), Evaluation of definite integrals involving sine and cosine, and real definite integrals around unit and semi circles.
Unit III: **Laplace Transform** **10 Hours**
Definition, existence condition, Properties, Laplace transform of Periodic, Unit step and Dirac Delta functions, Laplace transforms of derivatives and integrals, Evaluation of integrals using Laplace transforms, Convolution theorem, Inverse Laplace transform, Application of Laplace Transform in solving initial value problems.
Unit IV: Fourier Transform **7 Hours**
Fourier integrals, Complex Fourier transforms, Fourier sine and cosine transforms, Properties of Fourier transforms, Convolution theorem, Fourier transforms of derivatives, Applications of Fourier transform in solving one dimensional Heat and Wave equations.
Unit V: Z Transform: **6 Hours**
Definition and Elementary properties of Z-transform (Unilateral, Bilateral), Inverse Z–transform, Convolution theorem, Solution of difference equations using Z - transform.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Manufacturing Processes I Laboratory				
Course Code	BTME2004				
Prerequisite	BTME1003 Product Manufacturing				
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

1. To learn to give initial shapes to a metal in foundry shop and to be processed further to make a product.
2. To train to join metal pieces using different welding techniques.

Course Outcomes

CO1	Prepare sand mould and it further used to produce casting.
CO2	Determine the characteristics of sand permeability number and fine grainness number.
CO3	Produce simple casting components using sand mould casting technique.
CO4	Prepare a weld joint by using different welding techniques.
CO5	Illustrate the relationship between cutting parameters of cutting speed, feed rate and depth of cut on forces generated in oblique cutting.

Text Book (s)

1. Manufacturing Processes I Lab manual prepared by faculties of School of Mechanical Engineering

Reference Book (s)

1. A.K. Hajra Choudhury, S.K. Hajra Choudhury and Nirjhar Roy (2009), Elements of Workshop Technology, Vol. – I, Media Promoters, ISBN: 978-8-185-09914-9.
2. W.A.J.Chapman (2001), Workshop Technology, Vol 1, 5th Edition, CBS Publishers, ISBN: 978-8-123-90401-6.
3. P.N.Rao. (2008), Manufacturing Technology – Foundry, Forging and Welding (Vol-1), 3rd Edition, McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 978-0-070-08798-9.

List of Experiments

1. Preparation of green sand mould using wooden pattern.
2. Determination of grain fineness number.
3. Determination of permeability number.
4. Determination of compressive and shear strength of moulding sand.
5. Preparation of casting using non-ferrous metals with the help of tilting furnace.
6. Preparation of butt joint using gas oxy acetylene gas welding.
7. Welding of stainless steel specimen using TIG welding.
8. Preparation of butt joint with V-groove using MIG welding.
9. To establish the relationship between cutting parameters of cutting speed, feed rate and depth of cut on forces generated in oblique cutting.
10. Study and identification of various types of flames generated in oxy-acetylene gas welding.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

50	--	50	100

Name of The Course	**Machine Drawing Laboratory**				
Course Code	**BTME2005**				
Prerequisite	BTME1002 Product Design using Graphics				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

1. To introduce the students to the basics and standards of engineering drawing related to machine elements.
2. To enable the students to draw sectioned views, development of surfaces and orthographic views of machine elements.
3. To train the students technical skills regarding part drawings, production and assembly drawings.

Course Outcomes

CO1	Draw and interpret sectioned solids and development of surfaces.
CO2	Explain various standards and specifications related to standard machine components.
CO3	Apply the knowledge of fits and tolerances for various applications.
CO4	Draw orthographic views of machine elements.
CO5	Select, configure and synthesize mechanical components into assemblies.

Text Book (s)

1. N.D. Bhatt (2011), Machine Drawing, Published by R.C.Patel, 46th Edition, Charotar Publishing House Book Stall, ISBN: 978-9-380-35846-8.

Reference Book (s)

1. K C John (2009), Engineering Graphics for Degree, Prentice Hall of India. ISBN: 978-8-120-33788-3.
2. Warren Luzadder and Jon M. Duff (2009), Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production, 11th Edition, PHI Learning, ISBN: 978-8-120-30885-5.
3. P.S. Gill (2012), Machine Drawing, S. K. Kataria & Sons, ISBN: 978-8-185-74979-2.
4. Ajeet Singh (2012), Machine Drawing (with AutoCAD), 2nd Edition, Tata Mcgraw Hill Education, ISBN: 978-0-071-07294-6.
5. Barclay James and Griffiths Brian (2002), Engineering Drawing for Manufature, Butterworth-Heinemann, ISBN: 978-1-857-18033-6.

Course Content:

Unit I: Sectioning of Solids and Development of Surfaces **6 lab hours**
Selection of Views-Parts not usually sectioned- Development of Surfaces and application in sheet metal industry.
Unit II: Machine Drawing Conventions **4 lab hours**

Need for drawing conventions- introduction to BIS conventions-Reference to hand book for the selection of standards-Conventional representation of material, common machine elements and parts -Methods and general rules of dimensioning of holes, centers, curved and tapered features.
Unit III: Limits, Fits and Tolerances **4 lab hours**
Limits, Fits and tolerances – Allocation of fits for various mating parts – Tolerance data sheet – Tolerance table preparation –Geometric tolerance.
Unit IV: Drawing of Machine Elements **10 lab hours**
Drawing of the following machine elements: threaded fasteners and joints, keys, cotters and pin joints, welded and riveted joints, pipe joints, shaft coupling and pulleys, journals and bearings.
Unit V: Assembly Drawings **4 lab hours**
Drawings of assembled views for the part drawings of the Engine parts and and other machine parts- Screw jack, Machine Vice, single tool post. Valves: Steam stop valve, feed check valve.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	**Skill-1 (Solid Works)**			
Course Code	**BTME2006**			
Prerequisite	BTME1002 Product Design using Graphics			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives:

1. To enable students to use a modern CAD software package for solid modeling.
2. To draw 3D views of various machine elements.
3. To apply the knowledge of software package to model any chosen prototype.

Course Outcomes

CO1	Use SolidWorks software package for solid modeling.
CO2	Draw solid models of various machine elements in SolidWorks.
CO3	Apply the knowledge of SolidWorks to model any chosen prototype.

Text Book (s)

1. Matt Lombard, : Solidworks 2013 Bible", 2013, ISBN: 978-1-118-50840-4

Reference Book (s)

1.Greg Jankowski, Richard Doyle, "SolidWorks For Dummies", 2nd Edition, 2011 ISBN: 978-1-118-05147-4

	Unit	**Unit Topics**
Week 1(2Hours)	**1.Introduction to SOLIDWORKS**	• Introduction to SOLIDWORKS 2016 • Getting Started with SOLIDWORKS • Menu Bar and SOLIDWORKS Menus • Command Manager • Toolbar • Dimensioning Standard and Units • Important Terms and Their Definitions • Hot Keys • Color Scheme

Week 1 (2Hours)	**2. Drawing Sketches for Solid Models**	• The Sketching Environment • Starting a New Session of SOLIDWORKS 2016 • Task Panes • Starting a New Document in SOLIDWORKS 2016 • Understanding the Sketching Environment • Setting the Document Options • Learning Sketcher Terms • Drawing Sketch Entities • Drawing Display Tools • Deleting Sketched Entities
Week2(2Hours)	**3. Editing and Modifying Sketches**	• Editing Sketched Entities • Creating Patterns • Editing Patterns • Writing Text in the Sketching Environment • Modifying Sketched Entities
Week2(2Hours)	**4. Adding Relations and Dimensions to Sketches**	• Applying Geometric Relations to Sketches • Design Intent • Dimension a Sketch • Concept of a Fully Defined Sketch • Deleting Overdefined Dimensions • Opening an Existing File
Week3(2Hours)	**5. Advanced Dimensioning Techniques and Base Feature Options**	• Advanced Dimensioning Techniques • Measuring Distances and Viewing Section Properties • Creating Base Features by Extruding Sketches • Creating Base Features by Revolving Sketches • Determining the Mass Properties of Parts • Dynamically Rotating the View of a Model • Modifying the View Orientation • Restoring the Previous View • Displaying the Drawing Area in Viewports • Display Modes of a Model • Additional Display Modes • Assigning Materials and Textures to Models
Week3(2Hours)	**6. Creating Reference Geometries**	• Importance of Sketching Planes • Reference Geometry • Advanced Boss/Base Options • Modeling Using the Contour Selection Method • Creating Cut Features • Concept of Feature Scope

Week 4 (2Hours)	**7. Advanced Modeling Tools-I**	• Creating Simple Holes • Creating Standard Holes Using the Hole Wizard • Adding External Cosmetic Threads • Creating Fillets • Selection Options • Creating Fillets Using the FilletXpert • Creating Chamfers • Creating Shell Features • Creating Wrap Features
Week 4 (2Hours)	**8. Advanced Modeling Tools-II**	• Creating Mirror Features • Creating Linear Pattern Features • Creating Circular Pattern Features • Creating Sketch Driven Patterns • Creating Curve Driven Patterns
Week 5 (2Hours)		• Creating Table Driven Patterns. • Creating Fill Patterns • Creating Variable Patterns • Creating Rib Features • Displaying the Section View of a Model • Changing the Display States
Week 5 (2Hours)	**9. Editing Features**	• Editing Using the Edit Feature Tool • Editing Sketches of the Sketch-based Features • Editing the Sketch Plane Using the Edit Sketch Plane Tool • Editing Using the Instant3D Tool • Editing Features and Sketches byUsing the Cut, Copy, and Paste Options • Cutting, Copying, and Pasting Features and Sketches fromOne Document to the Other • Copying Features Using Drag and Drop • Deleting Features • Deleting Bodies • Suppressing Features • Unsuppressing the Suppressed Features • Unsuppressing Features with Dependents • Hiding Bodies • Moving and Copying Bodies • Reordering the Features • Rolling Back the Feature • Renaming Features • Creating Folders in the FeatureManager Design Tree • What's Wrong Functionality
Week 6 (2Hours)	**10. Advanced Modeling Tools-III**	• Creating Sweep Features • Creating Cut-Sweep Features • Creating Loft Features • Adding a Section to a Loft Feature • Creating Lofted Cuts

Week 6 (2Hours)		• Creating 3D Sketches • Creating Grid Systems • Editing 3D Sketches • Creating Curves • Extruding a 3D Sketch • Creating Draft Features
Week 7 (2Hours)	**11. Advanced Modeling Tools-IV**	• Advanced Modeling Tools • Creating Fastening Features • Creating Freeform Features • Dimensioning a Part Using DimXpert
Week 7 (2Hou	**3D Modelling Project**	• Use the concept of Reverse Engineering and Redesign the parts by measuring them using the Measuring Instrument
Week 8 (2Hou	**3D Modelling Project**	• Use the concept of Reverse Engineering and Redesign the parts by measuring them using the Measuring Instrument
Week 8 (2Hours)	**12. Assembly Modeling-I**	• Assembly Modeling • Creating Bottom-up Assemblies • Creating Top-down Assemblies • Moving Individual Components • Rotating Individual Components • Moving and Rotating Individual Components Using the Triad • Assembly Visualization
Week 9 (2Hours)	**13. Assembly Modeling-II**	• Advanced Assembly Mates • Mechanical Mates • Creating Sub-assemblies • Deleting Components and Sub-assemblies • Editing Assembly Mates • Editing Components • Editing Sub-assemblies • Dissolving Sub-assemblies • Replacing Components
Week 9 (2Hours)		• Creating Patterns of Components in an Assembly • Copying and Mirroring Components • Copying a Component along with Mates • Simplifying Assemblies using the Visibility Options • Checking Interferences in an Assembly • Checking the Hole Alignment • Creating Assemblies for Mechanism • Creating the Exploded State of an Assembly

Week 10 (2Hours)	**14. Working with Drawing Views-I**	• The Drawing Mode • Starting a Drawing Document • Types of Views • Generating Standard Drawing Views • Generating Derived Views • Working with Interactive Drafting in SOLIDWORKS • Editing and Modifying Drawing Views • Modifying the Hatch Pattern in Section Views
Week 10 (2Hours)	**15. Working with Drawing Views-II**	• Adding Annotations to Drawing Views • Adding the Bill of Materials (BOM) to a Drawing • Linking Bill of Materials • Adding Balloons to the Drawing Views • Adding Balloons Using the AutoBalloon Tool • Creating Magnetic Lines • Adding New Sheets to the Drawing Views • Editing the Sheet Format • Creating User-Defined Sheet Formats
Week 11 (2Hours)	**16. Surface Modeling**	• Creating an Extruded Surface • Creating a Revolved Surface • Creating a Swept Surface • Creating a Lofted Surface • Creating a Boundary Surface • Creating a Planar Surface • Creating a Fill Surface • Creating a Radiated Surface • Offsetting Surfaces, Trimming Surfaces • Untrimming Surfaces
Week 11 (2Hours)		• Extending Surfaces, Knitting Surfaces ,Filleting Surfaces • Creating a Mid-Surface, Deleting Holes from Surfaces • Replacing Faces, Deleting Faces • Moving and Copying Surfaces • Mirroring Surface Bodies • Adding Thickness to Surface Bodies • Creating a Thicken Surface Cut, Creating a Surface Cut
Week 12 (4Hours) + Week 13 (2Hours)	**3D Modeling, Assembly and Drafting Project (Minimum 10 parts)** **Project Display**	• Use the concept of Reverse Engineering and Redesign the parts by measuring them using the Measuring Instrument • Creating Assemblies of parts created earlier • Drafting of the assembly model created • Student needs to demonstrate his project

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	**PBL-1 (Machine Drawing/Mechanics)**				
Course Code	**BTME2007**				
Prerequisite	BTME1002 Product Design using Graphics				
Corequisite	BTME2005 Machine Drawing Lab				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

1. To enable the students to have a hands on experience of application of machine drawing in the field.
2. To enable the students to develop soft models of assemblies and components of machines and automobiles.
3. To help the students reflect on the inputs in machine drawing gained in the class room and explore associated areas.

Course Outcomes

CO1	Apply the concepts learnt in the machine drawing lab to design various machine components.
CO2	Model geometrically the mechanical devices and parts of machines/automobiles using modeling softwares.
CO3	Illustrate the measurement techniques for dimensions and curvatures for different views of the component.
CO4	Select the appropriate tools and their relevance to implement the project.
CO5	Summarize the design modifications based on the study of machine elements.

Text Book (s)

1.N.D. Bhatt (2011), Machine Drawing, Published by R.C.Patel, 46th Edition, Charotar Publishing House Book Stall, ISBN: 978-9-380-35846-8.

Reference Book (s)

1.K C John (2009), Engineering Graphics for Degree, Prentice Hall of India. ISBN: 978-8-120-33788-2.
2.Warren Luzadder and Jon M. Duff (2009), Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production, 11th Edition, PHI Learning, ISBN: 978-8-120-30885-5.
3.P.S. Gill (2012), Machine Drawing, S. K. Kataria & Sons, ISBN: 978-8-185-74979-2.
4.Ajeet Singh (2012), Machine Drawing (with AutoCAD), 2nd Edition, Tata Mcgraw Hill Education, ISBN: 978-0-071-07294-6.
5.Barclay James and Griffiths Brian (2002), Engineering Drawing for Manufacture, Butterworth-Heinemann, ISBN: 978-1-857-18033-6.

Thrust areas of projects in geometric modeling with tentative project titles

1. Lathe Machine Components and Assembly
2. Drilling Machine Components and Assembly
3. Automobile Components and Assembly
4. Household Appliances

5. Industrial Equipments
6. Construction Equipments
7. Electrical Machines
8. Computers and Accessories
9. Office Equipments
10. Gadgets
11. I.C. Engine Parts
12. ……..
13. ……..

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	Mechanics of Materials				
Course Code	BTME2008				
Prerequisite	BTME2001-Engineering Mechanics				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To develop the relationship between the loads applied to a non-rigid body, the internal stresses and deformations induced in the body.
2. To study the general state of stresses and strains in a given loaded member and the magnitude and direction of the principal stresses
3. To understand the different approaches to calculate slope and deflection for various types of beams.
4. To analyze the columns with different edge conditions by using different theories.

Course Outcomes

CO1	Understand the basics of simple stress and strain
CO2	Draw Mohr's circle and solve problems involving biaxial state of stress.
CO3	Apply theory of simple bending for analysing problems.
CO4	Calculate deflection of various beams of different shapes.
CO5	Calculate torsion in shafts and buckling load of column.

Text Book (s)

1. S. S. Rattan (2011) Strength of material Tata McGraw Hill Education. ISBN: 978-0-071-07256-4.

Reference Book (s)

1. S.P. Timoshenko and D.H. Young (2011), Strength of Materials, 5th edition, East West Press Ltd, ISBN: 978-8-176-71019-0.

2. R.K. Bansal (2010), Strength of Materials, 5th Edition, Laxmi Publications, ISBN: 978-8-131-80814-6.

Course Content:

Unit I: Stresses and Strains **8 Hours**
Definition/derivation of normal stress, shear stress, and normal strain and shear strain – Stress-strain diagram- Elastic constants – Poisson's ratio – relationship between elastic constants and Poisson's ratio – Generalized Hook's law – Strain energy – Deformation of simple and compound bars – thermal stresses.
Unit II: Bi-axial Stress system **8 Hours**
Biaxial state of stress – Stress at a point – stresses on inclined planes – Principal stresses and Principal strains and Mohr's circle of stress, Theories of failure Thin cylinders and shells – deformation of thin cylinders and shells; Thick Cylinders, Shrink fits, Compounding. Fundamentals of theory of elasticity.

Unit III: Simple Bending **8 Hours**
Types of beams: Cantilever, Simply supported, Overhanging: Shear Force and Bending Moment Diagrams. Theory of simple bending – bending stress and shear stress in beams.
Unit IV: Deflection of Beams **8 Hours**
Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method.
Unit V: Torsion and columns **8 Hours**
Introduction to Torsion – derivation of shear strain – Torsion formula – stresses and deformations in circular and hollow shafts – Stepped shafts – shafts fixed at the both ends Theory of columns – Long column and short column - Euler's formula – Rankine's formula - Secant formula - beam column.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Fluid Mechanics				
Course Code	BTME2009				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. Understand fluid behaviour for engineering design and control of fluid systems.
2. Develop competence with mass, energy and momentum balances.
3. Study the development of boundary layers.

Course Outcomes

CO1	Explain the properties of fluid and its kinematics.
CO2	Categorize the types of flow and applications of governing equations in a fluid flow system.
CO3	Examine the losses of fluid flow through pipes and study about pipe network design.
CO4	Calculate the dependent and independent parameters of fluid flow.
CO5	Examine the boundary layer and no-slip boundary condition in the fluid flow.

Text Book (s)

1. R. K. Bansal (2010), A Textbook of Fluid Mechanics and Hydraulic Machines, 9thEdition, Laxmi Publication (P) Ltd., New Delhi. ISBN- 978-8-131-80815-3
2. G.K. Batchelor, An Introduction to Fluid Dynamics, Cambridge Mathematical Library, ISBN: 9780521663960

Reference Book (s)

1. Yunus A. Çengel (2010), Fluid Mechanics, Tata McGraw Hill, ISBN: 978-0-070-70034-5.
2. Frank M. White (2011), Fluid Mechanics, 7th edition, Tata McGraw-Hill Education, ISBN- 978-0-071-33312-2.

Course Content:

Unit I: Fluid Properties and Hydrostatics **6 Hours**
Density, Viscosity, Surface tension, compressibility, capillarity, Hydrostatic forces on plane, inclined and curved surfaces, buoyancy, centre of buoyancy, metacentre.
Unit II: Fluid Dynamics **6 Hours**
Control volume, Fluid Kinematics, Types of flows; Steady flow, Unsteady flow, Uniform and Non Uniform flow, Rotational flow, Irrotational flow, 1-D, 2-D, 3-D flows– Streamline and Velocity potential lines, Euler and Bernoulli's equations and their applications, moment of momentum, Momentum and Energy correction factors, Impulse, Momentum equation- Navier-Stokes Equations, Applications.
Unit III: Open & Closed Channel Flow **12 Hours**
Open Channels Flow, Laminar & turbulent flow through pipes, Darcy's law, Minor losses, Multi reservoir problems, Moody's diagram, Hagen Poiseuille equation, Turbulent flow, Specific Energy, Critical flow concept,

Hydraulic jump, uniform flow and gradually varying flow concepts, Pipe network design, Measurement of pressure and flow, Measurement of pipe flow, velocity through pipes and open channels.
Unit IV: Dimensional Analysis **10 Hours**
Dimensional homogeneity, Raleigh and Buckingham π theorems, Non-dimensional numbers, Model laws and distorted models, Module quantities, Specific quantities
Unit V: Boundary layers **6 Hours**
Boundary layers, Laminar flow and Turbulent flow, Boundary layer thickness, momentum- Integral equation, Drag and lift, Separation of boundary layer, Methods of separation of boundary layer.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Manufacturing Processes II and Metrology				
Course Code	BTME2010				
Prerequisite	BTME2003- Manufacturing Processes I				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To get acquainted with the theory of metal cutting, mechanism of machining and the parameters that influences the machining processes.
2. To get basic idea about different conventional and non conventional machining processes.
3. To gain knowledge of various instruments for linear measurement, angular measurement and surface finish etc

Course Outcomes

CO1	Explain the mechanism of chip formation in machining.
CO2	Describe the various machining processes such as turning, drilling, boring, shaping, slotting, milling and grinding.
CO3	Illustrate the principle of gear generation process.
CO4	Illustrate the working principle of Non-traditional machining processes.
CO5	Explain the principle of different metrology instruments.

Text Book (s)

1. P.C. Sharma, (2008), Text book of Production Technology, 7th Edition, S. Chand & Company Ltd, New Delhi, ISBN: 978-8-121-91114-6.
2. O.P. Khanna & M. Lal (2010), A Text book of Production Technology, Dhanpat Rai Publications, New Delhi, ISBN: 978-8-189-92832-2.

Reference Book (s)

1. S. Kapakjianand S.R. Schmid (2005), Manufacturing Engineering and Technology, 4thEdition, Pearson Education (Singapore) Pvt. Ltd. ISBN: 978-8-177-58170-6.

Course Content:

Unit I: Theory of Metal Cutting **10 Hours**
Mechanism of chip formation – Tool Specification System- Tool signature for single point & Multi-point cutting Tools- Orthogonal and Oblique cutting – Single Point and Multipoint Cutting Tools-Machining forces - Merchant's Circle Diagram - Thermal aspects of metal machining - Cutting fluids - Machinability - Cutting tool materials - Tool wear and Tool life calculations.
Unit II: Lathe and Basic Machine Tools **08 Hours**
Lathe - Types - Operating Parameters - lathe operations – Tool nomenclature - Work holding devices. Shaping - Planing - Slotting – Drilling - Boring – Reaming – Tapping – Broaching.

Unit III: Milling, Grinding Machines and Gear Generation	**08 Hours**
Milling machines - Cutters - Milling operations - Indexing. Grinding – Types of grinding machines - Grinding wheel designation and selection - Bond and Bonding processes. Gear generating principles - Gear Hobber - Gear finishing methods - Bevel gear generator	
Unit IV: **Non-traditional Machining Processes**	**07 Hours**
Classification of Nontraditional Machining process – Principle of AJM, WJM, USM, EDM, ECM, LBM - Process characteristics – Applications	
Unit V: Metrology and Instrumentation	**07 Hours**
Measurement standards - Linear, angular and form measuring instruments – Comparators – Gauge blocks – Gauges - Optical instruments – Profilometer – Coordinate measuring machine	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Probability and Statistics				
Course Code	MATH2003				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

The aim of this course is to introduce students to the basic concepts of probability distributions and their applications. The course also serves as a foundation to analyze problems in Science and Engineering applications through statistical testing methods.

Course Outcomes

CO1	Define the basic concepts of Probability theory and Random variables.
CO2	Identify the type of distribution and Apply it in problem solving.
CO3	Apply the concept of correlation and Regression.
CO4	Explain the concepts of sampling distributions and estimation theory and apply it to estimate the confidence intervals.
CO5	Apply statistical tests to solve the hypothesis testing problems.

Text Book (s)

1. R. E. Walpole, R. H. Mayers, S. L. Mayers and K. Ye (2007), Probability and Statistics for Engineers and Scientists, 9th Edition, Pearson Education, ISBN:978-0-321-62911-1.
2. Sheldon M. Ross (2011), Introduction to Probability and Statistics for Engineers and Scientists, 4th Edition, Academic Foundation, ISBN:978-8-190-93568-5.

Reference Book (s)

1. Douglas C. Montgomery (2012), Applied Statistics and Probability for Engineers, 5th Edition, Wiley India, ISBN: 978-8-126-53719-8.
2. M. R. Spiegel, J. Schiller and R. A. Srinivasan(2010), Probability & Statistics, 3rd Edition, Tata-McGraw Hill, ISBN:978-0-070-15154-3.
   https://nptel.ac.in/courses/111105041/

Course Content:

Unit I: Variables and probability Distributions **12 Hours**
Review of Probability, Probability density function, Cumulative distribution function, Expectation and Variance. Binomial, Poisson and Geometric distributions, Probability density function, Cumulative distribution function, Expectation and Variance, Uniform, Normal, Exponential distributions, Joint distribution and joint density functions, Conditional distribution.
Unit II: Correlation and Regression **8 Hours**
Curve fitting by method of least squares, Fitting of straight lines, Polynomials, Exponential curves, Correlation, Rank correlation, Regression analysis, Linear and non-linear regression, Multiple regression.

Unit III: Sampling and Estimation Theory **10 Hours**
Population and sample, Statistical inference, Sampling with and without replacement, Random samples, Population parameters, Sample statistics, Sampling distributions, Sample mean, Sampling distribution of means, Sample variances, Sampling distribution of variances, Case where population variances is unknown, Estimators, Point and Interval Estimation, Confidence Interval estimates of population parameters, Confidence intervals for variance of a Normal distribution, Maximum likelihood estimates.
Unit IV: Tests of Hypothesis and Significance **10 Hours**
Statistical hypothesis, Null and Alternate hypothesis, test of hypothesis and significance, Type I and Type II errors, Level of Significance, Tests involving the Normal distribution, One-Tailed and Two-Tailed tests, P value, Special tests of significance for Large and Small samples (F, chi- square, z, t- test), one way ANOVA.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Organisation Behaviour**				
Course Code	**BBAD 1014**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Outcomes

CO1	Use the basic foundations of Organizational Behaviour and the knowledge of the concepts of perception and personality to illustrate their effects on individual behaviour in organizational settings.
CO2	Relate to the process of learning, attitude formation and pattern of individual values for effective management among employees in organizations.
CO3	Illustrate how interpersonal skills have an impact on groups and team work in an organization, explaining the behavioral patterns of human beings at individual and group levels for building high-performing teams.
CO4	Compare various motivational theories and identify the most effective leadership styles in different organizational settings.
CO5	Illustrate various techniques for managing conflicts within organizations and discuss the basic nature of organizational change while handling stress effectively.

Text Book (s)

1. Arora, M. N. (2012). A Textbook of Cost and Management Accounting, New Delhi
2. L.M. Prasad, 5th Edition, Sultan Chand and Sons, 2014.

Reference Book (s)

1. P.G. Aquinas, 2nd Edition, Excel Books, 2013.Horngren, C. T., Sundem, G. L., & Stratton, W. O. (2009). Introduction to Management Accounting,
2. John M. Ivancevich, Robert Konopaske and Michael T. Matteson, 9th Edition, Tata McGraw Hill Education Pvt. Ltd., 2012.

Course Content:

Unit I:Role of Individuals in understanding of Organisational Behaviour 8 Hours
The purpose of this module is to understand the nature of organizational behaviour and identify the research foundations of OB. Also the module analyzes the role of perception and personality of individual for managers and suggests measures of developing perceptual skills.
Unit II: Learning, Attitudes and Values 6 Hours
This module discusses the learning concept and its implications for organizational behaviour. The focus is to understand through classical and Operant conditioning theories how learning takes place in organizational settings. The module emphasises to understand the nature and role of attitudes and values in human behaviour. It makes students understand how attitudes and values are formed in an individual; also understand how attitudes and values can be managed effectively.
Unit III: Group & Team dynamics for effective Interpersonal Relationships 8 Hours

This module discusses the nature of group dynamics. It also examines the behaviour of different groups that exist in the organization-both formal and informal. Also it makes students understand the synergy in teams. The module also focuses on understanding the importance of interpersonal behaviour at workplace, analyze and improve interpersonal behaviour through transactional analysis.
Unit IV: Motivation and Leadership **6 Hours**
The module discusses the concept of motivation and the way it affects human behaviour, understand various theories of motivation for identifying how people are motivated. The module also discusses the contents of leadership as a process of influence, understand various theories so as to identify how leaders emerge and various leadership styles so that managers can adopt suitable styles.
Unit V: Stress and Conflict Management and Change Management **9 Hours**
The module discusses the nature and causes of stress, understand the impact of stress on behaviour and identify the strategies for coping stress effectively. Module also focuses on understanding the nature and causes of organizational conflicts, identify the levels at which conflicts emerge and adopt the strategies for minimising the negative consequences of conflicts. The module also discusses the basic nature of organizational change and reasons behind this. The module will acquaint students with the reasons for resistance to change and strategies to overcome it.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Microeconomics				
Course Code	BBAD1003				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Outcomes

CO1	Describe basic concepts and techniques of microeconomic analysis and their applications to managerial decision-making to sustain the business in long-run.
CO2	Explain how demand and supply analysis helps in clearing markets and understand the concepts and determinants of demand and supply elasticities.
CO3	Demonstrate how a consumer maximizes his utility subject to constraints and the concept of consumer surplus.
CO4	Use concepts of production, costs and revenue in determining equilibrium of the producer with the help of iso-quants and iso-cost lines.
CO5	Differentiate between different kind of market forms and their short run and long run equilibrium positions.

Text Book (s)

1.Microeconomics (Connect for McConnell), Campbell R. McConnell; Stanley L. Brue; Sean M. Flynn

Reference Book (s)

1. D. N. Dwivedi, (2012), 2e, Pearson Education., Microeconomics: Theory and Applications,
2. Neva Goodwin, Nelson 2nd edition.(2009), PHI Learning, Microeconomics in context
3. N. Gregory Mankiw, 4e, Thomson: South-Western, Principles of Microeconomics
4. Koutsoyiannis, ELBS, Modern Microeconomics
5. Geetika, Piyali Ghosh, 2e McGraw-Hill, Managerial Economics
6. S. Prusty, PHI., Managerial Economics
7. Paul A. Samuelson & William D. Nordhaus, 17e, McGraw-Hill, Economics

Course Content:

Unit I: Introduction to Microeconomics **5 Hours**
Introduction to Microeconomics: Economics is a Social Science, Two Major Branches of Economics, Microeconomics As a positive Science, Microeconomics As a normative Science, The Uses of Microeconomic Theories, Limitations of Microeconomic Theories, Case study: Government Intervention
Unit II: Supply-Demand Analysis **10 Hours**
The Concept of Market, The Demand Side of the Market: Meaning, Law of Demand, The Demand Side of the Market: Factors behind the Law of Demand, The Supply Side of the Market: Meaning, Law of Supply, The Supply Side of the Market: Shifts in the Supply Curve, The Market Equilibrium: Market Mechanism, Graphical Illustration of Price Determination, The Elasticity of Demand, Price Elasticity of Demand: Measuring Arc and Point Elasticity of Demand Determinants of Price Elasticity of Demand, Price Elasticity of Supply: Definition and Measurement, Determinants of Price Elasticity of Supply, Mathematical Illustrations on Price Elasticity of Demand& Supply, Case Study.

Unit III Consumer Behaviour	**6 Hours**
Theory of Consumer Demand: Utility Approach, Cardinal utility approach, The Law of Diminishing Marginal utility, Consumer Equilibrium, Ordinal utility approach ,Properties of Indifference curves, consumer Equilibrium, Marshallian Concept of Consumer Surplus	
Unit IV: Production Analysis, Cost of Production, and Profit Analysis of the Firm	**10 Hours**
Meaning of Production, Input and output, Theory of production in short-run [relationship among total, average and marginal productivity of labour, law of diminishing returns] Theory of production in long-run [expansion path, and returns to scale], The Isoquant curve, Derivation and properties of Isoquant curve, Isoquant map and economic region of production, Cobb-Douglas production function and returns to scale, Types of costs in short-run [fixed, variable, total, average, marginal, break-even analysis, shut-down point] Types of costs in long-run [total, average, marginal, and inter-relationships], Mathematical Illustrations	
Unit V: Market structure	**9 Hours**
Perfectly competitive market [characteristics, supply and demand curve] Case study: Outsourcing to India: Way to Fast Track, Perfectly competitive market [profit maximizing price determination in short-run and long-run], Monopoly [characteristics, demand curve], Cost and Revenue curves under monopoly, Price Discrimination under monopoly, Monopolistic Competition [characteristics, supply and demand curve, profit maximizing price determination in short-run and long-run, Monopolistic competitive market [product differentiation (advertising and brand names), solve problems], Excess Capacity under Monopolistic competition (solve problems]	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	**Financial Management**				
Course Code	**BBAD 2007**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives

1. To acquire basic knowledge about the financial management practices in busienss organizations
2. To acquire knowledge about various methods of capital budgeting, captial structuring, dividend payouts and workign capital management.
3. To understand capital budgeting, dividend payment in detail and application of these in real world scenarios.

Course Outcomes

CO1	Describe the theory and practice of corporate finance techniques using Time value of Money.
CO2	Assess common investment criteria and project cash flows associated with corporate project evaluation.
CO3	Relate how risk and the cost of capital impact on investment appraisal, and understand how this cost is impacted by taxation, "leverage" and other factors.
CO4	Relate the theories of capital structure and Assess the external and internal influences on a corporation's capital structure, payout policy.
CO5	Apply techniques of working capital, receivables and investment management for long term financing of the firm.

Text Book (s)

1. Financial Management - I M Pandey, Vikas Publishing House Pvt. Ltd.

Reference Book (s)

1. Financial Management and Policy - Van Home, J.C, Prentice Hall of India.
2. Corporate Finance : Theory and Practice - Charles P Jones, John Wiley
3. Financial Management - Prasanna Chandra, Tata McGraw Hill
4. Financial Management - Khan & Jain, Tata McGraw Hill

Course Content:

Unit I: Introduction and Time Value of Money **6 Hours**
Introduction to Financial Management,Nature and scope of Financial Management, Finance functions, Role of finance manager, Financial goal: Profit maximization Vs wealth maximization, Concept of agency and agency problem. Time Preference for money, Future Value- Single Cash flow, Annuity, Sinking Fund ,Present Value- Single Cash flow, Valuation of Bonds and shares, Risk and Return, Exercises on Future Value, Present Value, and Bonds Valuation
Unit II: Investment Decisions **10 Hours**
Risk Analysis in Capital Budgeting. Investment Evaluation Criteria: NPV based numerical, IRR: Concept, Limitations and its significance, Payback: Meaning, and calculating payback periods, ARR: Meaning, Scope, and

calculating ARR, Profitability Index: Meaning, Nature, Significance, and functions, calculating Practical exercises having calculation of various capital budgeting decisions collectively like NPV, PI and PB simultaneously etc. Case Study: Hola-Kola-The Capital Budgeting Decision by Lena Booth
Unit III: Cost of Capital and Leverage Analysis **10 Hours**
Cost of capital: Concept, Significance, nature, and factors affecting cost of capital, Cost of Debt, Preference Shares, Equity Shares, Weighted Average Cost of Capital(WACC). EBIT-EPS Analysis, Leverage analysis- Operating, Financial and Combined Leverage.
Unit IV: Capital structure and Dividend Decisions **10 Hours**
Theories of Capital structure, Net Income (NI),Traditional, Net Operating Income(NOI) Approach, MM Hypothesis. Dividend: Concept, meaning, types, and significance for stakeholders, Theories/Models in dividend policy, Walter, Gordon MM (Miller Modigliani) Hypothesis and theory, Determinants of dividend policy.
Unit V: Working Capital Decisions **5 Hours**
Working Capital Management: Concept, meaning, objectives, types and significance, Principles of working capital management, Receivables Management, Inventory Management- EOQ, Reorder Level, Cash Management.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Fluid Mechanics Laboratory**				
Course Code	**BTME2011**				
Prerequisite	BTME2009 Fluid Mechanics				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

1. To provide practice in estimating friction losses.
2. To impart training to use various flow measuring devices for making engineering judgments.

Course Outcomes

CO1	Demonstrate the basic measurement techniques of fluid mechanics.
CO2	Apply the basic laws of fluid mechanics in flow measurement.
CO3	Calculate the frictional losses in fluid flow.
CO4	Experiment with flow measurement devices like venturimeter and orifice meter.
CO5	Predict the coefficient of discharge for flow through pipes.

Text Book (s)

1. R. K. Bansal (2010), A Textbook of Fluid Mechanics and Hydraulic Machines, 9thEdition, Laxmi Publication (P) Ltd., New Delhi. ISBN- 978-8-131-80815-3

Reference Book (s)

1.Yunus A. Çengel (2010), Fluid Mechanics, Tata McGraw Hill, ISBN: 978-0-070-70034-5

COURSE CONTENT

1. Conducting experiments to verify Bernoulli's theorem.
2. Determination of the Coefficient of discharge and coefficient of velocity for the given Orifice meter.
3. Determination of the Coefficient of discharge of given Venturi-meter.
4. Determination of the Coefficient of discharge of given Rectangular notch.
5. Determination of the Coefficient of discharge of given 'V' notch.
6. Comparative study of head loss in pipes connected series and parallel.
7. Study of fluid flow types using Reynolds apparatus.
8. Determination of drag force at different incidence angle in wind tunnel.
9. Determination of metacentric height.
10. Determination of the Reynolds no. in fluid flows.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	**Mechanics of Materials Laboratory**				
Course Code	**BTME2012**				
Prerequisite					
Corequisite	BTME 2008-Mechanics of Material				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

To supplement the theoretical knowledge gained in Strength of Materials with practical testing under applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness.

Course Outcomes

CO1	Conduct tension and compression tests on standard specimens.
CO2	Calculate impact strength of standard specimen.
CO3	Determine spring constant of closed and open coil helical spring.
CO4	Calculate the fatigue strength of given specimens.
CO5	Calculate hardness of specimens, and determine the young's modulus of material by deflection test.

Text Book (s)

1. Lab Manual prepared by SOME

Reference Book (s)

1. S. S. Rattan (2011), Strength of Material, Tata McGraw Hill Education.
2. S.P. Timoshenko and D.H. Young (2011), Strength of Materials, 5th edition, East West Press Ltd.
3. R.K. Bansal (2010), Strength of Materials, 5th Edition, Laxmi Publications.

COURSE CONTENT

1. To determine Brinell Hardness Number (BHN) for the given material of the specimen.
2. To determine Rockwell Hardness Number (RHN) for the given material of the specimen.
3. To determine the stiffness and modulus of rigidity of open coil helical spring.
4. To determine the stiffness and modulus of rigidity of closed coil helical spring.
5. To determine the impact strength for the given specimen using Charpy test.
6. To determine the impact strength for the given specimen using Izod test.
7. To determine the Young's modulus of the given material by conducting the deflection test.
8. To study the fatigue strength for the given specimen using Fatigue test.
9. To determine the Young's modulus by conducting tension test on a given mild steel specimen.
10. To determine the Maximum compressive strength by conducting compression test on a given specimen on UTM.
11. To study the strain aging behavior of steel (associated with the yield-point phenomena) using load-elongation curve obtained from tensile test.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	Manufacturing Processes II and Metrology Laboratory				
Course Code	BTME2013				
Prerequisite	BTME1003, Product Manufacturing				
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

1. To learn and identify parts of a Lathe Machine and different operations on a Lathe.
2. To become skilled to handle and use drilling, lathe, milling and surface grinding machines.
3. To gain hands on practices in measurements and measuring instruments

Course Outcomes

CO1	Develop a component using basic operations of lathe and drilling machine.
CO2	Produce a component using milling and shaper machine.
CO3	Create a single point cutting tool with various angles using tool and cutter grinder
CO4	Measure the different measurements using measuring instruments and analyse the errors.

Text Book (s)

1. Manufacturing Processes II and Metrology Lab manual prepared by faculties of School of Mechanical Engineering.

Reference Book (s)

1. Manufacturing Practices Lab Manual, SOME, Galgotias University, Dr. P. Tamilchelvan, 2016.
2. Metrology Lab Manual, SOME, Galgotias University, Dr. P. Tamilchelvan, 2016.
3. A.K. Hajra Choudhury, S.K. Hajra Choudhury and Nirjhar Roy (2010), Elements of Workshop Technology, Vol. – II, Media Promoters, ISBN: 978-8-185-09915-6.
4. Manufacturing Engineering and Technology, S. Kapakjian and S.R. Schmid, 4th Edition, Pearson Education (Singapore) Pvt. Ltd. (2005) ISBN: 978-8-177-58170-6.

COURSE CONTENT

1. Lathe Exercise – Facing, Straight turning, knurling, chamfering, Thread cutting operations using Lathe Machine
2. Drilling - Countersinking and Tapping using Drilling Machine.
3. End milling and Gear cutting using Milling Machine.
4. Surface finishing using Surface Grinding Machine.
5. Grinding of single point cutting tool using Tool and Cutter Grinder.
6. Machining a block on shaper machine.
7. Study & working of simple measuring instruments like Vernier calipers and micrometer.
8. Measurement of effective diameter of a screw thread.
9. Measurement of angle using sine bar & slip gauges.
10. Study & angular measurement using bevel protector.
11. Measurement of various angles of SPCT (Single Point Cutting Tool-HSS) using Tool maker's Microscope.
12. Measurement of various dimensions of spur gear using Optical Profile Projector.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	**PBL – 2 (Material Microstructures)**				
Course Code	**BTME 2014**				
Prerequisite	Phys1003-Physics of Materials				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

1. To enhance the basic knowledge acquired by the students in the discipline of materials science and engineering by making it more project oriented.
2. To provide the knowledge about the micro structural characterisation and analysis of different engineering materials.
3. To introduce the concepts of structure-property relationships.

Course Outcomes

CO1	Describe the process to obtain microstructures.
CO2	Analyze the materials microstructure for different engineering materials.
CO3	Demonstrate the shape, size and arrangement of grains in materials.
CO4	Compare the microstructure grain size variation with the mechanical properties
CO5	Explain the grain growth and grain refinement of steel after heat treatment

Text Book (s)

1."ASM Handbook Volume 9: Metallography and Microstructures" by George F. Vander Voort

Reference Book (s)

1. "Characterization of Metals and Alloys (Materials Characterization Series)" by Paul H. Holloway and P.N. Vaidyanathan
2. "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods" by Yang Leng
3. "An Introduction to Material Characterization" by Khangaonkar P R
4. "Characterization of Materials" by Mitra P.K
5. "Microstructural Characterization of Materials" by David Brandon and Wayne D. Kaplan
6. "Materials Characterization Techniques" by Sam Zhang and Lin Li
7. "Molecular Materials: Preparation, Characterization, and Applications" by Sanjay Malhotra and B. L. V. Prasad
8. "Characterization of Metals and Alloys (Materials Characterization Series)" by Paul H. Holloway and P.N. Vaidyanathan
9. "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods" by Yang Leng

Thrust areas of projects with tentative project titles
1. Establish correlation of microstructure developed due to different heat treatment with tensile strength of plain carbon steel.

2. Develop relation of microstructure arises because of different heat treatment with hardness of plain carbon steel.
3. Establish correlation of microstructure developed due to different heat treatment with impact toughness of plain carbon steel.
4. To find effect of cutting parameters on microstructure of surface produced in case of planning.
5. To find effect of heat input on microstructure of weld produced in shielded metal arc welding.
6. To find effect of heat input on microstructure of weld produced in metal inert gas welding.
7. To find effect of heat input on microstructure of HAZ produced in shielded metal arc welding.
8. To find effect of heat input on microstructure of HAZ produced in shielded metal arc welding.
9. Compare the microstructure of weld and HAZ for weld joint of shielded metal arc welding and metal inert gas welding.
10. Compare the microstructure of austenitic, ferritic and martensitic stainless steel.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	Applied Thermodynamics I				
Course Code	BTME3001				
Prerequisite	BTME2002 Engineering Thermodynamics				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

- To apply knowledge of basic laws of thermodynamics to engineering applications.
- To acquire knowledge about various thermodynamics cycles.
- To understand jet propulsion systems.

Course Outcomes

CO1	Apply thermodynamics relations for equation development of thermodynamic process.
CO2	Analyze combustion process at different operating parameters of combustible hydrocarbon fuels.
CO3	Describe steam formation and its thermodynamic behaviour for different vapour power cycles.
CO4	Explain the function and application of different types of steam turbines, nozzles and its selection criteria.
CO5	Illustrate the fundamental of gas turbine cycles and jet propulsion system with its application area.

Text Book (s)

1.P. K. Nag (2010), Basic and Applied Thermodynamics, Tata McGraw-Hill PublishingCompany Ltd., ISBN 978-0-070-15131-4.
2.R. K. Rajput, Applied Thermodynamics, Laxmi Publications Pvt Ltd; Second edition.

Reference Book (s)

1.Yunus A. Cengel and Michael A. Boles, Thermodynamics, Engineering Approach, 6th Ed., McGrawHill, 2006.
2.Onkar Singh (2009) Applied Thermodynamics, New Age International. ISBN:978-8-122-42583-3.

Course Content:

Unit I: Thermodynamic relations	**7 Hours**
Tds equations, Maxwell relations, Clapeyron equation,Joule-Thompson coefficient and InVersion 2.1curve, General Relations for Change in Entropy,Enthalpy, Internal Energy and Specific Heats, Coefficient of volume expansion, Adiabaticand Isothermal compressibility.	
Unit II: Fuels and Combustion	**7 Hours**
Introduction to Combustion analysis, Classification of Fuels, Combustion Equations,Theoretical Air and Excess Air, Stoichiometric Air Fuel (A/F) Ratio , Air-Fuel Ratio fromAnalysis of Products, ConVersion 2.1of Volumetric Analysis to Weight Analysis, ConVersion 2.1ofWeight Analysis to Volumetric Analysis, Weight of Carbon in Flue Gases,Weight of FlueGases per kg of Fuel Burnt , Analysis of Exhaust and Flue Gas, Calorific or Heating Values of Fuels.	
Unit III: Vapour Power Cycles	**9 Hours**

Phase Change of a Pure Substance, Formation of Steam, Thermodynamic Properties of Steamand Steam Tables, Carnot Cycle, Rankine Cycle, effect of pressure and temperature onRankine cycle, Reheat Cycle, Regenerative Cycle, open and closed feed water heaters, BinaryVapour Cycle.

Unit IV: Steam Turbines and Nozzles **9 Hours**

Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overallefficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistageimpulse and reaction turbines and related calculations, work done, efficiencies of reaction,Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines,Flow through Convergent and convergent-divergent nozzles, variation of velocity, area andspecific volume, Choked flow, throat area, Nozzle efficiency, Off design operation of nozzle,Effect of friction on nozzle, Super saturated flow.

Unit V: Gas Turbine and Jet Propulsion **8 Hours**

Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles withintercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropicefficiency, Deviation of actual cycles from ideal cycles, Introduction to the principles of jetpropulsion, Turbojet and turboprop engines and their processes, Principle of rocketpropulsion, Introduction to Rocket Engine.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Kinematics of Machines				
Course Code	BTME3002				
Prerequisite	BTME2001 Engineering Mechanics				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To familiarize students with basic types of mechanisms, joints and degrees of freedom to perform position, velocity and acceleration analysis using graphical and analytical methods.
2. To provide students an understanding of different types of mechanisms.
3. To teach the basics of synthesis of simple mechanisms.
4. To teach students the kinematic analysis of cam-follower motion and gear train configurations.

Course Outcomes

CO1	Understand the concepts of various mechanisms and pairs.
CO2	Analyze the displacement, velocity and acceleration of different links in a simple mechanism.
CO3	Synthesize simple mechanisms based on the given input conditions.
CO4	Draw the profile of cam for different types of follower motions.
CO5	Apply kinematics principle to gears operation.

Text Book (s)

1. S.S. Rattan (2009), "Theory of Machines", 3rd Edition, Tata McGraw-Hill. ISBN: 978-0-070-14477-4.

Reference Book (s)

1. J. Uicker John, Gordon R. Pennock Jr. and Joseph E. Shigly (2011), Theory of Machines and Mechanisms, 4th Edition, Oxford University Press, ISBN: 978-0-199-77781-5.
2. Thomas Bevan (2009), Theory of Machines, 3rd Edition, Pearson Education, ISBN: 978-8-131-72965-6.
3. A. Ghosh (2009), Theory of Mechanisms and Machines, 3rd Edition, East-West Press Pvt. Ltd., New Delhi, ISBN: 978-8-185-93893-6.
4. Kenneth J Waldron and Gary L. Kinzel (2007), Kinematics, Dynamics, and Design of Machinery, 2nd Edition, John-Wiley and Sons Inc., New York, ISBN: 978-8-126-51255-3.

Course Content:

Unit I: Basics of Mechanisms	**8 Hours**
Introduction to mechanisms and its terminologies - Degree of freedom – Mobility - Kutzbach criterion - Grubler's criterion for planar mechanisms - Grashoff's law - Kinematic InVersion 2.2s of 4-bar chain - Single slider and double slider crank chains - Quick return mechanism - Limiting positions - Mechanical advantage - Transmission angle - Ratchets and escapements – Indexing Mechanisms – Rocking Mechanisms – Straight line generators.	
Unit II: Kinematic Analysis of Simple Mechanisms	**8 Hours**

Displacement, velocity and acceleration analysis in simple mechanisms having turning, sliding and rolling pair - Coriolis acceleration using graphical relative motion method - Instantaneous center method - Four bar and slider crank mechanisms - Analytical method for four bar and slider crank mechanisms.

Unit III: Synthesis of Simple Mechanisms **8 Hours**

Classification of kinematic synthesis problems - Two position synthesis of slider crank and crank rocker mechanisms - Three position synthesis of double rocker mechanism - Chebychev spacing - Freudenstein analytical method - synthesis of function generator using three precision positions, Graphical and analytical design of a four bar linkage for body guidance, path generation by graphical method.

Unit IV: Kinematics of CAMS **8 Hours**

Types of cams and followers - Definitions related cam profile - Derivatives of follower motion – High speed cams – Undercutting - Graphical disk cam profile design - Simple harmonic motion, Constant acceleration and deceleration, constant velocity, Cycloidal motion for knife edge and roller (in-line and offset), flat faced and oscillating followers - Tangent cam with roller follower - circular arc cam with flat faced follower.

Unit V: Kinematics of Gears and Gear Train **8 Hours**

Spur gear terminology and definitions - Law of toothed and involute gearing - Interchangeable gears - Gear tooth action - Interference and undercutting - Basics of nonstandard gear teeth -Helical – Bevel – Worm - Rack and pinion gears, cycloidal tooth properties - Comparison of involute and cycloidal tooth forms.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Heat and Mass Transfer				
Course Code	BTME3003				
Prerequisite	BTME2002 Engineering Thermodynamics, BTME2009 Fluid Mechanics				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the basic principle of heat transfer.
2. To able to analyse the system in which heat transfer takes place due to conduction, convection and radiation.

Course Outcomes

CO1	Employ the basic modes of heat transfer and analyze problems involving steady state heat conduction in simple geometries.
CO2	Assess the performance of fins in different applications and develop solutions for transient heat conduction in simple geometries.
CO3	Apply the fundamentals of convective heat transfer process and evaluate heat transfer coefficients for forced and natural convection.
CO4	Calculate radiation heat transfer between black and gray body surfaces.
CO5	Analyze heat exchanger performance by using LMTD and NTU methods.

Text Book (s)

1. R. C. Sachdeva (2005), Fundamentals of Heat and Mass Transfer, New AgeInternational (P) Ltd. ISBN: 978-8-122-40076-2.
2. P.K Nag, Heat and Mass Transfer, McGraw-Hill PublishingCompany Limited, ISBN: 9780070702530

Reference Book (s)

1. J. P. Holman (2005), Heat Transfer, 9th Edition, McGraw-Hill PublishingCompany Limited. ISBN: 978-0-070-29618-3.
2. Dewitt Lavine, Bergmann and Incropera (2010), Fundamentals of Heat andMass Transfer, 6th Edition, John Wiley & Sons, ISBN: 978-8-126-52764-9.

Course Content:

Unit I: Conduction – I	9 Hours
Basic concepts, conduction, convection and radiation, Laws, General equation of heat conduction, Derivation in Cartesian, cylindrical and spherical coordinates, One dimensional steady state heat conduction in simple geometries, plane wall, cylinder and sphere, Heat transfer composite walls, composite cylinders and composite spheres, Critical thickness of insulation, Thermal contact resistance, Overall heat transfer coefficient, Electrical analogy, Heat generation in plane wall, cylinder and sphere, Extended surfaces, general equations, types and applications of fins, Fin efficiency and effectiveness, Fin performance.	
Unit II: Conduction, II	**8 Hours**

Two and Three dimensional steady state heat conduction, Analytical, Graphical and Numerical methods, Conduction shape factor, Unsteady state heat conduction, Lumped parameter system, Non-dimensional numbers in conduction, Significance of Biot and Fourier numbers, Transient heat flow in semi-infinite solid, Use of Heisler and Grober charts.

Unit III: Convection **8 Hours**

Boundary layer theory, Conservation equations of mass, momentum and energy for laminar flow over a flat plate, Turbulent flow over a flat plate, Flow over cylinders, spheres, tube bank, Internal flow through pipes, annular spaces, Analogy between momentum and heat transfer, Natural convection in vertical, inclined and horizontal surfaces, Mixed convection, Dimensional analysis.

Unit IV: Condensation, Boiling and Radiation **8 Hours**

Condensation and Boiling, Film wise and drop wise condensation, Film condensation on a vertical plate, Regimes of Boiling, Forced convection boiling, Radiation heat transfer, Thermal radiation, Laws of radiation, Black body concept, Emissive power, Radiation shape factor, Gray bodies, Radiation shields.

Unit V: Heat Exchangers and Mass Transfer **7 Hours**

Heat Exchangers, Types and practical applications, Use of LMTD, Effectiveness, NTU method, Compact heat exchangers, Plate heat exchangers, Fouling factor, Heat pipes, Types and applications, Principle of Mass Transfer-Mass transfer by molecular diffusion, Fick's law of diffusion, Analogy of heat and mass transfer. Waste Heat recovery systems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Machine Design				
Course Code	BETM3013				
Prerequisite	BTME2008				
Corequisite	BTME3002				
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the design methodologies for various machine elements.
2. To understand the various standards and methods of standardization
3. To produce working drawings of the system involving shafts, couplings, joints and bearings.

Course Outcomes

CO1	Understand and implement the design process in machine elements.
CO2	Apply fatigue failure criteria in the analysis and design of mechanical components.
CO3	Design and analyze the power transmission in shafts and couplings carrying different elements under various loading conditions.
CO4	Design and analyze the permanent and detachable structural joints under various loading conditions.
CO5	Design and analyze the sliding and rolling contact bearings.

Text Book (s)

1. V.B. Bhandari (2010), Design of Machine elements, 3rd Edition, Tata McGraw Hill.ISBN: 978-0-070-68179-8.

2. V.B. Bhandari (2014), Machine Design Data Book, 1st Edition, Tata McGraw Hill. ISBN: 978-9-351-34284-7

Reference Book (s)

1.Joseph Edward Shigley and Charles, R. Mischke (2011), Mechanical Engineering Design, 9th Edition,McGraw –Hill International Editions, ISBN: 978-0-071-07783

Course Content:

Unit I: Introduction to Design Process **9 Hours**
Introduction to Design process – Factors – Materials selection direct - Bending and Torsional stress equation - Impact and Shock loading - - Factor of safety - Design stress - Theories of failures — Design of Levers, Problems.
Unit II: Fatigue strength and design of springs **9 Hours**
Stress concentration factor - Size factor -Surface limits factor ,Variable and cyclic loads – Fatigue strength – S- N curve – Continued cyclic stress – Soderberg and Goodman equations – Design of Helical – Leaf - Disc springs under Constant loads.
Unit III:Design of Shafts and Coupling **7 Hours**
Design of Shafts carrying various elements with geometrical featuresunder various loading conditions,Design and drawings of couplings – Rigid – Flexible

Unit IV:Design of Joints **9 Hours**
Design and Drawings of Cotter joints - Knuckle joints, Riveted joints, Welded joints and Screwed fasteners
Unit V: Design of bearings **6 Hours**
Design of sliding contact bearing using Sommerfield number – Design using Mckee'sequation – Selection of rolling contact bearings.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Applied Thermodynamics & HMT Lab**				
Course Code	**BTME3004**				
Prerequisite	BTME2002 Engineering Thermodynamics				
Corequisite	BTME3014 Applied Thermodynamics				
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

1. Identify the various parts of IC engines and explain its functions for running the engines.
2. Evaluate the performance characteristics of air compressor.
3. Study of the effect of forward, backward, curved and radial vanes of the centrifugal blower.

Course Outcomes

CO1	Examine the performance of compressors and blower.
CO2	Analyze the performance of vapour compression refrigeration system at different operating conditions.
CO3	Demonstrate the working of air-conditioner and its psychrometric test.
CO4	Calcualte the heat transfer co-efficient for free and forced convection.
CO5	Calculate the heat transfer coefficient for parallel flow, counter flow heat exchangers, and study the radiation heat transfer phenomenon.

LIST OF EXPERIMENTS

1. To find out the volumetric efficiency, isothermal power and isothermal efficiency of air Compressor.
2. To study the effect of forward, backward, curved and radial vanes and find out the discharge, head and overall efficiency of the centrifugal blower.
3. To study the different components of vapour compression refrigeration system.
4. To calculate the actual Coefficient of Performance of Vapour compression refrigeration cycle on VCR test Rig and compare with theoretical COP using p-h diagram.
5. To determine various psychrometric properties on Air conditioning test Rig.
6. To calculate total thermal resistance and thermal conductivity of composite wall.
7. To calculate the average heat transfer co-efficient of vertical cylinder under natural convection.
8. To calculate the heat transfer coefficient experimentally and theoretically for free and forced convection and compare the theoretical temperature distribution with experimentally obtained distribution.
9. To determine the value of Stefan-Boltzman constant for radiation heat transfer.
10. To study and compare temperature distribution, heat transfer rate, overall heat transfer coefficient in parallel flow and counter flow heat exchanger.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	**PBL -3 (Applied Thermodynamics)**				
Course Code	**BTME3005**				
Prerequisite	BTME2002				
Corequisite	BTME3001, BTME3003, BTME3004				
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

1. Assess the existing thermal/hydraulic design.
2. Suggest improvement to the design.
3. Test the improved design using Matlab/CFD/Fluent

Course Outcomes

CO1	Describe the thermal and hydraulic design process, including the concept of design constraints and the iterative nature of design.
CO2	Specify appropriate tools and their relevance to implement the project.
CO3	Develop/deliver work/concept in an environment friendly..
CO4	Interpret the results and justify the variation of results with system operation.
CO5	Carry out initial research on a real-world design task and present it effectively

Text Book (s)

1. Dewitt Lavine, Bergmann and Incropera (2010), Fundamentals of Heat andMass Transfer, 6th Edition, John Wiley & Sons, ISBN: 978-8-126-52764-9.1.

2. Yunus A. Cengel and Michael A. Boles, Thermodynamics, Engineering Approach, 6th Ed., McGrawHill, 2006.

Reference Book (s)

1. J. P. Holman (2005), Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited. ISBN: 978-0-070-29618-3.

Thrust areas of projects with tentative project titles

1. Design a new wall construction for renovation of old building by adding glass fiber insulation to the wood framed walls where no installation existed before. All insulating materials shall be designed and installed such that no vapor condensation shall occur in the building walls as a result of the insulation design. At your own initiative you decide to check if condensation will occur in the new wall construction of the buildings.

   The student should be able to answer:

a) What are the known facts and unknown relevant facts in this case?
b) Discuss the legality of what the engineering manager is suggesting.
c) Does it violate any professional codes (e.g. ASME, IS)?
d) Does it violate the engineer's conscience?
e) Develop positive and negative paradigms as well as problematic cases that would fall between them.
f) What are the possible choices of action for the engineer?
g) What are the consequences of the possible solutions?

h) Design alternate solutions to present to your engineering manager.

2. Rating of a heavy duty truck cooling system radiator
3. Pin fins of aluminium are to be compared in terms of their relative performance as a function of diameter. Three "pins" having diameters of 2, 5, and 10 mm with a length of 5 cm are exposed to a convection environment with T_∞ =20◦C, and h=40 W/m^2◦C. The base temperature is 200◦C. Develop a matlab code and plot the variation of heat transfer with pin diameter.
4. It is frequently represented that the energy savings resulting from installation of extra ceiling insulation in a home will pay for the insulation cost within a three-year period. You are asked to evaluate this claim. For the evaluation it may be assumed that 1 kW of electrical input to an air-conditioning unit will produce about 1.26×10^4 kJ/h of cooling and that electricity is priced at Rs. 8/kWh. Assume that an existing home has no ceiling insulation and is to be upgraded. Choose two alternative insulation materials from and calculate the allowable costs per unit volume of insulating material to accomplish the three-year payback with the two specified values. Make your own assumptions regarding (1) temperature difference between the interior of the house and the attic area and (2) the hours of operation for the air-conditioning system during an annual period. Comment on the results and assumptions.
5. A groundwater heat pump is a refrigeration device that rejects heat to the ground through buried pipes instead of to the local atmosphere. The heat rejection rate for such a machine at an Oklahoma location is to be 22 kW in a location where the ground temperature at depth is 17◦C. The thermal conductivity of the soil at this location may be taken as 1.6W/m· ◦C. Water is to be circulated through a length of horizontal buried pipe or tube with the water entering at 29◦C and leaving at 23.5◦C. The convection coefficient on the inside of the pipe is sufficiently high that the inner pipe wall temperature may be assumed to be the same as the water temperature. Select an appropriate pipe/tube material, size, and length to accomplish the required cooling. You may choose standard steel pipe sizes. Standard tubing or plastic pipe sizes are obtained from other sources. Examine several choices before making your final selection and give reasons for that selection.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	Applied Thermodynamics II				
Course Code	BTME3006				
Prerequisite	BTME2002 Engineering Thermodynamics, BTME3001 Applied Thermodynamics-I				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. Understand the working of internal combustion engines and their key components.
2. Evaluation of performance parameters affecting IC engine processes.
3. Perform cooling load calcutions and estimation.

Course Outcomes

CO1	Differentiate among different internal combustion engines and identify and assess the factors affecting normal and abnormal combustion
CO2	Evaluate the performance parameters and perform heat balance on different internal combustion engines.
CO3	Demonstrate knowledge of combustion and combustion chamber of SI and CI engine.
CO4	Apply the basic laws of thermodynamics in air and vapour compression refrigeration systems and evaluate the performance of refrigeration systems.
CO5	Identify the different psychometric processes and perform the cooling load calculations for air conditioning systems

Text Book (s)

1.Internal Combustion Engines, V. Ganesan (2008), , Tata McGraw-HillPublishing Company Ltd. ISBN: 978-0-070-64817-3.

2. Refrigeration and Air Conditioning , C.P Arora (2009), , Tata McGraw-HillPublishing Company Ltd. ISBN: 978-0-071-26756-4.

Reference Book (s)

1. Internal Combustion Engine Fundamentals, John B. Heywood McGraw-Hill Education; 2 edition (31 May 2018), ISBN-13: 978-1260116106
2. Refrigeration and Air Conditioning, P L Ballaney, Khanna Publisher. ISBN-13: 978-8174091369

Course Content:

Unit I: IC Engines	**9 Hours**
Construction and working of two stroke and four stroke engines – Fuel-air Cycle,Dissociation effect, Actual Cycle and its Analysis – Carburetor - Principle of Carburetion,Calculation of A:F ratio, Heat Rejection and Cooling – Piston and Cylinder temperaturedistribution, Parameters affecting engine heat transfer, Need and Characteristics of anefficient cooling system – Engine Friction and Lubrication – Blow by losses, Pumping loss,Factors affecting Mechanical friction, Properties of Lubricants, Crankcase ventilation.	
Unit II: Measurements and Performance of IC Engines	**7 Hours**

Measurement of friction power, Measurement of brake power, Measurement of emissions- Engine power, Engine efficiencies, Methods of improving engine performance, Heat balance,Engine performance characteristics, Supercharging, turbocharging.
Unit III: Combustion and Combustion Chambers 8 Hours
Combustion – Stages of combustion in SI engine, Flame front, Flame speed, Normal andabnormal combustion, Phenomenon of knock in SI engine, Combustion chambers for SIengines, Stages of combustion in CI engine, factors affecting delay period, Phenomenon ofknock in CI engine, Combustion chambers for CI engines.
Unit IV: Refrigeration 8 Hours
Reverse Carnot cycle, Bell-Colman cycle, Air craft refrigeration cycles, Vapor compressioncycle analysis - P-h and T-s diagrams, VCS Calculations, Effect of operating conditions, subcooling and super-heating, Refrigerants, Vapour absorption system – LiBr-water and NH3-water absorption systems, Cascdae systems.
Unit V: Psychrometry and Air Conditioning 8 Hours
Properties of moist air- Psychrometric properties, Psychrometric chart, Mixing process,Psychrometric processes in air-conditioning equipment – Summer and winter airconditioning – Cooling load calculations – SHF – RSHF – GSHF – ESHF.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Dynamics of Machines				
Course Code	BTME3008				
Prerequisite	BTME3002 Kinematics of Machines				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the concepts of turning moment diagrams, flywheel design and the dynamics of reciprocating engines.
2. To understand the balancing procedures for rotating and reciprocating masses, rotors and engines.
3. To understand the fundamentals of free and forced vibrations.
4. To understand the mechanisms for control.

Course Outcomes

CO1	Conduct dynamic force analysis of various systems.
CO2	Describe static and dynamic balancing of high speed rotary and reciprocating machines.
CO3	Analyze free and forced vibrations of machines, engines and structures.
CO4	Calculate the frequency of transverse and torsional vibration systems.
CO5	Calculate gyroscopic couple and its effect on various vehicles, and apply the concept of governors for speed control.

Text Book (s)

1. S.S. Rattan (2009), "Theory of Machines", 3rd Edition, Tata McGraw-Hill Publishing Company Ltd, ISBN: 978-0-070-14477-4.

Reference Book (s)

1. J. Uicker John, Gordon R. Pennock Jr., and Joseph E. Shigly (2009), Theory of Machines and Mechanisms, 3rd Edition, Oxford University Press, ISBN: 978-0-198-06232-5.
2. J. Peter Sadler and Charles E. Wilson (2008), Kinematics and Dynamics of Machinery, 3rdPearson Education, ISBN: 978-8-131-72022-6.
3. A. Ghosh (2009), Theory of Mechanisms and Machines, 3rd Edition, East-West Press Pvt. Ltd., New Delhi, ISBN: 978-8-185-93893-6.
4. T Thomson William, Dillon Dahleh Marie and PadmanabhanChandramouli (2008), Theory of Vibration with applications, 5th Edition, Pearson Education Publishers, ISBN: 978-8-131-70482-0.

Course Content:

Unit I: Dynamic Force Analysis	**8 Hours**
D'Alembert's principle – Equivalent offset inertia force – Dynamic analysis of four bar mechanism – Dynamic Analysis of reciprocating engines – Piston effort, Crank effort, Turning moment on crankshaft, Inertia of connecting rod – Inertia force in reciprocating engines (Graphical method). Turning moment diagrams – Single and multi cylinder engines – Fluctuation of energy – Fly Wheels – Applications in engines and punching presses.	
Unit II:Balancing	**8 Hours**

Static and Dynamic balancing of rotating masses – Balancing of reciprocating masses – Balancing of locomotives – Partial balancing of reciprocating masses – Multi cylinder Inline and radial engines.
Unit III: Vibration – Singh Degree of Freedom Systems 8 Hours
Introduction to vibration – Terminology – Classification of vibrations –Undamped and Damped free vibration of single degree of freedom systems – Viscous damping – Introduction to coulomb damping. Forced vibration – harmonic excitation – Magnification factor – Vibration isolation and Transmissibility.
Unit IV: Transverse and Torsional Vibration Systems 8 Hours
Transverse vibrations of shafts and beams – Rayleigh's and Dunkerley's method – Whirling of shafts. Torsional vibrations – Single rotor, two rotors and three rotors systems – Free vibration of geared systems.
Unit V: Mechanism for Control 8 Hours
Functions of Governors – Gravity controlled and Spring controlled governor characteristics. Stability – Hunting and Isochronisms. Effect of friction – Calculation of equilibrium speeds and ranges of speed of governors. Gyroscopic couple – Gyroscopic effects on the movement of air planes and ships – Stability of two wheel drive and four wheel drive – Gyroscope stabilization.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**CAM & Automation**				
Course Code	**BTME3009**				
Prerequisite	BTME3013 Machine Design				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To understand the importance use of computer hardware applied in an CAM environment.
2. To know about the NC and CNC machine and part programming to produce a component.
3. To get acquinted with automation of an industry and CIM.

Course Outcomes

CO1	Explain the input and output devices of a computer.
CO2	Prepare a program to produce a component on CNC mahines.
CO3	Group the parts produced into families so that he can arrange the machines accordingly.
CO4	Apply advanced concepts in computer integrated manufacturing.
CO5	Apply the knowledge gained in CAM and automation to suggest how to make an industry automated

Text Book (s)

1. Mikell P. Groover (2008), Automation, Production Systems and Computer Integrated Manufacturing, 3rd Edition, Pearson Education. ISBN: 978-8-120-33418-2.

Reference Book (s)

1. Ibrahim Zeid (2009), Mastering CAD/CAM, 2nd Edition, Tata McGraw Hill International Edition, ISBN: 978-0-070-15134-5.
2. P N Rao (2010), CAD/CAM Principles and Applications, 3rd Edition, Tata McGraw-Hill Education, ISBN: 978-0-070-68193-4.
3. James A. Rehg and Henry W. Kraebber (2004), Computer Integrated Manufacturing, 3rd Edition, Pearson Education, ISBN: 978-0-131-13413-3
4. Mikell P. Groover and Emory W. Zimmers (2003), CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall Edition, ISBN: 978-8-177-58416-5.

Course Content:

Unit I: Computer Hardware	**8 Hours**
Product Development Cycle – Introduction to CAM – Graphics input devices- cursor control devices, Digitizers, Scanners, speech oriented devices and touch panels, Graphics displaydevices – CRT, color CRT monitors, DVST, Flat- panel display, Graphics output Devices –Printers and Plotters – Graphics Standards – Neutral File formats – IGES, STEP.	
Unit II: CNC Machine Tools	**8 Hours**

Introduction to NC, CNC, DNC- Manual part Programming – Computer Assisted PartProgramming – Examples using NC codes- Adaptive Control – Canned cycles and subroutines –CAD / CAM approach to NC part programming – APT language, machining from 3D models.
Unit III: Group Technology, CAPP and FMS 8 Hours
Introduction to part families-parts classification and cooling – group technology machine cells-benefits ofgroup technology – Process Planning – CAPP & types of CAPP – Flexible manufacturing systems (FMS)– the FMS concept-transfer systems – head changing FMS – Introduction to Rapid prototyping,Knowledge Based Engineering.
Unit IV: Automation 8 Hours
Introduction to automation-Basic Elements of an Automated System, Advanced AutomationFunctions, Levels of Automation, Industrial Control Systems, Continuous Versus Discrete Control, Computer Process Control.
Unit V: Computer Integrated Manufacturing 8 Hours
CIM wheel – CIM Database- CIM-OSI Model– Networking Standards in CIM Environment –Network structure – Network architecture –TCP/IP, MAP – Virtual Reality, Augmented Reality-Artificial Intelligence and Expert system in CIM.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Dynamics of Machines Laboratory				
Course Code	BTME3010				
Prerequisite					
Corequisite	BTME3008 Dynamics of Machines				
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

1. To supplement the principles learnt in Kinematics and Dynamics of Machinery.
2. To understand how certain measuring devices are used for dynamic testing.

Course Outcomes

CO1	Calculate natural frequency of longitudinal vibration.
CO2	Determine torsional frequency of a single rotor system.
CO3	Measure the magnitude of gyroscopic couple in a motorized gyroscope.
CO4	Compare Tri–Filar / Bi-Filar system for determining moment of inertia of an object.
CO5	Calculate thecritical speed of a shaft and determine the performance characteristics of governors.

Text Book (s)

1.S.S. Rattan (2009), "Theory of Machines", 3rd Edition, Tata McGraw-Hill Publishing Company Ltd, ISBN: 978-0-070-14477-4.

Reference Book (s)

1.J. Uicker John, Gordon R. Pennock Jr., and Joseph E. Shigly (2009), Theory of Machines and Mechanisms, 3rd Edition, Oxford University Press, ISBN: 978-0-198-06232-5.

LIST OF EXPERIMENTS
1. To determine natural frequency of longitudinal vibration in spring mass system.
2. Determination of torsional frequency of a single rotor system.
3. To study nomenclature of cam and plotting the cam profile.
4. To determine gyroscopic couple on motorized gyroscope.
5. Comparative study of different types of clutches
6. To determine the frequency of un-damped free vibration of an equivalent spring mass system.
7. To perform experiment on Watt and Porter governors to determine performance
8. Comparative study of static and dynamic balancing in rotors.
9. To find out critical speed and to compare the whirling speed of a shaft.
10. To study TRI –FILAR / BI-FILAR System
11. Comparative study of different types of clutches

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	Energy systems and Technologies				
Course Code	BTME4001				
Prerequisite	BTME2002 Engineering Thermodynamics, BTME 2009 Fluid Mechanics				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To apply knowledge of basic laws of thermodynamics to compressors.
2. Describe the operating characteristics of hydraulic machinery (pumps and turbines), and the factors affecting their operation and specifications, as well as their operation in a system..
3. To understand the working of key components of conventional and non conventional power plants.

Course Outcomes

CO1	Calculate the thermal efficiencies of blowers and compressors, and identify the common problems in compressor working.
CO2	Evaluate the pump output and efficiencies of different hydraulic pumps.
CO3	Explain working of hydraulic turbines and its perfromance evaluation.
CO4	Demonstrate conventinal power generation systems and their components.
CO5	Demonstrate non conventinal power generation systems and their components.

Text Book (s)

1. S. S. Rattan (2011), Fluid Mechanics and Hydraulic Machines, Khanna Publishers, ISBN: 978-8-187-52246-1.
2. R. K. Rajput, (2008), A Text Book of Power Plant Engineering, 4th Edition Laxmi Publications (P) Ltd. ISBN: 978-81-318-0255-7.

Reference Book (s)

1. S.M. Yahya, (2010), Turbine, Fans and Compressors, TMH, 2010
2. P.K. Nag, Power Plant Engineering, Tata McGraw-Hill Publishing Company Ltd., ISBN: 9789339204044.

Unit I: Fans, Blowers and Compressors	**9 Hours**
Construction details of Centrifugal fans, blowers and compressors, stage work, Stage pressure rise, Stage pressure co-efficient, Stage efficiency, Degree of reaction, Various slip factors, h-s diagram for centrifugal compressor. Axial flow Fans and Compressors, Stage velocity triangles, Blade loading and flow co- efficient, Static pressure rise, h-s diagram, Degree of reaction, Work done factors, Free and Forced Vortex flow performance, Stalling and Surging. Construction details of Reciprocating compressors, working, Effect of clearance volume, Multi staging, Volumetric efficiency, Isothermal efficiency.	
Unit II: Hydraulic Pumps	**8 Hours**

Centrifugal pumps, Work done, Head developed, Pump output and Efficiencies, priming, minimum starting speed, performance of multistage pumps, cavitation and methods of prevention, Pump characteristics, Constructional details of axial flow pumps, characteristics, Non-dimensional parameters, Efficiencies, Reciprocating pumps, Work done and efficiency, Vibration and Noise in hydraulic pumps.
Unit III: Hydraulic Turbines 9 Hours
Classification of hydraulic turbines, Pelton wheel, Francis turbine, Kaplan and Propeller turbines, Velocity triangles, Specific speed, Theory of draft tube, Governing, Performance characteristics, Selection of turbines.
Unit IV: Introduction to power plants 8 Hours
Classification, Selection of site, Steam power plants – Fire tube and Water tube boilers, Feed water treatment, Cooling Tower, Pulverized coal firing systems, Electrostatic precipitator, Nuclear power plants – working principle and basic components, pressurized water reactor, Hydro power plants – basic components, function and details of Reservoirs, Dam, Trash Rack, Forebay, Surge Tank, Penstock, Spillway, Prime Mover and Generator, Draft Tube.
Unit V: Non Conventional Power Plants 6 Hours
Introduction to Non Conventional energy resources, Basic Components of Solar power plant, principle and working, Basic Components of Wind power plant, principle and working.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Operations Research				
Course Code	BTME4002				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide students the knowledge of optimization techniques and approaches.
2. To enable the students to apply mathematical, computational and communication skills needed for the practical utility of Operations Research.

Course Outcomes

CO1	Apply operations research techniques in industrial optimization problems.
CO2	Calculate transportation problems using various operation research methods
CO3	Evaluate project using PERT and CPM techniques
CO4	Demonstrate various inventory models used in industries.
CO5	Illustrate the use of queuing models in practical applications and develop the basic knowledge game theory

Text Book (s)

1. Kanti Swarup, P.K. Gupta and Manmohan Lal (2010), Operations Research, 15th Edition, S.Chand & Sons, ISBN: 978-8-180-54771-3.
2. H. M. Wagner (2009), Principles of Operation Research, 2nd Edition, Prentice Hall of India Ltd ISBN: 978-8-120-30162-7.

Reference Book (s)

1. Hamdy Taha, (2008), Operations Research-An Introduction, 8th Edition, Pearson Education, ISBN: 978-8-131-71104-0.
2. R. Panneerselvan (2006), Operations Research, 2nd Edition, Prentice Hall of India Pvt Ltd ISBN: 978-8-120-31743-7.
3. J. K. Sharma (2013), Operations Research, 5th Edition, Macmillan Publications, ISBN: 978-9-350-59336-3.

Course Content:

Unit I: Linear programming problems	**10 Hours**
Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Two Phase Simplex method – Big M Method – Duality	
Unit II: Transportation and Assignment problems	**8 Hours**
Transportation problems – Least cost method – Northwest Corner method – Vogel's Approximation method – MODI method – Transhipment problems, Assignment problems.	
Unit III: Sequencing and Network Models	**8 Hours**

Sequencing –Problem with N jobs and 2 machines using Johnson's method, Problems with N jobs - 3 machines and 'M' machines.using modified Johnson's method Network Models – Basic Concepts – Construction of Networks – CPM and PERT – Crashing of Network.
Unit IV: Inventory Models **6 Hours**
Deterministic Inventory Models – Various Costs and Concepts–EOQ–Deterministic inventory models with instenteneous production and finite rate of production.
Unit V: Queuing Models and Game Theory **8 Hours**
Queuing models – Characteristics of Queuing Model, M/M/1 & M/M/S system, cost consideration Game theory – Two person zero sum game – Graphic solution - Property of dominance – Algebraic solution

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Energy systems Laboratory**				
Course Code	**BTME4004**				
Prerequisite					
Corequisite	BTME4001 Energy system and Technologies				
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

COURSE OBJECTIVES

1. To impart the practical knowledge about the performance characteristics of pumps and turbines.
2. To impart knowledge of boilers.

Course Outcomes

CO1	Carryout the performance analysis of reciprocating pump.
CO2	Carryout the performance analysis of centrifugal pump.
CO3	Predict the efficiency of hydraulic turbines.
CO4	Explain the working of water and fire tube boilers.
CO5	Prepare a heat balance sheet by conducting the morse test

LIST OF EXPERIMENTS
1. To study the performance characteristics of Centrifugal pump
2. To study the performance characteristics of reciprocating pump.
3. To study the performance characteristics of Pelton wheel turbine
4. To study the performance characteristics of Francis turbine
5. To study the performance characteristics Kaplan turbine.
6. To study construction and working of water tube boiler.
7. To study construction and working of fire tube boiler.
8. To prepare heat balance sheet.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
50	--	50	100

Name of The Course	**Project Work I**				
Course Code	**BTME9998**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	0	3

Course Objectives:

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to mechanical engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes

CO1	Explore as a team, the fundamentals, domain knowledge and skills in engineering to identify / conceive a problem.
CO2	Analyze and outline the various aspects of complex engineering systems to formulate the problem.
CO3	Select appropriate methodology using critical and creative thinking and design subsystems / systems.
CO4	Develop a functional product prototype highlighting its utility to society, environment, safety and address ethical concerns.
CO5	Present and demonstrate the product to peers, academicians, general and industry community.

CATALOGUE DESCRIPTION

The project work can be an investigative analysis of a technical problem in the relevant area, planning and/or design project, experimental project or computer application based project on any of the topics. Each project group will submit abstract of the project within three weeks from start of seventh semester. Project evaluation committee consisting of three or four faculty members specialized in the various fields of department, shall study the feasibility of each project work before giving consent.

COURSE CONTENT

The project group consisting of not more than four members is expected to fix any topic of mechanical engineering domain and complete preliminary studies like literature review, recent developments, description of a problem etc. in this semester. This work will be continued as a Project Work II during eighth semester.

Mode of Evaluation

The evaluation committee shall consist of faculty members constituted by the Dean of School which will comprise of at least three members comprising of the Division Chair/Program Chair a nominee of the Dean. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Dean. There will not be more than three students for a group for such project submission.

The assessment of all the projects should be done at the end of the seventh semester by the project evaluation committee formed. The students will present their project details and progress of their project to the committee.

The complete project report is not expected at the end of the seventh semester. However, a three-four page typed report based on the work done should be submitted by each student to the assessing committee.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

Name of The Course	**Project Work II**				
Course Code	**BTME9999**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	-	9

Course Objectives:

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes

CO1	Implement the design using advanced engineering tools
CO2	Test and validate the proposed solution
CO3	Collect and interpret results ensuring that the concerns of utility to society, environment, safety and ethical issues are addressed
CO4	Compare performance with existing similar systems
CO5	Present and demonstrate the product to peers, academicians, general and industry community

CATALOGUE DESCRIPTION

The project work can be an investigative analysis of a technical problem in the relevant area, planning and/or design project, experimental project or computer application based project on any of the topics. The problem description done on the seventh semester shall be continued in this semester and solved with various tools or techniques needed for the project work.

COURSE CONTENT

Project work II is expected to be completed in the eighth semester with each student group consisting of not more than five members is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project groups are expected to solve the problem chosen on Project Work I with various tools or techniques required for the project work.

Mode of Evaluation

The evaluation committee shall consist of faculty members constituted by the Dean of School which will comprise of at least three members comprising of the Division Chair/Program Chair a nominee of the Dean. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Dean. There will not be more than three students for a group for such project submission.

The assessment of all the projects should be done at the end of the eighth semester by the project evaluation committee formed. The students will present their project details and progress of their project to the committee. The complete project report based on the work done should be submitted by each student to the assessing committee.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	--	50	100

ELECTIVE SUBJECTS

Name of The Course	**Automobile Engineering**				
Course Code	**BTME3051**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To broaden the understanding of students in the structure of vehicle chassis and engines.
2. To introduce students to steering, suspension, braking and transmission systems.
3. To introduce students to engine auxiliary systems like heating, ventilation and air-conditioning and also the importance of alternate fuels.

Course Outcomes

CO1	Demonstrate the knowledge of components of different automobile systems.
CO2	Identify different fuel supply and injection systems, and link emissions with them.
CO3	Perform the study of clutch and relate with modern transmission systems.
CO4	Classify suspension, steering and braking systems.
CO5	Illustrate the working of modern automobile equipments/systems.

Text Book (s)

1. William.H.Crouse (2006), Automotive Mechanics, 10th Edition, McGraw-Hill, ISBN: 978-0-07-063435-0.
2. Kirpal Singh (2011), Automobile Engineering, 12th edition, Standard Publications, ISBN**:** 978-8-180-14177-5.

Reference Book (s)

1. Joseph Heitner (1999), Automotive Mechanics: Principles and Practices, 2nd edition, Affiliated East West Pvt. Ltd, ISBN: 978-8-176-71015-2.
2. Bosch Automotive Hand Book (2007), 8th Edition, SAE Publications, ISBN: 978- 0-7680-4851-3.
3. K. Newton and W. Steeds (2001), The motor vehicle, 13th Edition, Butterworth-Heinemann Publishing Ltd, ISBN: 978-0-080-53701-6

Course Content:

Unit I: Introduction to Vehicle Structure and Alternate Fuels **8 Hours**
Vehicle construction, Chassis and body, Specifications, Engine, Types, Construction, Location of engine, Cylinder arrangement, Construction details, Cylinder block, Cylinder head, Cylinder liners, Piston – piston rings, Piston pin, Connecting rod, Crankshaft, Valves. Lubrication system, Types, Oil pumps, Filters, Cooling system, Types, Water pumps, Radiators, Thermostats, Anti-freezing compounds, Ignition system
Unit II: Ignition, Fuel Supply and Emission Control System **8 Hours**

Coil and Magneto, Spark plug, Distributor – Electronic ignition system, Fuel system, Carburetor, Fuel pumps, Fuel injection systems, Mono point and Multi point – Module injector – Nozzle types, Electronic Fuel Injection system (EFI), Automobile Emissions, Source of formation – Effects on human health and environment, Control techniques, Exhaust Gas Recirculation (EGR), Catalytic converter, Emission tests and standards (Indian and Europe).

Unit III: Transmission System **8 Hours**

Clutches, Function, Types, Single plate, Multiple plate and Diaphragm Clutch, Fluid coupling, Gearbox, Manual, Sliding, Constant, Synchromesh, Overdrive, Automatic transmission, Torque converter, Epicylic and Hydromatic transmission, Continuously variable transmission, Universal joint, Propeller shaft, Hotchkiss drive – Final drive, Rear axle assembly, Types,Differential, Need, Construction – Non-slip differential – Differential locks, Four wheel drive.

Unit IV: Steering, Suspension and Braking System **7 Hours**

Principle of steering, Steering Geometry and wheel alignment, Steering linkages – Steering gearboxes, Power steering, front axle, Suspension system, Independent and Solid axle – coil, leaf spring and air suspensions, torsion bar, shock absorbers, Wheels and Tires, Construction, Type and specification, Tire wear and causes, Brakes, Needs – Classification –Drum and Disc Mechanical, Hydraulic and pneumatic, Vacuum assist – Retarders

Unit V: Instrumentation and Advances in Automobile Engineering **9 Hours**

Dash board instrumentation, Passenger comfort , Safety and security, HVAC, Seat belts, Air bags, Automotive Electronics, Electronic Control Module (ECU), Common-Rail Diesel Injection (CRDI) – Multipoint fuel injection system(MPFI), Gasoline Direct Injection (GDI), Variable Valve Timing (VVT), Active Suspension System (ASS), Anti-lock Braking System (ABS), Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP) Traction Control System (TCS), Global Positioning System (GPS), X-by-wire, Electric, Hybrid vehicle

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Robotics				
Course Code	BTME3052				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To get acquainted with constructional features and other basic information on robotics.
2. To know about the sensors used in robotics.
3. To learn robot programming of a typical robot and also the concepts of path planning and applications.

Course Outcomes

CO1	Explain the basics of robotics.
CO2	Explain the control system of robot.
CO3	Evaluate the importance of sensing system in robot.
CO4	Write code for robot program.
CO5	Apply economic measures to justify the advantages of robots in industry.

Text Book (s)

1.Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, (2010), Robotic Engineering An Integrated Approach, 1st Edition, Prentice-hall of India. ISBN: 978-8-120-30842-8

Reference Book (s)

1. John J. Craig (2008), Introduction to Robotics: Mechanics and Control, 3rd Edition, Pearson Education. ISBN: 978-8-131-71836-0.
2. S. R. Deb and Sankha Deb (2009), Robotics Technology and Flexible Automation, 2nd Edition, Tata McGraw-Hill Education. ISBN: 978-0-070-07791-1.
3. Robert Joseph Schilling (2007), Fundamentals of Robotics: Analysis and Control, Prentice Hall India. ISBN: 978-8-120-31047-6.

Course Content:

Unit I: Introduction	**8 Hours**
Definition of a Robot – Basic Concepts –Robot configurations – Types of Robot drives – Basic robot motions – Point to point control – Continuous path control.	
Unit II: Components and Operation	**8 Hours**
Basic control system concepts – Control system analysis – Robot actuation and feed back - Manipulators – direct and inverse kinematics - Coordinate transformation – Brief Robot dynamics. Types of Robot and Effectors – Robot/ End – Effector interface.	
Unit III: Sensing and Machine Vision	**6 Hours**
Range sensing – Proximity sensing –Touch sensing – Force and Torque sensing. Introduction to Machine vision – Sensing and Digitizing – Image processing and analysis.	

Unit IV: Robot Programming **6 Hours**
Methods – Languages – Capabilities and limitation – Artificial intelligence – Knowledge representation –Search techniques in A I and Robotics.
Unit V: Industrial Applications **6 Hours**
Application of robots in machining – Welding – Assembly – Material handling –Loading and Unloading – CIM – Hostile and Remote environments.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Computational Fluid Dynamics				
Course Code	BTME3053				
Prerequisite	BTME2009 Fluid Mechanics BTME3003 Heat and Mass Transfer				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the mathematical basis and evolution of the governing equations of fluid flow and heat transfer.
2. To solve one and two-dimensional partial differential equations using traditional CFD tools.
3. To learn meshing methods and intricacies and techniques of discretization.
4. To apply the various finite differencing schemes to CFD problems.
5. To learn the algorithms for standard CFD problems.

Course Outcomes

CO1	Explain CFD techniques, basic aspects of discretization and grid generation.
CO2	Solve fluid flow fields using CFD methods.
CO3	Model fluid flow and heat transfer problems.
CO4	Demonstrate the type of fluid flow that is occurring in a particular physical system and to use the appropriate model equations to investigate the flow.
CO5	Demonstrate the real fluid-flow system and its simplified model problem.

Text Book (s)

1.J.D. Anderson, Jr., (2012), Computational Fluid Dynamics – The basics with applications, McGraw-Hill, ISBN: 978-1-259-02596-9.

Reference Book (s)

1. John D. Ramshaw (2011), Elements of Computational Fluid Dynamics, Imperial College Press. ISBN: 978-1-848-16695-0.
2. Oleg Zikanov (2010), Essential Computational Fluid Dynamics, John Wiley & Sons. ISBN: 978-0-470-42329-5.

Course Content:

Unit I: Introduction and Governing Equations	**8 Hours**
Introduction, Impact and applications of CFD in diverse fields, Governing equations of fluid dynamics – Continuity, Momentum and energy, Generic integral form for governing equations, Initial and Boundary conditions, Classification of partial differential equations – Hyperbolic, Parabolic, Elliptic and Mixed types, Applications and relevance.	
Unit II: Discretization	**8 Hours**

Basic aspects of discretization, Discretization techniques – Finite difference, Finite volume and Finite Element Method– Comparison of discretization by the three methods, Introduction to Finite differences, Difference equations, Uniform and non-uniform grids, Numerical errors, Grid independence test, Optimum step size.
Unit III: Grid Generation and Transformation 8 Hours
Grid generation – Transformation of non-uniform grids to uniform grids, General transformation of the equations, Form of the governing equations suitable for CFD, Compressed grids, Boundary fitted co-ordinate systems – Elliptic grid generation, Adaptive grids, Modern developments in grid generation.
Unit IV: Numerical Heat Transfer 8 Hours
Steady one-dimensional, two and three-dimensional conduction, Steady one-dimensional convection and diffusion, Transient one-dimensional and two-dimensional conduction – Explicit, Implicit, Crank-Nicolson, ADI scheme – Stability criterion.
Unit V: Calculation of Flow Field 8 Hours
Discretization of convection, Diffusion – Central difference, upwind, hybrid and power law schemes, Representation of the pressure, Gradient term and continuity equation – Staggered grid, Momentum equations, Pressure and velocity corrections, Pressure Correction equation, Numerical procedure for SIMPLE algorithm, Boundary conditions for the pressure correction method. Stream function – Vorticity method, Discussion of case studies.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Welding Technology				
Course Code	BTME3054				
Prerequisite	BTME2003, Manufacturing Processes I				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the principles and applications of various types of welding processes.
2. To know about the different types of advanced joining processes of solid state welding and special welding processes.
3. To be aware of metallurgical aspects of welding.

Course Outcomes

CO1	Describe concepts of various types of welding.
CO2	Select a particular type of power source to be applied for welding for the given applications.
CO3	Explain apply commonly used fusion as well as solid state welding processes.
CO4	Explain special welding techniques and their specific applications.
CO5	Select proper welding technique for joining of two pieces for the given application.

Text Book (s)

1. Cornu. J (2007), Advanced Welding Systems, Volumes I, II and III, 3rd Edition, Affiliated Springer Publishers, ISBN: 978-3-540-18757-8.

Reference Book (s)

1. L. F. Lancaster (1986), The Physics of Welding, 2nd Edition, Affiliated Pergamum Press ISBN: 978-0-080-34076-0.
2. American Welding Society, Welding Handbook, 8th Edition, Affilated Misc.ISBN: 978-0-871-71281-3.
3. R. S. Parmer (2011), Welding processes and Technology, 3rd Edition, Affilated Khanna publishers.ISBN: 978-8-174-09126-0.
4. N. K. Srinivasan (2012), Welding Engineering, 4th edition, Affiliated Khanna Publishers. ISBN: 978-8-174-09159-8.
5. P. N. Rao (2008), Manufacturing Technology (Foundry, Forming and Welding) II 3rd Edition, Affiliated Tata McGraw Hill Pub. Co. Ltd, New Delhi.ISBN: 978-0-070-08798-9.

Course Content:

Unit I: Power sources	**8 Hours**
Classification of welding processes, Heat sources, Power sources, Arc characteristics, V-I relationship, Different types of electrodes, Ingredients and function of electrode coverings, Types of weld joints.	
Unit II: Fusion welding processes	**8 Hours**

Shielded metal arc welding, gas welding, TIG welding, MIG welding, Submerged arc welding processes.
Unit III: Solid state welding processes **8 Hours**
Resistance, Friction, Friction stir, Ultrasonic, Induction, Pressure, Diffusion welding processes, Explosive welding.
Unit IV: Special welding processes **8 Hours**
Electron beam, laser beam welding, plasma arc processes; advantages, limitations, Introduction to Robotic welding, underwater welding.
Unit V: Welding metallurgy **8 Hours**
Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of different materials, defects in welds, their causes and remedies.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Supply Chain Management				
Course Code	BTME3055				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To develop an understanding of how to manage the supply chain partners.
2. To learn how to manage logistics functions.
3. To learn about the current trends in supply chain management.

Course Outcomes

CO1	Explain basic terminology and supply chain operations in the context of today's business environment.
CO2	Make efficient decision about sourcing of supply chain.
CO3	Design supply chain networks.
CO4	Plan for risks and uncertainties in managening the supply chain.
CO5	Utilize current trends in supply chain management.

Text Book (s)

1. Supply Chain Management by S. Chopra and P. Meindl, Prentice Hall, 2010 (4th Edition)

Course Content:

UNIT I INTRODUCTION **8 Hours**
Supply Chain – Fundamentals –Evolution- Role in Economy Supplier- Manufacturer-Customer chain. - Enablers/ Drivers of Supply Chain Performance. Supply chain strategy - Supply Chain Performance Measures.
UNIT II STRATEGIC SOURCING **8 Hours**
Make Vs buy - Identifying core processes - Market Vs Hierarchy - Make Vs buy continuum -Sourcing strategy - Supplier Selection and Contract Negotiation. Creating a world class supply base- Supplier Development.
UNIT III SUPPLY CHAIN NETWORK **8 Hours**
Network Design – Role - Factors Influencing Options, Value Addition – Distribution Strategies - Models for Facility Location and Capacity allocation. Distribution Center Location Models. Supply Chain Network optimization models.
UNIT IV PLANNING INVENTORY AND SUPPLY **8 Hours**
Managing supply chain cycle inventory. Uncertainty in the supply chain –- Analysing impact of supply chain redesign on the inventory - Risk Pooling - Managing inventory for short life - cycle products -multiple item - multiple location inventory management. Pricing and Revenue Management.

UNIT V CURRENT TRENDS	**8 Hours**
Supply Chain Integration - Building partnership and trust in SC Value of Information: Bullwhip Effect - Effective forecasting - Coordinating the supply chain. . SC Restructuring - SC Mapping - SC process restructuring, Postpone the point of differentiation – IT in Supply Chain - Agile Supply Chains -Reverse Supply chain.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Product Design				
Course Code	BTME3056				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To acquire skills to design and develop products in a structured way.
2. To get aware with general design principles for manufacturability.
3. To understand the incorporation of ergonomics in product design.

Course Outcomes

CO1	Explain product development process and review design of existing product considering reliability.
CO2	Design a product according to requirement of market.
CO3	Evaluate the existing design on the basis of strategies.
CO4	Use DFMA software for product development.
CO5	Incorporate the ergonomics into the product design.

Text Book (s)

1. Karl T. Ulrich and Steven D. Eppinger (2009), Product Design and Development, 4th Edition, Tata McGraw-Hill Publishing Company Limited, ISBN: 978-0-070-14679-2.

Reference Book (s)

1. Stephen C. Armstrong (2005), Engineering and Product development Management– The Holostic Approach, Cambridge University Press, ISBN: 978-0-521-01774-9.
2. IbrahimZeid (2006), Mastering CAD/CAM, 2nd Edition, Tata McGraw-Hill, ISBN: 978-0-070-63434-3.
3. Anoop Desai, Anil Mital and Anand Subramanian (2007), Product Development: A Structured Approach to Consumer Product Development, Design, and Manufacture, 1st Edition, Butterworth-Heinemann, ISBN: 978-0-750-68309-8.

Course Content:

Unit I: New Product development	**8 Hours**
Product development – Trends– Best practices– Product development process and organizations – Collaborative product development – Time compression Technologies – risk management – Stages of Product development. Conceptual / Industrial / Engineering design. Design analysis and validation.	
Unit II: Conceptual design	**8 Hours**
Early design – Customer needs – Requirement Definition and Conceptual design – Optimization using cost and utility metrics – Trade-off analysis- models and parameters- design to cost – Design to Life cycle cost – Design for warranties- problem solving – Benchmarking.	

Unit III: Evaluation	**8 Hours**
Detailed design – Analysis and modeling – Best practices for detailed design – Design analyses – Prototypes in detailed design – Test and Evaluation – Design review, prototyping – simulation and testing – Manufacturing – Strategies – planning and methodologies.	
Unit IV: Design for Manufacture and assembly	**8 Hours**
General design principles for manufacturability – strength and mechanical factors, mechanism selection- process capability – Feature tolerances – Geometric tolerances – Assembly limits – Datum features – Tolerance stacks – Problems on tolerancing – Exposure on DFMA software.	
Unit V: Design for X	**8 Hours**
Simplification – commonality and preferred methods – Modularity and scalability – part reduction – functional analysis and value engineering – Reliability – Strategies and practices – Testability – Design for test and inspection. Design for people – Ergonomics, Reparability, Maintainability, safety and product liability.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Advanced Machining Processes				
Course Code	BTME3057				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the principles of material removal mechanism of advanced machining processes such as mechanical, electro-chemical and thermal.
2. To get in depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine material.
3. To become aware of advanced finishing processes to achieve submicron/nano surface finish.

Course Outcomes

CO1	Identify and suggest the suitable manufacturing process for advanced materials and critical finishing.
CO2	Describe and use Electro chemical machining process for making a job
CO3	Describe the Electric Discharge Machining process and select its machining parameters to be used to machine a component
CO4	Select a proper process for a given application such as IBM, EBM, PAM.
CO5	Explain about advanced finishing processes like AFM and MAF.

Text Book (s)

1.V. K. Jain (2004), Advanced Machining Processes, 1st Edition, Affilated Allied Publishers. ISBN: 978-8-177-64294-0.

Reference Book (s)

1. Hassan El-Hofy (2005), Advanced Machining Processes, 1st edition Affilated McGraw-Hill. ISBN: 978-0-071-45334-9.
2. Gary F. Benedict (1987), Nontraditional Machining Processes, 1st Edition, Affilated CRC press. ISBN 082-4-773-527.
3. M. Adithan (2008), Modern Machining Methods, 1st Edition, Affilated Khanna Publishers New Delhi. ISBN: 978-8-174-09225-0.
4. K. P. Mishra (2006), Nonconventional Machining, Edition 1st , Affilated Narosa Publishing House. ISBN: 978-8-173-19138-1.
5. C. P Pandy and H. S. Shan (1980), Modern Machining Processes, Edition 1st, Affilated Tata McGraw Hill Publishing Company Ltd., New Delhi.ISBN: 978-0-070-96553-9.

Course Content:

Unit I: Mechanical Advanced Machining Processes **8 Hours**
Need and classification of nontraditional machining processes – Material removal in traditional and nontraditional machining processes - considerations in process selection. Ultrasonic machining – Working principle, mechanism of metal removal – Theory of Shaw, elements of the processes, tool feed mechanism, effect of parameters, applications and numerical. Abrasive jet machining, Water jet machining and abrasive water jet machine - Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations.

Unit II: Electro – Chemical Processes	**8 Hours**
Principle of ECM process, chemistry of the ECM processes, Parameters of the process, determination of the metal removal rate, dynamics of ECM process, polarization, tool design, advantages and disadvantages, application, electrochemical grinding, electrochemical honing, electrochemical deburring, Application of ECM for deep hole drilling - electrostream drilling and shaped tube electrolytic machining. Chemical machining - Fundamental principle, types of chemical machining, maskants, etchants, advantages, disadvantages, applications.	
Unit III: Electric Discharge Machining	**8 Hours**
Working principle of EDM, Power circuits for EDM - RC pulse generator and controlled pulse generator– Analysis of R-C Circuits – Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface and recent development in EDM. Wire EDM – Working principle, process variables, process characteristics and applications. Electric discharge grinding and electric discharge diamond grinding - working principle, process capabilities and applications.	
Unit IV: Laser, Electron Beam, Ion Beam and Plasma Arc Machining	**8 Hours**
General working principle of laser beam machining – Generation of Laser, types of Lasers, process characteristics and applications. Electron Beam Machining - Equipment for production of Electron Beam, theory of EBM, thermal and non-thermal type, process characteristics and applications. Ion Beam Machining - Mechanism of metal removal and associated equipments, process characteristics and applications.Plasma Arc Machining - Metal removal mechanism, process parameters, process characteristics, types of torches, applications.	
Unit V: Advanced Finishing Processes	**8 Hours**
Abrasive flow Machining (AFM) - working principle, AFM system, process variables, process performance and applications. Magnetic abrasive finishing (MAF) - working principle, MAF system, material removal and surface finish, process variables and applications. Chemomechanical polishing, working principle, material removal and surface finish and applications.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Mechatronics				
Course Code	BTME3058				
Prerequisite	BEE1002 Basic Electrical and Electronics Engineering				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce integrated approach to the design of complex engineering systems.
2. To provide knowledge of sensors, actuators and their selection for an application.
3. To expose interfacing of devices with controllers.

Course Outcomes

CO1	Identify the elements of mechatronics system.
CO2	Select suitable sensors, actuators and controllers to meet specific requirements.
CO3	Implement control action based on Microprocessor based Controllers
CO4	Write PLC programs for effective control
CO5	Handle advanced topics in mechatronics systems involving artificial intelligence

Text Book (s)

1. W. Bolton (2008), Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering, 4th Edition, Prentice Hall. ISBN: 978-0-273-74286-9.

Reference Book (s)

1. Devdas Shetty and Richard A. Kolk (2012), Mechatronics System Design, 2nd Edition, C. L. Engineering, ISBN: 978-8-131-51828-1.
2. Michael B. Histand and David G. Alciatore (2005), Introduction to Mechatronics and Measurement systems, McGraw-Hill. ISBN: 978-0-070-64814-2
3. B.P. Singh (2006), Advanced Microprocessor and Microcontrollers, New Age International Publisher.ISBN: 978-8-122-41956-6.
4. A. Smaili and F. Mrad (2008), Mechatronics: Integrated Technologies for Intelligent Machines, 1st Edition, Oxford University Press. ISBN: 978-0-198-06016-1.

Course Content:

Unit I: Introduction to Mechatronics **8 Hours**
Introduction to Mechatronics – Conventional and Mechatronics approach in designing products – Mechatronics design process – Mechatronics in manufacturing – Adaptive and distributed control systems – Modeling and simulation of Mechatronics Systems
Unit II: Sensors and Actuators **8 Hours**
Overview of sensors and transducers – Microsensors – Signal conditioning – Operational amplifiers – Protection – Filtering – Analog and Digital converters. Electro-pneumatics and Electro-hydraulics – Solenoids – Direct Current motors – Servomotors – Stepper motors – Micro actuators – Drives selection and application.

Unit III: Microprocessor based Controllers **8 Hours**
Architecture of microprocessor and microcontroller – System interfacing for a sensor, keyboard, display and motors – Application cases for temperature control, warning and process control systems.
Unit IV: Programmable Logic Controllers **8 Hours**
Architecture of Programmable Logic Controllers – Input/Output modules – Programming methods – Timers and counters – Master controls – Branching – Data handling – Analog input/output – Selection of PLC and troubleshooting.
Unit V: Intelligent Mechatronics and Case Studies **8 Hours**
Fuzzy logic control and Artificial Neural Networks in mechatronics – Algorithms – Computer-based instrumentation – Real-time Data Acquisition and Control – Software integration – Man-Machine Interface – Vision system – Mechatronics system case studies.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Project Management				
Course Code	BTME3059				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To acquaint students with basic concepts of the Project Management and its uses in real life situation, the formulation of the problems and basic insight of Capital Budgeting decision.
2. To be able to recognize and analyse the Market – Demand & Supply factors affecting the Project Execution and study risk factors associated with Project Management.
3. To know how to plan, organize and control the resources to achieve specific goals.

Course Outcomes

CO1	Explain basic concepts of the Project Management and its uses in real life situation.
CO2	Take decisions about Capital Budgeting.
CO3	Analyze the Market – Demand & Supply factors affecting the Project Execution.
CO4	Select the risk factors associated with Project Management.
CO5	Plan, organize and control the resources to achieve specific goals.

Text Book (s)

1. Project Management, Prasanna Chandra, Mc. Graw Hill

Reference Book (s)

1. Project Management, S Chaudhry, Tata Mc. Graw Hill.
2. Total Quality Management, P.K. Joy, Macmillan Indian Ltd.
3. Project Finance, H.R. Machiraju, Vikas Publishing House
4. Project Management in Practice, Meredith, Jack R., Sutton, Margaret M., Shafer, Scott M., Wiley.

Course Content:

Unit I: Introduction to Project Management **8 Hours**
Introduction to Project Management, Uses, scope and applications of Project Management in managerial decision-making, Characteristics of Projects, Classification of Projects: National & International, Project Management: Tools and Techniques, Roles and Responsibilities of Project Manager, Project Life cycle, Project Selection Process.
Unit II: Capital Expenditure Decisions **8 Hours**
Meaning and features of capital budgeting decisions, Importance of capital budgeting decisions, Kinds of capital expenditure decisions, Capital expenditure budgeting process, Criteria of capital budgeting, Resource allocation framework and budgeting difficulties.
Unit III: Market Demand Analysis **8 Hours**

Information required for marketing and demand analysis, Information required for marketing and demand analysis, Secondary sources of information, Market survey, Demand forecasting, Uncertainties in demand forecasting, Coping with uncertainties: Technical and Financial Analysis.
Unit IV: Determination of Risk factors **8 Hours**
Analyses of Project Risk, Market Risk and Firm Risk, Social-Cost, benefit analysis: Need for social cost benefit analysis, Main feature of social cost benefit analysis: UNIDO approach, Little-Mirrless approach.
Unit V: Network Analysis **8 Hours**
Rules for drawing the network diagram, Application of CPM and PERT techniques in project planning and control, Illustration by taking numerical examples on CPM and PERT, Case Study: **China Telecom Corporation uses PMI standards to develop communications network for Nanshan District.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Computer Aided Design			
Course Code	BTME3060			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To introduce the CAD concepts both theoretically and application wise.
2. To provide students the necessary foundation to advance understanding of both design and manufacturing
3. To enable the students to model geometry of objects using curves and surfaces, so that the models can be used further for downstream applications.

Course Outcomes

CO1	Understand the computer hardware and graphics.
CO2	Develop an analytical ability to represent transformations of rigid bodies using CAD.
CO3	Employ the mathematical techniques for geometric modeling.
CO4	Interpolate or fit curves through given points, and design curves to achieve the required shape using CAD methods.
CO5	Design surfaces to model shapes of objects in the nature mathematically.

Text Book (s)

1. Newman & Sprawl (1978), Principles of interactive Computer Graphics, Mcgraw hill college, ISBN-978-0-074-63293-2
2. Michel E. Mortenson (2006), Geometric modeling, Industrial press, ISBN-978-0-201-84840-3
3. Van Dam, Hughes Jhon, James Foley (2002), Computer graphics, principles and practices Pearson, ISBN- 978-0-201-84840-3

Reference Book (s)

1. Foley & van dam (1982), Fundamental of Interactive computer graphics, Addison Wesley longman publishing co, ISBN- 978-1-852-33818-3
2. David Rogers (2001), Procedural elements of Computer graphics, TMH, ISBN- 978-0-070-53529-9
3. Rogers and Adams (2002), Mathematical elements of Computer Graphics, TMH,ISBN- 978-0-070-53529-9
4. Hearn & baker (2011), Computer Graphics, Pearson,ISBN- 978-8-177-58765-4.

Course Content:

Unit I: Introduction to CAD and Computer Graphics 9 Hours
Product Development Cycle – Introduction to CAD, Hardware and software requirement of CAD; Graphics input devices- cursor control devices, Digitizers, Scanners, speech oriented devices and touch panels, Graphics display devices- Refresh cathode ray tubes, Raster-scan displays, Random-scan displays, CRT Monitors; Input devices-keyboard, joy-stick, mouse, scanner; DVST, Flat- panel display, Hard copy devices - Printers and Plotters, dot

matrix, inkjet, laser printers, Graphics Standards – Neutral File formats –IGES, STEP, Graphics software, Graphics functions, output primitives- Bresenham's Algorithm and DDA.
Unit II: Transformation **9 hour**
Geometric Transformation - Basic transformation, translation, rotation, scaling, reflection, homogeneous coordinates; Composite Transformation- Introduction, translation, rotation, scaling, 3-D transformation- translation, rotation, scaling, reflection; 3-D composite transformation- generalized rotation, generalized reflection.
Unit III: Projection and Geometric Modeling **8 Hours**
3 D projections- orthographic projection, axonometric projection, oblique projection, perspective projection, Geometric Modeling – Wireframe, Surface and Solid – CSG and B-Rep- World/device co-ordinate representations.
Unit IV: Curves **8 Hours**
Introduction to curves, parametric continuity condition, geometric continuity condition, spline representation, spline specification, geometric and algebra forms, cubic spline interpolation method, natural cubic spline, Bezier curves, B-spline curves, curve animation.
Unit V: Surfaces **6 Hours**
Quadric surfaces- sphere, ellipsoid, torus; Bezier surfaces; B-spline surfaces, design surface using software.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Finite Element Analysis			
Course Code	BTME3061			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis
2. To understand the characteristics of various finite elements.
3. To develop finite element equations for simple and complex domains.

Course Outcomes

CO1	Understand concepts of variational principle and elasticity.
CO2	Discretize simple and complex bodies.
CO3	Populate stiffness matrix for a given discretized body.
CO4	Solve advanced field problems.
CO5	Use advanced special elements for solving complex engineering problems.

Text Book (s)

1. Tirupathi R. Chandrupatla (2009), Finite Element Analysis for Engineering and Technology, 1st Edition, University Press. ISBN: 978-8-173-71427-6.
2. P. Seshu (2010), Text book of Finite Element Analysis, Prentice Hall of India. ISBN: 978-8-120-32315-5

Reference Book (s)

1. J.N. Reddy (2005), An Introduction to the Finite Element Method, McGraw-Hill, Third Edition. ISBN: 978-0-070-60741-5.
2. S. S. Rao (2012), The Finite Element Method in Engineering, 5th Edition, Elsevier. ISBN: 978-9-380-93155-5.
3. O.C. Zienkiewicz, R.L. Taylor and J. Z. Zhu (2005), The Finite Element Method: Its Basis and Fundamentals, 6th Edition, Butterworth-Heinemann. ISBN: 978-0-750-66320-5.

Course Content:

Unit I: Introduction to Theory of Elasticity **8 Hours**
Introduction to Theory of Elasticity: Definition of stress and strain – plane stress – plane strain – stress strain relations in three dimensional elasticity. Introduction to Variational Calculus: Introduction –General field problems, discrete and continuous models, Variational formulation in finite elements – Ritz method - Weighted residual methods – Galerkin – sub domain – method of least squares and collocation method - numerical problems.
Unit II: Discretization of the problem **8 Hours**

Discretization of the Problem: Introduction – Geometrical approximations – Simplification through symmetry – Element shapes and behaviour – Choice of element types – size and number of elements – Element shape and distortion – Location of nodes – Node and Element numbering. Interpolation Function: Simplex - complex and multiplex elements – Linear interpolation polynomials for various simplex elements – Convergence requirements – derivation of shape function equations.
Unit III: Stiffness matrix formulation **8 Hours**
One dimensional elasticity – Bar with constant and varying cross section - and Pin jointed truss member – Two dimensional elasticity – Plane stress - plane strain and axisymmetric simplex elements only - simple numerical problems.
Unit IV: Field problems **8 Hours**
General field equation – Formulation of 1D and 2D – steady state heat transfer problems involving conduction and convection and torsion of prismatic members – simple numerical problems.
Unit V: Higher order problems **8 Hours**
Natural coordinate system and numerical integration – Higher order 1D and 2D elements – Derivation of shape function equations for Four node quadrilateral - six node triangle and eight node quadrilateral elements – formulation of element equation.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Mechanical Measurements			
Course Code	BTME3062			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To introduce a variety of sensors and instruments commonly used in Mechanical Engineering practice.
2. To instill a fundamental understanding of various instrumentation and control detection circuits as they relate to temperature, pressure, flow, and level monitoring.
3. To learn professional measurement techniques used to engineer thermal and mechanical systems.
4. To enable students apply control engineering techniques to the automatic control systems found in modern manufacturing, processing and transportation environments.
5. Identify, formulate, and solve engineering problems.

Course Outcomes

CO1	Understand fundamental elements of measurement systems
CO2	Recommend the proper measuring transducers for mechanical measurements such as pressure and temperature
CO3	Recommend the proper measuring method for stress and strains
CO4	Understand the fundamentals of control systems
CO5	Recommend proper advanced instrumentations and measurement techniques

Text Book (s)

1. Thomas G. Beckwith, Roy D. Marangoni and John H. Liennard (1999), Mechanical Measurements, Addison-Wesley Longman, New Delhi
2. Katsuhiko Ogata (1996), Modern Control Engineering, Prentice-Hall of India Pvt. Ltd., New Delhi.
3. B.C. Kuo (2003), Automatic Control Systems, 7th Edition, Prentice-Hall of India Pvt. Ltd

Reference Book (s)

1. Ernest O. Doeblin (2004), Measurement Systems: Application and Design, Tata McGraw- Hill.
2. J.P. Holman (2004), Experimental Methods for Engineers, Tata McGraw-Hill.
3. I.J. Nagrath and M. Gopal (1999), Control Systems Engineering, New Age Int. Pub.
4. R.S. Sirohi and H.C. Radhakrishna (1996), Mechanical Measurements, New Age International Publications.
5. A. Nagoor Kani (2005), Control Systems, RBA Publications.
6. K.K. Chaudhry and B.S Nakra (2006), Instrumentation, Measurement and Analysis, Tata McGraw-Hill

Course Content:

Unit I: Fundamentals of Measuring Systems	8 Hours

General concepts of Mechanical measuring instruments – Elements of a measuring system – Requirements of measuring instruments – Calibration. Errors in measurements and its analysis, types of errors, mean value, accuracy and precision.
Unit II: Measuring Devices - I **8 Hours**
Measurement of vibrations – Accelerometer – Measurement of Low, Medium, and High pressures- Measurement of temperature: bi-metallic thermometer, thermocouple, RTD, thermistor, pyrometer – Measurement of flow- hot wire anemometer – magnetic flow meter – ultrasonic meter
Unit III: Measuring Devices - II **8 Hours**
Measurement of displacement – Measurement of Force – Proving Ring, Strain gauge, Load cells- Measurement of torque – Measurement of Speed – Case study assignments
Unit IV: Fundamentals of Control System **8 Hours**
Introduction to Control systems – Open and Closed loop systems – servomechanisms. Transfer function: Block diagram of feedback control, Introduction to Transducers and Sensors – Classification and types.
Unit V: Advanced instrumentations and measurement techniques **8 Hours**
Introduction to computer Aided measurements, Fibre-optics transducers, Microsensors, smartsensors. Optical methods of measurements –Introduction, Laser beam as light pointer, length/displacement measurement, diffraction strain gauge, Laser Doppler anemometer(LDA).

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Design of Transmission Systems			
Course Code	**BTME3063**			
Prerequisite	BTME3013 Machine Design of Elements, BTME3002 Kinematics of Machines			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. To understand the design methodologies for mechanical power transmission components.
2. To understand the various standards and methods of standardization
3. To produce working drawings of the system involving Gears, Gear Box, Belts, Chains and ropes.

Course Outcomes

CO1	Design Pulleys, chain drives, rope drives and belt drives.
CO2	Design and analyze spur gears under different loading condition
CO3	Design and analyze the helical, bevel and worm gears.
CO4	Design and analyze gear boxes
CO5	Design and analyze brakes and clutches

Text Book (s)

1. V.B. Bhandari (2010), Design of Machine elements, 3rd Edition, Tata McGraw Hill.ISBN: 978-0-070-68179-8.
2. V.B. Bhandari (2014), Machine Design Data Book, 1st Edition, Tata McGraw Hill.ISBN: 978-9-351-34284-7

Reference Book (s)

1. Joseph Edward Shigley and Charles, R. Mischke (2011), Mechanical Engineering Design, 9th Edition,McGraw –Hill International Editions, ISBN: 978-0-071-07783

Course Content:

Unit I: Design of flexible power transmission systems **5 Hours**
Design of Belts – Flat Belts and Pulleys – V Belts and Pulleys – Design of chain drives – Wire ropes.
Unit II: Spur Gear **9 Hours**
Gear geometry – Kinematics – Forces on gear tooth – Stresses in Gear tooth – Selection of gear material based on bending stress and contact stress – Design of Spur gear – Power transmitting capacity. Computer– Aided Spur gear Design and Analysis.
Unit III: Helical, Bevel and Worm Gears **10 Hours**

Parallel Helical Gears – Application of Kinematics, Tooth proportions , Force analysis and Stresses in Helical gear (without derivations) –Design of helical gear – Crossed Helical gears – Straight Bevel gears – Kinematics – Force analysis –Stresses in straight bevel gear tooth – Design of bevel gear – Worm gearing – Kinematics – Forces - Friction and Efficiencies – Stresses in worm gear tooth.
Unit IV: Design of Gear boxes **6 Hours**
Design of Speed reducers – Design of multi speed gear boxes for machine tools – Structural and ray diagrams.
Unit V: Motion control: clutches and brakes **10 Hours**
Internal – Expanding Rim clutches and Brakes – External – Contracting Rim clutches and Brakes – Band type Clutches – Core clutches and Brakes – Energy considerations – Temperature rise – Friction materials.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Renewable Energy Sources			
Course Code	**BTME3066**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. To study bio-fuels, hydrogen energy and solar energy.
2. To understand the importance of energy efficiency and conservation.
3. To develop focus on promoting the use of renewable energy resources and technologies.

Course Outcomes

CO1	Possess the knowledge of global energy resources.
CO2	Using the renewable technologies like solar, biomass, wind, hydrogen etc. to produce energy.
CO3	Involve in optimizing and selecting an alternate source of energy.

Text Book (s)

1. B. H. Khan, (2009), Non-Conventional Energy Resources, 2nd Edition, Tata McGraw Hill, ISBN: 978-0-070-14276-3.

Reference Book (s)

1. David Merick and Richard Marshall (2001), Energy: Present and Future Options, Vol. I and II, John Wiley and Sons, ISBN: 978- 0-471-27922-8.
2. V. R. Koteswara Rao (2006), Energy Resources-Conventional and Non Conventional, Second Edition, BS Publications, ISBN: 978-8-178-00124-1
3. J.D. Ritchie, (1999), Source Book for Farm Energy Alternative, McGraw Hill. ISBN 978-0-070-52951-9.

Course Content:

Unit I: Biofuels	**8 Hours**
Biofuels classification – Biomass production for energy forming – Energy through fermentation – Pyrolysis – Gasification and combustion - Biogas - Aerobic and Anaerobic bio conversion process - Feed stock - Properties of bio-gas composition - Biogas plant design and operation - Alcoholic fermentation.	
Unit II: Hydrogen Energy	**6 Hours**
Electrolytic and thermo chemical hydrogen production – Metal hydrides and storage of hydrogen – Hydrogen energy conversion systems hybrid systems – Economics and technical feasibility.	

Unit III: Solar Energy **8 Hours**
Solar radiation - Availability- Measurement and estimation- Isotropic and an isotropic models - Introduction to solar collectors (liquid flat- Plate collector - Air heater and concentrating collector) and thermal storage - Steady state transient analysis - Photovoltaic solar cell - Hybrid systems - Thermal storage- Solar array and their characteristics evaluation – Solar distillation – Solar drying.
Unit IV: Ocean Thermal Energy Conversion **6 Hours**
Geothermal - Wave and Tidal energy - Availability - Geographical distribution - Power generation using OTEC - Wave and Tidal energy - Scope and economics - Geothermal energy - Availability - Limitations.
Unit V: Wind Energy **6 Hours**
Wind energy - General considerations - Wind Power plant design – Horizontal axis wind turbine - Vertical axis wind turbine - Rotor selection - Design considerations - Number of blades - Blade profile - Power regulation - Yaw system - Choice of power plant - Wind mapping and selection of location - Cost analysis and economics of systems utilizing renewable sources of energy.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Refrigeration and Air-Conditioning			
Course Code	BTME3067			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To understand the principles of refrigeration and air conditioning.
2. To calculate the cooling load for different applications of Refrigeration and Air-conditioning.
3. To learn the principles of psychrometry.
4. To develop the knowledge of selecting the right equipment for a particular application of Refrigeration and Air-conditioning

Course Outcomes

CO1	Possess the knowledge of system components of refrigeration and air conditioning.
CO2	Design and implement refrigeration and air conditioning systems using standards.
CO3	Apply the knowledge of psychrometry in calculating cooling load and heating load calculations.

Text Book (s)

1. Arora, C. P., (2008), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Ltd. ISBN: 978-0-070-08390-5.

Reference Book (s)

1. Manohar Prasad, (2003), Refrigeration and Air conditioning, New Age International. ISBN : 978-81-224-1429-5
2. W. F. Stocker and J. W. Jones, (2002), Refrigeration and Air conditioning, McGraw Hill. ISBN: 978-0-070-66591-0.

Course Content:

Unit I: Refrigeration Cycles and Refrigerants	**8 Hours**
Vapour compression refrigeration cycles-Air refrigeration cycles-Simple saturated vapour compression refrigeration cycle-P-H charts - Multi stage compression –Multi evaporator system-cascade system-Vapour absorption systems.	
Unit II: System Components	**5 Hours**
Refrigeration classification –Designation-Alternate refrigerants –Global warming and Ozone depleting aspects. Refrigerant compressors Reciprocating –Rotary - Condensers - Evaporators - Expansion devices - Cooling towers.	

Unit III: Cycling Controls and System Balancing	**8 Hours**
Pressure temperature control range and different settings - Selection and balancing of system components - Graphical method.	
Unit IV : Psychrometry	**9 Hours**
Moist air properties - Psychrometric chart - Different Psychrometric process analysis.	
Unit V: Air Conditioning	**9 Hours**
Air conditioning systems – classification - Cooling load calculations - different types of loads - GRSHF - ERSHF - Estimation Of total load - Air distribution patterns - Dynamic and frictional losses in air ducts - Equal friction method - Fan characteristics of duct system.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Metal Forming: Theory and Practice			
Course Code	BTME3065			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To understand the basic principles of Metal Forming Theory.
2. To know the various types of forming processes.
3. To get acquainted with advanced metal forming methods.

Course Outcomes

CO1	Choose forming techniques for various applications.
CO2	Estimate power requirement for forming processes.
CO3	Calculate the forming limit for various processes.

Text Book (s)

1. Uday S. Dixit, R. Ganesh Narayanan (2013), Metal Forming: Technology and Process Modelling, 1st Edition, Tata McGraw Hill Education. ISBN: 978-1-259-00734-7

Reference Book (s)

1. Robert M. Caddell and William F. Hosford (2011), Metal Forming : Mechanics and Metallurgy, 4th Edition, Cambridge University Press. ISBN: 978-1-107-00452-8.
2. Thomas H. Courtney (2009), Mechanical Behavior of Materials, 2nd Edition, McGraw-Hill. ISBN: 978-0-073-22824-2.
3. B L Juneja (2006), Fundamentals of Metal Forming Processes, 1st Edition, New Age International. ISBN: 978-8-122-41952-8.
4. George E Dieter (1988), Mechanical Metallurgy, 3rd Edition, Tata McGraw Hill, ISBN: 978-0-071-00406-0.

Course Content:

Unit I: Theory of Plasticity **8 Hours**
Theory of Plasticity - stress tensor – hydrostatic & deviator components of stress – flow curve – true stress strain – yielding criteria – yield locus – octahedral shear stress and shear strains – invariants of stress strain – slip line field theory plastic deformations of crystals.
Unit II: Plastic Forming of Metals-Forging **8 Hours**
Basics of plastic forming & forging- mechanics of metal working – temperature in metal working – strain rate effects – friction and lubrication – deformation zone geometry. Forging process – classification – equipment – calculation of forging loads – forging defects – residual stresses.

Unit III: Plastic Forming of Metals-Rolling and Extrusion 6 Hours
Rolling and Extrusion – classification -rolling mills - rolling of bars & shapes – rolling forces – analysis of rolling – defects in rolling- theories of hot & cold rolling – torque power estimation. Extrusion: classification-equipment – deformation lubrication and defects – analysis – hydrostatic extrusion – tube extrusion.
Unit IV: Plastic Forming of Metals- Drawing and Sheet metal forming 6 Hours
Drawing & Sheet Metal Forming- rod & wire drawing equipment – analysis – deep drawing – tube drawing – analysis, residual stresses sheet metal forming – methods – shearing and blanking – bending – stretch forming – deep drawing – forming limit criteria – defects -Stretch forming – press brake forming – explosive forming.
Unit V: Unconventional Forming Methods 5 Hours
Electro hydraulic forming – magnetic pulse forming – super plastic forming – electro forming – fine blanking – P/M forging-Isothermal forging – HERF.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Fuels and Combustion			
Course Code	BTME3064			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To learn about various types of fuels, their composition and properties
2. To acquire depth knowledge of solid, liquid and gaseous fuels
3. To understand the thermodynamics of combustion
4. To learn about the types of pollution and its control

Course Outcomes

CO1	Analyze the composition of various types of fuels and their properties.
CO2	Estimate the possible pollution of fossil fuels and its control.
CO3	Demonstrate the knowledge of combustion thermodynamics.

Text Book (s)

1. Stephen Turns, (2011), an Introduction to Combustion: Concepts and Applications, Tata McGraw Hill. ISBN: 978-1-259-02594-5.

Reference Book (s)

1. Samir Sarkar (2010), Fuels and combustion, Orient Longman. ISBN 978-1-439-82541-9.

2. Samir Sarkar (2009), Fuels and Combustion 3rd Edition, Universities Press, ISBN: 978-8-173-71669-0

3. Mishra, D. P, (2000), Fundamentals of Combustion, Prentice Hall of India. ISBN: 978-81-203-3348-2

4. Sharma.S.P., Cahandramohan, (1984), Fuels and combustion., Tata McGraw-Hill. ISBN 978-0-070-96627.

Course Content:

Unit I: Fuel Characteristics	**6 Hours**
Fuels – Types and Characteristics of Fuels – Determination of Properties of Fuels - Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination – Calorific Value - Gross and Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation - Flue gas Analysis - Orsat Apparatus - Fuel and Ash Storage and Handling – Spontaneous Ignition Temperatures.	
Unit II: Solid and Liquid Fuels	**6 Hours**
Solid Fuels: Wood and Wood charcoal-Origin of coal-Composition of coal –Analysis and properties of different grades of coal-preparation and storage of coal-coal washing –Briquetting. Liquid coals: Origin of petroleum fuels-Production –Composition-Petroleum refining-Various grades of petro-Products-Properties and testing –Alcohol shale oil-Gasification of liquid fuels –Synthetic fuels -Storage and handling of liquid fuels.	

Unit III: Gaseous Fuels **9 Hours**
Classification - Composition and Properties – Estimation of Calorific Value - Gas Calorimeter. Rich and Lean Gas - Wobbe Index - Natural Gas - Dry and Wet Natural Gas - Stripped NG - Foul and Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas – Town Gas - Coal Gasification – Gasification Efficiency - Non - Thermal Route - Biogas - Digesters - Reactions – Viability - Economics.
Unit IV: Combustion: Stoichiometry and Kinetics **9 Hours**
Stoichiometry - Mass Basis and Volume Basis – Excess Air Calculation - Fuel and Flue Gas Compositions – Calculations - Rapid Methods - Combustion Processes - Stationary Flame – Surface or Flameless Combustion – Submerged Combustion - Pulsating and Slow Combustion Explosive Combustion. Mechanism of Combustion – Ignition and Ignition Energy - Spontaneous Combustion - Flame Propagation - Solid - Liquid and Gaseous Fuels Combustion - Flame Temperature - Theoretical - Adiabatic and Actual - Ignition Limits – Limits of Inflammability.
Unit V: Air Pollution **9 Hours**
Types of pollution - Combustion-Generated air pollution - Effects of air pollution - Pollution of fossil fuels and its control - Pollution from automobiles and its control.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100