Hindi Seva Mandal's,

Shri Sant Gadge Baba

College of Engineering & Technology,

Near Z.T.C., Bhusawal. Dist. - Jalgaon (Maharashtra) Pin - 425203.

An Autonomous Institute

Accreditation by NAAC with A+ Grade

(Affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere.)

www.ssgbcoet.com

Bachelor of Technology (B.Tech)

In

Mechanical Engineering

Programme Curriculum

With Effect from the Academic Year 2026-2027

4-year, 8 Semester Full time Programme Choice-Based Credit System (CBCS) and Grading System Outcome Based Education Pattern Aligned with National Education Policy (NEP) 2020

Program Specific Outcomes

PSO1: SPECIFY, DESIGN and **EVALUATE** mechanical components and systems using modelling and analysis software.

PSO2: APPLY knowledge of machines, tools, automation, properties of advanced materials and modern management methods for manufacturing of mechanical components and systems.

PSO3: **APPLY** core aspects of thermal and fluid engineering to determine the performance of mechanical systems including power absorbing and power generating systems.

Program Educational Objectives

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the program is preparing a graduate to achieve.

PEO1: The graduate will have a successful career in mechanical engineering with strong technical, research & professional skills.

PEO2: The graduate will possess an ability to work in diversified fields along with team work and leadership qualities.

PEO3: The graduate will continue to learn and to adapt in a society of constantly evolving technological environment

Programme Outcomes (POs)

Program Outcomes (POs) are statements that articulate what students are expected to know, understand, and be able to do by the time they graduate from the program. These outcomes are aligned with the overall educational objectives of the program and reflect the skills, knowledge, attitudes, and behaviors acquired by students throughout their academic journey. On successful completion, students will be able to:

PO No.	Title	Program Outcome Description
PO1	Engineering Knowledge	Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.
PO2	Problem Analysis	Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	Design / Development of Solutions	Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society and environment. (WK5)
PO4	Conduct Investigations of Complex Problems	Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
PO5	Engineering Tool Usage	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling, recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	The Engineer and The World	Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)
PO7	Ethics	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual and Collaborative Team Work	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
PO10	Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects in multidisciplinary environments.
PO11	Life-Long Learning	Recognize the need for, and have the preparation and ability for: (i) independent and life-long learning, (ii) adaptability to new and emerging technologies, and (iii) critical thinking in the broadest context of technological change. (WK8)

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
CA:	Continuous Assessment
MSE:	Mid Semester Examination
ESE:	End Semester Examination
PCC:	Professional Core Course
OE:	Open Elective
PEC:	Programme Elective Course
IKS:	Indian Knowledge Society
MDM:	Multidisciplinary Minor
HSSM:	Humanities Social and Management
VEC:	Value Education course
CEP:	Community Engineering Project
VSEC:	Vocational and skill Enhancement course
EN:	Entrepreneurship
AEC:	Ability Enhancement Course

Shri Sant Gadge Baba College of Engineering and Technology, Bhusawal
Department of Mechanical Engineering
Proposed Second Year Structure 26-27 as per NEP 2020

Semester III											
Course Category	Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
				L	T	P	CA	MSE	ESE	Total	
PCC	Programme Core Course	BTME25PC301	Applied Mathematics for Mechanical Engineering	3	0	0	20	20	60	100	3
PCC	Programme Core Course	BTME25PC302	Mechanics of Machines - I	3	0	0	20	20	60	100	3
PCC	Programme Core Course	BTME25PC303	Fundamentals of Engineering Thermodynamics	2	0	0	20	20	60	100	2
MDM	Multidisciplinary Minor Bucket	BTME25MD304	MDM**	3	0	0	20	20	60	100	3
OE	Open Elective Bucket	BTME25OE305A BTME25OE305B BTME25OE305C BTME25OE305D	Total Quality Management Materials Science and Metallurgy Machine Tool Design Human Resource Management	3	0	0	20	20	60	100	3
PCC	Programme Core Course Lab	BTME25PC306L	Mechanics of Machines - I Lab	0	0	2	50		50	100	1
PCC	Programme Core Course Lab	BTME25PC307L	Fundamentals of Engineering Thermodynamics Lab	0	0	2	50		50	100	1
OE	Open Elective	BTME25OE308L	Open Elective Lab	0	0	2	50		50	100	1
HSSM	Entrepreneurship	BTME25HM309	Case Study/EDP Programme/ Start Up Activity	0	0	4	50			50	2
VEC	Value Education Course	BTME25VEC310	Basics of Human Rights	1	0	0	50			50	1
VEC	Value Education Course	BTME25VEC311	Indian Constitution- Value Education	1	0	0	50			50	1
CEP	Community Engg. Project	BTME25CEP312	Field Visit/Special Study/ Internship/ Social Activity Project/ Community Initiative			4	50		0	50	2
	Total			16	00	14	450	100	450	1000	23

MDM offers to other departments: **BTME25MD304A - Basic Thermodynamics / BTME25MD304B- Non-Conventional Energy Resources**

MDM** (The students will have to choose the MDM course being provided by other disciplines / offered at the college)

Second Year Structure 26-27 as per NEP 2020

Semester IV											
Course Category	**Category under NEP**	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
				L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC	Programme Core Course	BTME25PC401	Mechanics of Machines – II	3	0	0	20	20	60	100	3
PCC	Programme Core Course	BTME25PC402	Manufacturing Techniques - I	3	0	0	20	20	60	100	3
PCC	Programme Core Course	BTME25PC403	Engineering Fluid Mechanics	2	0	0	20	20	60	100	2
MDM	Multidisciplinary Minor Bucket	BTME25MD404	MDM**	3	0	0	20	20	60	100	3
OE	Open Elective Bucket	BTME25OE405A BTME25OE405B BTME25OE405C BTME25OE405D	Reliability Engineering Biomechanics Strength and Mechanics of Materials Product Design Engineering	2	0	0	20	20	60	100	2
(AEC)	Programme Core Course Lab. (AEC)	BTME25AE406L	Mechanics of Machines - II Lab	0	0	2	50		50	100	1
(AEC)	Programme Core Course Lab (AEC)	BTME25AE407L	Engineering Fluid Mechanics Lab	0	0	2	50		50	100	1
(VSEC)	Open Elective Course Lab (VSEC)	BTME25AE408L	Open Elective Lab	0	0	2	50		50	100	1
(VSEC)	Vocational & Skill Enhancement Course	BTME25VSE409	Workshop/ Skill Activity/Course/Seminar	0	0	2	50			50	1
HSSM	Humanities Social Science and Management	BTME25HM410	Universal Human Values	3	0	0	20	20	60	100	3
EN	Entrepreneurship	BTME25HM411	Mini Project/ Case Study/EDP Programme/ Start Up Activity	0	0	4	50			50	2
VEC	Value Education Course	BTME25VEC412	Life of Shri Sant Gadge Baba	1	0	0	0		0	0	AU
VEC	Value Education Course	BTME25VEC413	Moral and Ethical Development	1	0	0	50			50	1
	Total			18	00	12	420	120	510	1050	23

MDM offers to other departments: **BTME25MD404A - Manufacturing Technique, BTME25MD404B- Power Plant Engineering**

MDM** (The students will have to choose the MDM course being provided by other disciplines / offered at the college)

Subject Code BTME25PC301	Engineering Mathematics-III	Teaching Scheme 03L - 00T - 00P	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course objective:

1	Frequency distribution, correlation between two variables and lines of regression.
2	Evaluate statistical parameters using probability distribution and its fitting.
3	Testing of hypothesis and Chi- square test for goodness of fit and independence of attributes.
4	Solution of nth order Linear Differential Equations by analytical methods.
5	Applications of nth order LDE to Mass Spring system and applications of PDE to one and two dimensional Heat flow, Wave (Vibration) equations.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Compute coefficient of Correlation between two variables and estimate lines of regressions.
CO2	Find probability using Binomial, Poisson, and Normal distributions.
CO3	Understand the theory of sampling and testing of hypothesis.
CO4	Solve higher order linear differential equation using analytical methods.
CO5	Solve problems related to mass spring system, one and two dimensional Heat flow and vibration of string.

Mapping of course outcomes with program outcomes

Course Outcome	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	2	-	-	-	-	-	-	-	2
CO2	3	-	2	-	-	-	-	-	-	-	2
CO3	3	-	2	-	2	-	-	-	-	-	2
C04	3	-	2	-	1	-	-	-	-	-	2
C05	3	-	2	-	-	-	-	-	-	-	2

Course Contents

Unit I: Statistics (09 Hours)

Introduction to Basic Statistics and frequency distribution; Karl Pearson's coefficient of correlation; Spearman's Rank correlation; Coefficient of regressions; Lines of regression.

Unit II: Probability Distribution (09 Hours)

Theorems on probability; Probability distributions: Binomial, Poisson and Normal; Evaluation of statistical parameters for these three distributions; Fitting of probability distribution.

Unit III: Sampling theory and Testing of Hypothesis (09 Hours)

Introduction to sampling; Types of hypothesis; Type-I and Type-II errors; Test of significance; Large sample test for single proportion, difference of properties, Tests for single mean, difference of means, and difference of standard deviations. Chi- square test for goodness of fit and independence of attributes.

Unit IV: Linear Differential Equation (09 Hours)

Introductory remarks - complementary function, particular integral; Rules for finding complementary functions and particular integrals; Method of variation of parameters (second order only); Cauchy's homogeneous and Legendre's linear equations.

Unit V: Applications to Linear Differential Equations and Partial Differential Equations (09 Hours)

Mathematical Model of mass spring system and its solution; Applications to find solutions of one and two dimensional heat flow equation; and wave equation.

Text Books:

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. A Text Book of Engineering Mathematics, By N. P. Bali, Laxmi Publication, 2004 .
3. A Course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. Higher Engineering Mathematics by H. K. Dass and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
5. Fundamentals of Statistics by S. C. Gupta, Himalaya Publishing House.

Reference Books:

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O‟ Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw- Hill Publishing Company Ltd., New Delhi.
4. A First Course in Probability, by S. Ross, 6th Ed., Pearson Education India, 2002.

Subject Code BTME25PC302	Mechanics of Machines-I	Teaching Scheme 03L - 00T - 00P	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course objective:

1	To familiarize students with basic definitions and terminology related to mechanisms including links joints, kinematic chains, and degrees of freedom.
2	To develop skills in analyzing mechanisms for their displacement, velocity, and acceleration at any point, using both graphical and analytical methods.
3	To understand and evaluate the performance of friction-based components like clutches.
4	To familiarize students with the working principles of different types of brakes used in machines and power measurement by Dynamometer.
5	To provide transmission system by belt and rope drive.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identifying and analyzing various machine elements and mechanisms, determining the position, velocity, and acceleration of linkages
CO2	The ability to analyze the motion (position, velocity, and acceleration) of elements, understand and apply principles of kinematic pairs, chains, and their inversions, and use both graphical and analytical methods to solve kinematic problems for practical applications.
CO3	Students can evaluate the friction forces required to hold a system in static equilibrium also can explain methods to increase or decrease friction
CO4	Understanding the principles of different types of brakes and dynamometers, analyzing their performance, calculating braking effort, and evaluating their application in various machines
CO5	Choose an appropriate drive type based on dimension belts and rope ,application-specific factors, such as power requirements, speed ratio, and center distance between shafts

Mapping of course outcomes with program outcomes

Course Outcome	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	2	2	-	-	-	-	-	1
CO2	3	3	2	2	3	-	-	-	-	-	1
CO3	3	2	1	1	-	1	-	-	-	-	-
C04	3	3	2	2	-	2	-	-	-	-	1
C05	3	2	3	1	2	1	-	-	-	1	1

Course Contents

Unit 1 Introduction (09 Hours)

Definition of link, pair, kinematics chain, inversions, inversions of single and double slider crank chain, kinematic diagrams of mechanisms, equivalent linkage of mechanism, degree of freedom. Study of various mechanisms such as straight line mechanisms, pantograph, Geneva mechanism, steering gear mechanisms. Instantaneous center of rotation, body and space centrodes and their applications, Kennedy's theorem and its applications.

Unit 2: Velocity Acceleration Analysis (09 Hours)

Velocity and acceleration analysis and its purpose, velocity and acceleration diagrams using relative velocity method, ICR method, Corioli's component of acceleration, Velocity and acceleration of piston in slider crank mechanism by analytical method and Klein's construction.

Unit 3: Friction (09 Hours)

Types of friction, Law of friction, Limiting angle of friction, Angle of repose, friction between nut and screw with different types of threads, Friction Circle.

Friction Clutches: Single plate and multi-plate clutch, Cone clutch, Centrifugal clutch,
Torque transmitting capacity, Clutch operating mechanism.

Unit 4: Brakes and Dynamometers **(09 Hours)**

Brakes: Shoe brake, Internal and external shoe brakes, Block brakes, Band brakes, Band and block brakes, Braking torque.

Dynamometers: Different types of absorption and transmission type dynamometers, Construction and working of eddy current dynamometer, Torque measurement.

Unit5: Belt and Ropes Drives **(09 Hours)**

Introduction, Belt and Rope drives, Effect of slip on velocity ratio, Creep of belt, Law of belting, length of belt, Power transmitted by belt, ratio of driving tensions, centrifugal tension, initial tension in belt, maximum power transmitted by belt.

References:

1. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, Delhi.
2. J. E. Shigely, J. J. Uicker, "Theory of Machines and Mechanisms", Tata McGraw Hill Publications, New York, International Student Edition, 1995.
3. V. P. Singh**,** "Theory of Machines", Dhanpat Rai & Co. Publication, New Delhi, 4th edition 2016
4. A. Ghosh, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
5. S. S. Rattan, "Theory of Machines", Tata McGraw Hill, New Delhi.

Subject Code BTME25PC303	Fundamentals of Engineering Thermodynamics	Teaching Scheme 03L - 00T - 00P	Credits 02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course objective:

1	Introduce fundamental thermodynamic concepts such as systems, properties, processes, and equilibrium to build a strong conceptual foundation.
2	Explain the principles of energy interactions through work and heat transfer, including measurement techniques and thermodynamic laws.
3	Apply the First Law of Thermodynamics to closed and open systems, analyzing energy balances in engineering devices like turbines and compressors.
4	Explore the Second Law of Thermodynamics to understand entropy, irreversibility, and the limitations of energy conversion processes.
5	Familiarize students with ideal gases and pure substances, including phase changes, property diagrams, and steam tables for practical applications.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define and classify thermodynamic systems and processes, and distinguish between macroscopic and microscopic viewpoints.
CO2	Analyze energy interactions using the First Law of Thermodynamics in both closed and steady-flow systems.
CO3	Evaluate the performance of thermodynamic cycles and explain the implications of the Second Law, including entropy and reversibility.
CO4	Solve problems involving ideal gases using various equations of state and thermodynamic relations.
CO5	Interpret phase diagrams and steam tables to determine the properties of pure substances and analyze phase change processes.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	1
CO2	3	3	2	1	-	-	-	-	-	-	1
CO3	3	3	3	2	1	2	-	-	-	-	2
CO4	3	3	1	1	-	-	-	-	-	-	1
CO5	3	3	2	1	3	-	-	-	-	-	1

Course Contents:

Unit 1 **(06 Hours)**

Fundamental Concepts and Definitions

Thermodynamic system and its type; Macroscopic vs. Microscopic viewpoint, properties, processes and cycles, point function, path function. Thermodynamic equilibrium, Quasi-static process. Work and heat Transfer: Work transferred and other types of work, Heat transfer, temperature and its measurement (principle of measurement, various instruments etc.). Zeroth law of thermodynamics, specific heat and latent heat, relationship between C_P and C_V.

Unit 2 **(06 Hours).**

First Law of Thermodynamics

First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, different forms of energy, Enthalpy, PMM-I control volume. Application of first law of steady flow processes (nozzle, turbine, compressor, pump, boiler, throttle valve etc.)

Unit 3 **(06 Hours)**

Second Law of Thermodynamics

Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Kelvin- Plank and Clausius statements and their equivalence, Reversibility and Irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.

Entropy: Introduction, Clausius theorem, T-s plot, Clausius inequality, Entropy and Irreversibility, Entropy principle and its application, combined I and II law, Entropy and direction, Entropy and disorder

Unit 4 **(06 Hours)**

Ideal gas

Boyle‟s law, Charl‟s law, Avogadro‟s law, universal gas constant, ideal processes with question, other equations of states.

Unit 5 **(06 Hours)**

Properties of Pure Substance

Phase change phenomenon of pure substance, phase diagram of pure substance, p-v, T-s, and h-s diagrams properties of steam, critical point parameters, triple point, property table, representation of processes of steam on p-v, T-s, and other diagrams, Dryness fraction and its measurement.

Texts/Reference Books:

1. P. K. Nag, “Engineering Thermodynamics”, Tata McGraw Hill, New Delhi, 3rd edition, 2005.
2. Y. A. Cengel, M. A. Boles, “Thermodynamics - An Engineering Approach”, Tata McGraw Hill, 5thedition, 2006.
3. R K Rajput, A Textbook of Engineering Thermodynamics, Laxmi Publication, 5th Edition, 2016.
4. Domkunwar, A Course in Thermal Engineering, Dhanpat Rai & Co., 6th edition, 2016.
5. Y.V.C.Rao, An Introduction to Thermodynamics, Universities Press, 2004.
6. C. P. Arora,Thermodynamics, Tata McGraw-Hill Publishing Company Ltd,2005.
7. David R. Gaskell, Introduction to Thermodynamics of Materials, Taylor and Francis Publisher, 2003.
8. M. Achuthan, Engineering Thermodynamics, Prentice Hall India Limited, 2004.
9. G. J. Van Wylen, R. E. Sonntag, “Fundamental of Thermodynamics”, John Wiley and Sons, 5th edition, 1998.
10. J. Moran, H. N. Shapiro, “Fundamentals of Engineering Thermodynamics”, John Wiley and Sons, 4th edition, 2004.
11. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edit ion, Fundamentals of Thermodynamics, John Wiley and Sons.
12. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India.
13. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
14. Yunus A. Cengel, (2005), Thermodynamics: An Engineering Approach, Tata McGraw- Hill Publishing Company Ltd.

Subject Code BTME25OE305A	Total Quality Management	Teaching Scheme 03L - 00T - 00P	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: - 20 Marks End Semester Exam: - 60 Marks

Course objective:

1	To learn the basic concepts of quality and quality from organizational point of view
2	To learn the concept of total quality management from western and Japanese approach
3	To learn the internal politics, quality culture, education and training of the organization
4	To be aware of international/national Quality awards
5	To prepare students for implementing quality initiatives in organizations

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the principles and philosophies of Total Quality Management
CO2	Apply TQM tools and techniques (7 QC tools, benchmarking, QFD, FMEA) in problem-solving
CO3	Analyze the role of statistical process control in quality improvement
CO4	Evaluate the effectiveness of quality management systems like ISO 9001 and Six Sigma
CO5	Develop strategies for continuous improvement and customer satisfaction.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	-	-	-	-	-	-	1
CO2	3	3	2	-	3	-	-	-	-	-	-
CO3	3	3	-	2	2	-	-	-	-	-	-
CO4	2	2	-	-	-	2	-	-	-	-	2
CO5	-	-	2	-	-	-	-	-	-	2	2

Course Contents:

Unit 1 TQM Principles (09 Hours)

Quality Concepts – Definition of Quality, Dimensions of Quality, Cost of Quality and Quality Gurus. TQM Philosophy – Principles of TQM, Deming's Philosophy, Juran's Philosophy & Crosby's Philosophy.Quality Management System – ISO. Customer Focus, Supplier partnership and Employee Involvement

Unit 2 Design for Quality (09 Hours)

Detailed Design – Product Development & Quality Function Deployment (QFD), Target and Tolerance Design, Taguchi Loss Function for Tolerance Design. Design for Reliability – mathematics of Reliability & System Reliability. Design Optimisation – Fault Tree Analysis, Design for manufacturability, environment responsibility and excellence. Total Productive Maintenance (TPM) – Concept & Improvement Needs

Unit 3 Measuring & Controlling the Quality (09 Hours)

Statistical Fundamentals – Sampling Distributions, Confidence Intervals, Measures of Central Tendency and Dispersion, Population and Sample, Normal Curve. Measuring the Quality – Measurement of Quality control, system evaluation and process capability measurement. Controlling the Quality – Statistical Process Control for Variables & Attributes

Unit 4 Analysis & Improve the Quality (09 Hours)

Seven QC Tools – Stratification, Check Sheets, Control Chart, Histogram, Pareto Chart, Cause- and-effect diagram & Scatter diagram. New Management and planning tools – 5 Why Analysis, Affinity Diagram, Interrelationship Digraph & Tree Diagram, Matrix Diagram, Matrix Data Analysis, Process Decision Program Chart and Arrow Diagram.

Unit 5 Improve for Quality Excellence (09 Hours)

Continuous Process Improvements – Benchmarking, PDCA Cycle, 6S, Kaizen, Lean and Six- Sigma principles. Leadership – Characteristics of Quality Leaders, The 7 Habits of Highly Effective People, Ethics & The Deming Philosophy.

Text/Reference Books:

1. Managing for Quality and Performance Excellence, 9th Edition, James R Evans and William
2. Total Quality Management by N.V.R Naidu, G. Rajendra New Age international, ,First Edition,Jan 2006
3. Total Quality Management by R.S Naagarazan ,New Age international,3e, 2015 9 10
4. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India, 2004
5. Dale H. Besterfield, Carol Besterfield Michna, Glen Besterfield, Mary Besterfield Sacre, Hemant Urdhwareshe & Rashmi Urdhwareshe "Total Quality Management", Pearson.
6. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
7. Janakiraman. B and Gopal.R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

Subject Code BTME25OE305B	Material Science and Metallurgy	Teaching Scheme 03L - 00T - 00P	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course objective:

1.	To understand the atomic structure and imperfections in crystalline materials
2.	To explore the mechanisms of plastic deformation and evaluate mechanical properties through testing
3.	To interpret equilibrium phase diagrams and understand phase transformations in steels
4.	To comprehend heat treatment processes and their effects on material properties
5.	To develop skills in metallographic techniques for microstructural analysis

Course Outcomes: At the end of the course, students will be able to:

CO1	Differentiate between crystalline and amorphous structures and analyze crystal defects
CO2	Explain plastic deformation mechanisms and interpret mechanical test results
CO3	Construct and analyze equilibrium diagrams and transformation curves for steels
CO4	Apply appropriate heat treatment methods to modify material properties
CO5	Perform metallographic specimen preparation and interpret microstructural features using microscopy

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-
CO5	2	-	-	3	3	-	-	-	-	-	-

Course Contents:

Unit 1: Structure of Materials (09 Hours)

Crystal Structures: Atomic arrangement: crystalline vs. amorphous materials; unit cell, space lattice, 14 Bravais lattices, lattice parameters, 7 crystal systems; BCC, FCC, and HCP structures: Basic Characteristics: average number of atoms per unit cell, Coordination number, atomic packing factor; Indexing of lattice planes.

Crystal Imperfections: Importance, Classification: Point defects: vacancy, interstitials, impurities, Frenkel, Schottkey defects, Line defects: definition, types, edge, screw, mixed dislocations, characteristics of each type, planar defects: external surfaces, grain boundaries: high and low angle, tilt and twist boundaries; twin boundaries, stacking faults: intrinsic, extrinsic; Volume defects: examples.

Unit 2: Plastic Deformation and Mechanical Properties (09 Hours)

Mechanism of plastic deformation: Slip: slip direction, slip plane, slip systems for cubic structures, Mechanism of slip: movement of dislocations; slip and twinning; Deformation of single crystal by slip: Plastic deformation of polycrystalline materials, effect of grain size on stress-strain curve,

Mechanical Properties and their Testing: Tension test, Engineering stress-strain curves, True stress-strain curves, true strain, relationship between engineering and true stress – strain, Evaluation of properties: proportional stress, elastic limit, ultimate tensile strength, breaking or fracture stress, yield stress, proof stress, resilience, toughness, stiffness, ductility, Erichsen test; hardness testing, different hardness tests: Brinell, Rockwell and Vickers tests; Non-destructive testing: Introduction, dye penetrant test, magnetic particle inspection, ultrasonic test, and eddy current test.

Unit 3: Equilibrium Diagrams (09 Hours)

Introduction: Importance, Definitions of terms, Hume-Rothery rules of solid-solubility, Gibb's phase rule, solidification of a pure metal, types of cooling curves for pure metals and binary solid solutions, plotting of

equilibrium diagrams, Lever rule, Iron-iron carbide equilibrium diagram, phases present, different transformations, critical temperatures, non-equilibrium cooling of steels, , classification and applications of steels, specification of steels (as per Indian, American and British standards), transformation products of austenite: pearlite, bainite and martensite, TTT diagrams: determination, effect of carbon, critical cooling rate, CCT diagram: determination of CCT curves

Unit 4: Heat Treatment (09 Hours)

Introduction, Heat treatment of steels, Objectives/purposes, Heating: media, soaking; cooling: media, polymer quenching medium, mechanism of heat removal, Annealing processes: full annealing: purposes, process details and mechanism; isothermal annealing, spheroidize annealing, sub-critical annealing: types; Normalizing: comparison with annealing, Hardening: purpose, types, Tempering: purposes,

Surface hardening processes: Carburizing: solid, gas, and liquid carburizing; Nitriding: mechanism, white layer, advantages and limitations; Carbo-nitriding: process details; Flame hardening: various methods; Induction hardening: principle, types, advantages and drawbacks

Unit 5: Metallography (09 Hours)

Introduction: Definition, importance; Microscopy: Specimen preparation: Procedure, Metallographic polishing abrasives, Metallographic polishing clothes; Mounting of specimens; Etching: Mechanism for single- and two-phase alloys, procedure and reagents; Optical metallurgical microscope: Principle of working, construction, important terms.

Macroscopy: Procedure and methods; Macro tests: Sulphur printing, flow lines observation, Examination of fractures: fatigue, tensile, fibrous; Spark test.

Text/Reference books:

1. V. D. Kodgire, S.V. Kodgire, “Material Science and Metallurgy for Engineers”, Everest Publishing House, Pune, 24th edition, 2008.
2. W. D. Callister, “Materials Science and Engineering: An Introduction”, John Wiley and Sons, 5th edition, 2001.
3. V. Raghvan, “Material Science Engineering”, Prentice Hall of India Ltd.,1992.
4. S. H. Avner, “Introduction to Physical Metallurgy”, Tata McGraw Hill, 2nd edition, 1997.
5. R. A. Higgins, “Engineering Metallurgy: Part I”, ELBS, 6th edition,1996.
6. V. B. John, “Introduction to Engineering Materials”, ELBS, 6th edition,2001.
7. G. F. Carter, D. E. Paul, “Materials Science and Engineering”, ASM International, 3rd edition, 2000.
8. T. E. Reed-Hill, R. Abbaschian, “Physical Metallurgy Principles”, Thomson, 3rd edition, 2003

Subject Code BTME25OE305C	Machine Tool Design	Teaching Scheme 03L - 00T - 00P	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: - 20 Marks End Semester Exam: - 60 Marks

Course objective:

1	To understand the fundamental principles and classifications of machine tools and their drive systems
2	To develop the ability to design machine tool structures considering mechanical properties and stiffness
3	To gain knowledge of guideways and power screw design for precision and durability
4	To analyze spindle design and dynamic behavior of machine tools for improved performance
5	To explore control systems in machine tools and industrial robots, including programming and automation

Course Outcomes: At the end of the course, the student will be able to:

CO1	Explain the working principles, motion systems, and design considerations of machine tool drives
CO2	Design and evaluate machine tool structures such as beds, columns, and carriages based on stiffness and material properties
CO3	Select and design appropriate guideways and power screws for various machine tool applications
CO4	Perform calculations related to spindle deflection and analyze vibration characteristics in machine tools
CO5	Demonstrate understanding of control systems in machine tools and industrial robots, including programming languages and sensor integration

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-
CO4	3	3	-	2	-	-	-	-	-	-	-
CO5	3	-	2	-	3	-	-	-	-	-	2

Course Contents:

Unit 1 Principles of Machine Tool Design and Drives (09 Hours)

Introduction – Machine tools, classification. Working and auxiliary motion in machine tools. Mechanical and Hydraulic transmission elements ,Devices for Intermittent motion. Reversing and differential mechanism, General requirement of machine tool design. Engineering Design process applied to machine tools , Machine tool drive – Types of speed and feed regulation, classification of speed and feed boxes , Design of speed box - Stepped regulation of speed, selection of range ratio, geometric progression, structural diagram , Design of feed box in details , Development of gearing diagram

Unit 2 Design of machine tool structure (09 Hours)

Function of machine tool, structure and their requirements, design criteria for machine tool structure,Materials and its properties, dynamic and static stiffness, Profile of machine tool structure, factors affecting on the stiffness of machine tool structures, Basic design procedure machine tool structure, Design of beds and columns,Design of Housing, Design of bases and tables,Design of Cross rails, arms, saddle and carriages,Design of Rams

Unit 3 Design of Guide ways and power Screws (09 Hours)

Function and types of Guide ways, types of slide ways and types of anti friction ways, Design of slide ways – Shapes, materials, method of adjusting clearance in slide ways, Design criteria and calculation for slide ways – (i) for wear (ii) for stiffness , Guide ways operating under liquid friction conditions – (i) hydrodynamic slide ways (ii) Hydrostatic slide ways , Design of Aerostatic and anti-friction guide ways, Combination guide ways and protecting

devices for slide ways,Design of Power screw – (i) Design of sliding friction power screw, (ii) Design of rolling friction power screw.

Unit 4 Design of Spindles and Spindle supports (09 Hours)

Function of spindle unit and requirement, material of spindle ,Effect of machine tool compliance on machinery accuracy, Design calculation of spindles – Deflection of spindle axes due to bending and compliance of spindle support. Optimum spacing between spindle support. , Deflection due to compliance of tapered joint permissible deflection and design for stiffness, Anti-friction bearings and sliding bearings , Dynamics of machine tools – Forced vibration in machine tools, Dynamic characteristics of machine elements, Stability analysis – Static and dynamic cutting processes, characteristics, Regenerative chatter

Unit 5 Control System in Machine tools and Industrial Robots. (09 Hours)

Function, requirements and classification, control system for changing speeds and feed with simple centralized control , Control system for changing speeds and feed with pre-selective control

Control system for changing speeds and feed with Selective control , Control system for executing and forming auxiliary motion. Manual control system, Automatic control system and adaptive control system, Industrial robot and its application.- Introduction and basic function of robotic elements, mobility of robot , Reliability in operation and various control system in robots , Robot language – Robot language outline, general description of programming language. Real time, geometric modeling, movements, Sensors, tools, programming ARL, HARL, AL, VAL, AML, IRL, LM and MCL.

Text Book and Reference Books

1. D. K Pal, S. K. Basu, “Design of Machine Tool“, 4th Edition. Oxford IBH 2005, ISBN 81- 204-0968.
2. F. Koenigsberger, “Design Principles of Metal Cutting Machine Tools“, The Macmillan Company New York 1964.
3. Bhattacharya and S. G. Sen., “Principles of Machine Tool“, New central book agency Calcutta, ISBN 81-7381-1555.
4. N. S. Acherkan, “Machine Tool“, Vol. I, II, III and IV, MIR publications.
5. N.K. Mehta, “Machine Tool Design“, Tata McGraw Hill, ISBN 0-07-451775-9.
6. DR. V. P. Singh, “Mechanical Vibration”, S. Chand &Sons., New Delhi

Subject Code BTME25OE305D	Human Resource Management	Teaching Scheme 03L - 00T - 00P	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: - 20 Marks End Semester Exam: - 60 Marks

Course objective:

1	To introduce the foundational concepts and environmental influences in Human Resource Management
2	To develop understanding of employee training, management development, and career planning
3	To explore motivational theories and modern job design practices
4	To analyze performance appraisal systems and reward mechanisms
5	To understand HR maintenance functions including compensation, benefits, discipline, and workplace safety

Course Outcomes: At the end of the course, the student will be able to:

CO1	Explain the evolution, scope, and environmental factors influencing Human Resource Management
CO2	Design effective training programs and career development strategies for employees and managers
CO3	Apply motivational theories and job design models to enhance employee engagement and productivity
CO4	Evaluate performance appraisal methods and formulate reward systems aligned with organizational goals
CO5	Demonstrate knowledge of compensation structures, employee benefits, disciplinary procedures, and health and safety programs

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	1	-	-	-	-	1
CO2	-	-	-	-	-	-	-	2	-	2	-
CO3	-	-	-	-	-	-	-	3	-	-	-
CO4	-	-	-	-	-	-	2	-	-	2	-
CO5	-	-	-	-	-	2	2	-	-	1	-

Course Contents:

Unit 1 Introduction to Human Resource Management (09 Hours)

Concept of management, concept of human resource management, personnel to human resource management, human resource management model, important environmental influences like government regulations, policies, labor laws and other legislation. **Acquisition of human resources:** Human resource planning, Demand for manpower, Weaknesses of manpower planning, job analysis, job specification, recruitment sources, recruitment advertising, the selection process, selection devices, equal opportunities: Indian and foreign practices, socializing the new employee

Unit 2 Development of Human Resources (09 Hours)

Employee Training and Management Development: Training, Training and Learning,
Identification of training needs, training methods, Manager Development, Methods for developing managers, evaluating training effectiveness

Career Development: Concept of career, value of effective career development, external versus internal dimensions to a career, career stages, linking career dimensions with stages

Unit 3 Motivation of Human Resources (09 Hours)

Definition of motivation, Nature and Characteristics of Motivation, Theories of motivation: Maslow's Need Hierarchy Theory, Drucker Theory, Likert Theory, Herzberg Two Factor Theory, McClell and Theory, McGregor Theory X and Y, etc., Psychological approach.

Job Design and Work Scheduling: Design, Scheduling and Expectancy Theory, Job characteristics model, job enrichment, job rotation, workmodules, flex-time, new trends in work scheduling.

Unit 4 Performance Appraisal (09 Hours)

Performance appraisal and expectancy theory; appraisal process, appraisal methods, factors that can destroy appraisal.

Rewarding the Productive Employee: Rewards and expectancy theory, types of rewards, qualities of effective rewards, criterions for rewards.

Unit 5 Maintenance of Human Resources (09 Hours)

Compensation Administration: Concept of Compensation Administration, Job evaluation, Pay structures, Incentives compensation plans.

Benefits and Services Benefits: Something for everybody, Services, Trends in benefits and services.

Discipline: Concept of Discipline, types of discipline problems, general guidelines, disciplinary action, employment-at-will doctrine, disciplining special employee groups **Safety and Health:** safety programs, health programs, stress, turn out.

Text/Reference Books:

1. David A. DeCenzo, Stephen P. Robbins, "Personnel/Human Resources Management", Prentice Hall of India Pvt. Ltd, 3rd edition,2002.
2. Trevor Bolton, "An Introduction to Human Resource Management", Infinity Books, 2001.
3. Ellen E. Kossek, "Human Resource Management – Transforming the Workplace", Infinity Books, 2001.
4. G.S.Batra, R.C.Dangwal, "Human Resource Management New Strategies", Deep and Deep Publications Pvt. Ltd., 2001.
5. D. M. Silvera, "HRD: The Indian Experience", New India Publications, 2nd edition, 1990.

Subject Code	Mechanics of Machine Lab - I	Teaching Scheme	Credits
BTME25PC306L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: End Semester Exam: 50 Marks

Course Objectives:

1	To understand and apply the basic principles of kinematics for mechanical systems and machine components.
2	To practically identify and study different kinematic links, pairs, chains, mechanisms (e.g., four-bar linkage, slider-crank), and their inversions.
3	To be able to determine and visualize the displacement, velocity, and acceleration of various links and points in different mechanisms, often using graphical methods like the relative velocity and instantaneous center methods.
4	To understand and evaluate the performance of friction-based components like clutches and brakes.
5	To gain a practical understanding of different power transmission systems, such as belt drives, rope drive.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Demonstrate use of graphical differentiation method for kinematic analysis of slider crank mechanism or any other planar mechanism with a slider.
CO2	Perform graphically kinematic analysis of any planar mechanism using ICR and RV methods.
CO3	Perform graphically kinematic analysis of slider crank mechanism using Klein's construction.
CO4	The practical requires students to analyze the collected data and plot a slip curve against the load, demonstrating the relationship between the two variables.
CO5	Perform the computer program for velocity and acceleration prediction of slider crank.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	2	-	-	-	-	-	-	-
CO2	3	3	-	2	-	-	-	-	-	-	-
CO3	3	3	-	2	-	-	-	-	-	-	-
CO4	2	2	-	3	-	-	-	-	-	-	-
CO5	2	-	-	-	3	-	-	-	-	-	-

Course Contents

List of Practical's /Experiments/Assignments (Perform any 8)

1. Determination of displacement of slider crank mechanism with the help of a model and to plot displacement vs crank angle for it.
2. One sheet on Velocity by relative velocity method (2 Examples)
3. One sheet on Velocity & Acc^{n} by relative velocity method (2 Examples, one example on corolis component)
4. One sheet on Velocity by ICR method. (2 examples)
5. One Sheet on Klien's Construction. (2 examples)
6. Study of different types of dynamometers
7. Study of different types of clutches
8. To study and measurement of slip in flat belt drive.
9. One assignment on straight line mechanism.
10. Determine percentage of slip in belt drive.
11. Assignment on Develop a computer program for velocity and acceleration of single slider-crank mechanism.

Subject Code	Fundamentals of Engineering Thermodynamics Lab	Teaching Scheme	Credits
BTME25PC307L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Develop an understanding of the fundamental laws of thermodynamics through experiments.
2	Familiarise students with basic thermodynamic properties (pressure, volume, temperature, enthalpy, entropy, etc.).
3	Provide hands-on experience in measuring heat, work, and energy interactions in practical systems.
4	Strengthen the ability to verify theoretical concepts by experimental methods.
5	Introduce students to performance testing of basic thermodynamic devices (engines, compressors, boilers, calorimeters, etc.).

Course Outcomes: At the end of the course, the student will be able to:

CO1	Demonstrate understanding of basic gas laws and thermodynamic principles experimentally.
CO2	Determine calorific values, specific heat, latent heat, and gas constants using calorimetric methods.
CO3	Conduct performance tests on basic thermodynamic equipment (IC engine, compressor, blower, boiler).
CO4	Analyze experimental data, interpret results, and compare with theoretical values.
CO5	Work effectively in a team to perform experiments, record observations, and present technical reports.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	2	-	-	-	-	-	-	-
CO2	3	2	-	3	-	-	-	-	-	-	-
CO3	3	3	-	3	-	-	-	-	-	-	-
CO4	-	3	-	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	-

Course Contents

List of Experiments: (At least 8 experiments should be conducted from the list of experiments)

List of Experiments:

1. Study & Demonstration of types of thermodynamic systems.
2. Study & Demonstration of temperature measurement using different instruments.
3. Study & Demonstration of calorimeter.
4. Study & Demonstration of conversion of work into heat.
5. Study of PMM (Perpetual Motion Machine First Kind).
6. Study of throttling process and its characteristics.
7. Study of heat engine cycle and its components.
8. Study of Carnot heat engine cycle and Carnot refrigerator cycle.
9. Representation of steam processes on P–V diagram.
10. Representation of steam processes on T–S diagram.
11. Study of phase change phenomenon of pure substance.

Subject Code	Total Quality Management Lab	Teaching Scheme	Credits
BTME25OE308L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Understand domain-specific concepts and applications
2	Apply analytical and engineering principles
3	Develop problem-solving ability
4	Use modern tools and techniques
5	Enhance communication and teamwork

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply engineering knowledge in practical context
CO2	Analyze and solve domain-specific problems
CO3	Design or evaluate engineering systems
CO4	Use modern tools effectively
CO5	Communicate technical information clearly

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

Course Contents

1. Case Study on Quality Concepts
2. Study of TQM Philosophy in Practice
3. Study of Quality Management System (ISO)
4. Study of Product Design Using QFD
5. Study of Reliability and Design Optimization
6. Study of Statistical Quality Control
7. Study of Process Capability and Control
8. Study of Seven QC Tools
9. Study of New Management & Planning Tools
10. Study of Continuous Improvement & Leadership

Subject Code	Materials Science and Metallurgy Lab	Teaching Scheme	Credits
BTME25OE308L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Understand domain-specific concepts and applications
2	Apply analytical and engineering principles
3	Develop problem-solving ability
4	Use modern tools and techniques
5	Enhance communication and teamwork

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply engineering knowledge in practical context
CO2	Analyze and solve domain-specific problems
CO3	Design or evaluate engineering systems
CO4	Use modern tools effectively
CO5	Communicate technical information clearly

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

Course Contents

1. Study of Crystal Structures
2. Study of Bravais Lattices and Crystal Systems
3. Study of Crystal Imperfections
4. Study of Plastic Deformation Mechanisms
5. Study of Mechanical Properties through Testing
6. Study of Non-Destructive Testing (NDT) Methods
7. Study of Equilibrium Diagrams
8. Study of Iron-Iron Carbide Diagram
9. Study of Heat Treatment Processes
10. Study of Metallography and Material Characterization

Subject Code	Machine Tool Design Lab	Teaching Scheme	Credits
BTME25OE308L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Understand domain-specific concepts and applications
2	Apply analytical and engineering principles
3	Develop problem-solving ability
4	Use modern tools and techniques
5	Enhance communication and teamwork

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply engineering knowledge in practical context
CO2	Analyze and solve domain-specific problems
CO3	Design or evaluate engineering systems
CO4	Use modern tools effectively
CO5	Communicate technical information clearly

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

Course Contents

1. Study of Machine Tool Motions and Transmission Systems
2. Study of Speed and Feed Regulation in Machine Tools
3. Study of Design of Speed Box
4. Study of Design of Feed Box
5. Study of Machine Tool Structures
6. Study of Design of Machine Tool Elements
7. Study of Guideways in Machine Tools
8. Study of Power Screws Used in Machine Tools
9. Study of Spindle Design and Machine Tool Vibrations
10. Study of Control Systems and Industrial Robots

Subject Code	Human Resource Management Lab	Teaching Scheme	Credits
BTME25OE308L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Understand domain-specific concepts and applications
2	Apply analytical and engineering principles
3	Develop problem-solving ability
4	Use modern tools and techniques
5	Enhance communication and teamwork

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply engineering knowledge in practical context
CO2	Analyze and solve domain-specific problems
CO3	Design or evaluate engineering systems
CO4	Use modern tools effectively
CO5	Communicate technical information clearly

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

Course Contents

1. Study of Human Resource Management in an Organization
2. Study of Human Resource Planning and Recruitment
3. Study of Selection Process and Employee Socialization
4. Study of Training and Development Programs
5. Study of Career Development Practices
6. Study of Motivation Theories in Practice
7. Study of Job Design and Work Scheduling
8. Study of Performance Appraisal System
9. Study of Compensation and Reward Systems
10. Study of Employee Maintenance (Safety, Discipline, and Welfare)

Subject Code	Case Study/EDP Program/Startup Activity	Teaching Scheme	Credits
BTME25HM309		00L - 00T - 04P	02

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: -

Course Objectives

1	Understand the fundamentals of entrepreneurship and startup ecosystems.
2	Analyze real-world business case studies to identify challenges and strategic solutions.
3	Develop entrepreneurial skills through experiential learning and project-based activities.
4	Explore business planning, market analysis, and financial modeling techniques.
5	Apply innovation and design thinking to create viable startup ideas or social enterprises.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Demonstrate understanding of entrepreneurial concepts and startup dynamic
CO2	Analyze and present case studies with strategic insights
CO3	Design and execute business plans using EDP frameworks
CO4	Apply innovation and problem-solving skills to real-world challenges
CO5	Collaborate effectively to develop and pitch startup ideas or social ventures

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	-	-	3	2
CO2	-	2	-	-	-	-	-	-	2	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	3	-	-	-	-	-	-	-	2
CO5	-	-	-	-	-	-	-	3	3	-	-

Case Study Methodology

- Selecting and analyzing business cases
- Identifying problems, stakeholders, and solutions
- Presentation and documentation techniques

Entrepreneurship Development Program (EDP)

- Business model canvas
- Market research and feasibility analysis
- Financial planning and resource mobilization

Startup Activity and Incubation

- Ideation and validation
- MVP (Minimum Viable Product) development
- Pitching, funding, and scaling strategies

Subject Code	Basics of Human Rights	Teaching Scheme	Credits
BTME25HM310		01L - 00T - 00P	01

Teaching Scheme	Examination Scheme
Theory: 1 hr./week	Continuous Assessment: 50 Marks
Tutorial :	Mid-Semester Exam: -
Practical:	End Semester Exam: -

Course objective:

1	To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture
2	To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants
3	To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights
4	To develop sympathy in their minds for those who are denied rights
5	To make the students aware of their rights as well as duties to the nation

Course Outcomes: At the end of the course, the student will be able to:

CO1	Students will be able to understand the history of human rights.
CO2	Students will learn to respect others caste, religion, region and culture.
CO3	Students will be aware of their rights as Indian citizen.
CO4	Students will be able to understand the importance of groups and communities in the society.
CO5	Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	1	-	-	-	-	1
CO2	-	-	-	-	-	2	3	1	-	-	-
CO3	-	-	-	-	-	2	3	-	-	-	1
CO4	-	-	-	-	-	3	-	1	-	-	-
CO5	-	-	-	-	-	2	2	-	-	-	1

Course Contents:

Unit 1 Basic Concepts: (03 Hours)

The Basic Concepts: - Individual, group, civil society, state, equality, justice, Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution, Declaration of independence, Rights of citizen, Rights of working and exploited people.

Unit 2 Fundamental rights and economic programme: (03 Hours)

Fundamental rights and economic programme, Society, religion, culture, and their inter relationship, Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

Unit 3 Migrant worker (03 Hours)

Migrant workers and human rights violations, human rights of mentally and physically challenged, State, Individual liberty, Freedom and democracy, NGOs and human rights in India: - Land, Water, Forest issues.

Unit 4 Human rights in Indian constitution and law: (03 Hours)

Human rights in Indian constitution and law:- i) The constitution of India: Preamble ii) Fundamental rights iii) Directive principles of state policy vi) Fundamental duties v) Some other provisions.

Unit 5 Universal declaration: **(03 Hours)**

Universal declaration of human rights and provisions of India, Constitution and law, National human rights commission and state human rights commission.

Text/Reference Books:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005.
2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

Subject Code	Indian Constitution – Value Education	Teaching Scheme	Credits
BTME25VEC311		01L - 00T - 00P	01

Teaching Scheme	Examination Scheme
Theory: 1 hr./week Tutorial : Practical:	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam:-

Course objective:

1	Understand the historical background and philosophy behind the framing of the Indian Constitution
2	Explain the structure of the Indian government and its functioning at Union and State levels
3	Comprehend the Fundamental Rights, Directive Principles, and Fundamental Duties of Indian citizens
4	Analyze the distribution of powers, emergency provisions, and the role of constitutional bodies.
5	Develop awareness of constitutional values, governance ethics, and responsibilities as citizens of India

Course Outcomes: At the end of the course, the student will be able to:

CO1	Explain the historical evolution and salient features of the Indian Constitution
CO2	Describe the structure, powers, and functions of various organs of the government
CO3	Interpret the Fundamental Rights, Directive Principles, and Fundamental Duties of citizens
CO4	Analyze the functioning of constitutional bodies and evaluate governance mechanisms
CO5	Demonstrate responsible citizenship by applying constitutional values and principles in real life.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	3	2	-	-	-	-
CO4	-	-	-	-	-	2	-	-	-	-	-
CO5	-	-	-	-	-	3	3	1	-	-	-

Course Contents:

Unit 1 Introduction to the Constitution of India (09 Hours)

Historical Background and Making of the Constitution , Constituent Assembly: Composition, Committees, and Drafting Process , Preamble: Meaning, Components, and Significance, Salient Features of the Indian Constitution, Sources and Influences from Other Constitutions

Unit 2 Structure of the Union and State Governments (09 Hours)

Union Government: President, Vice-President, Prime Minister, Council of Ministers, Parliament: Composition, Powers, and Functions, State Government: Governor, Chief Minister, State Legislature, Judiciary: Supreme Court, High Courts, and Subordinate Courts, Federal System: Centre-State Relations and Inter-State Relations

Unit 3 Fundamental Rights, Directive Principles, and Duties (09 Hours)

Fundamental Rights: Nature, Scope, and Limitations (Articles 12–35), Directive Principles of State Policy: Meaning, Classification, and Implementation (Articles 36–51), Fundamental Duties: Origin, List, and Importance (Article 51A), Relationship between Rights, Duties, and DPSPs, Role of Judiciary in Protecting Fundamental Rights

Unit 4 Constitutional Bodies and Governance (09 Hours)

Election Commission of India, Finance Commission, NITI Aayog, and Comptroller & Auditor General (CAG), Union Public Service Commission (UPSC) and State PSCs, National Human Rights Commission, Women's Commission, and other statutory bodies, Local Self-Government: 73rd and 74th Amendments – Panchayati Raj and Municipalities

Unit 5 Amendments, Emergency, and Constitutional Values (09 Hours)

Procedure for Constitutional Amendments (Article 368), Major Amendments (1st, 42nd, 44th, 73rd, 74th, 86th, 101st), Emergency Provisions (Articles 352–360): Types and Effects, Constitutional Values and Ethics in Governance, Role of Citizens in Upholding Constitutional Morality and National Integration

Text/Reference Books:

1. *D.D. Basu,* Introduction to the Constitution of India, LexisNexis.
2. *M. Laxmikanth,* Indian Polity, McGraw Hill.
3. *Subhash Kashyap,* Our Constitution, National Book Trust.
4. P.M. Bakshi, The Constitution of India.
5. Granville Austin, The Indian Constitution: Cornerstone of a Nation.
6. Durga Das Basu, Shorter Constitution of India.

Subject Code	Field Visit/ Special Study/ Internship/ Social Activity Project/Community Initiative	Teaching Scheme	Credits
BTME25CEP312		00L - 00T - 04P	02

Teaching Scheme	Examination Scheme
Theory: 1 hr./week	Continuous Assessment: 50 Marks
Tutorial :	Mid-Semester Exam: -
Practical:	End Semester Exam:- -

Course objective:

1	To expose students to real-world industrial, organizational, or community environments.
2	To develop the ability to observe, analyze, and interpret field-based data.
3	To cultivate professional behavior, teamwork, and ethical responsibility in practical settings.
4	To encourage students to design and execute socially relevant or discipline-specific projects.
5	To enhance communication skills through report writing, documentation, and presentations.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Analyze and interpret field-based or organizational data in relation to academic concepts.
CO2	Demonstrate practical skills and professional behavior in real-world or community settings.
CO3	Design and implement socially relevant or discipline-specific projects with measurable outcomes.
CO4	Communicate findings and experiences effectively through written reports and oral presentations.
CO5	Reflect critically on personal growth, societal impact, and the learning process.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	3	-	2	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	2	-	-	2
CO3	-	-	3	-	-	-	-	-	-	2	-
CO4	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	-	3

- Orientation & planning
- Selection
- Execution
- Documentation & presentation

Subject Code BTME25PC401	Mechanics of Machines-II	Teaching Scheme 03L - 00T - 00P	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks/ Internal Assessment:

Course objective:

1.	To understand the principles, profiles, and performance parameters of toothed gears
2.	To analyze different types of gear trains and their torque transmission capabilities
3.	To study the working principles and performance characteristics of governors and gyroscopes
4.	To explore cam-follower mechanisms and flywheel dynamics in mechanical systems.
5.	To develop knowledge of balancing techniques for rotating and reciprocating masses in engines

Course Outcomes: At the end of the course, the student will be able to:

CO1	Explain gear terminology, conjugate action, and analyze gear profiles and contact parameters
CO2	Calculate velocity ratios, torque, and tooth loads in various gear train configurations
CO3	Evaluate the performance of governors and gyroscopes under dynamic conditions
CO4	Design cam profiles and determine flywheel dimensions based on energy fluctuation analysis.
CO5	Apply balancing techniques to reduce vibrations in rotating and reciprocating engine components

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	-	2	-	-	-	-	-	-	1
CO4	3	2	3	-	-	-	-	-	-	-	1
CO5	3	3	2	-	-	-	-	-	-	-	1

Course Contents

Unit 1 Toothed Gear (09 Hours)

Introduction, Classification, Terminology of gears, Conjugate action, Involute and cycloidal profile, Path of contact, Contact ratio, Interference, Effect of center distance variation, Internal gears.

Unit 2 Gear Trains (09 Hours)

Types of gear trains, Velocity ratio, Tooth load, Torque transmitted and holding torque, cyclometer, differential gear.

Unit 3 Governor and Gyroscope (09 Hours)

Governor: Function of governor, Inertia and centrifugal type of governors, Controlling force analysis, Governor Effort and governor power, Sensitivity, stability, Isochronisms and Hunting, Friction insensitiveness.

Gyroscope: Principles of gyroscopic action, Precession and gyroscopic acceleration, gyroscopic couple, Effect of the gyroscopic couple on ships and vehicles, gyroscopic stabilization.

Unit 4 Cam, Follower and Flywheel (09 Hours)

Cam and Follower: Types of cams and followers, Analysis of motion, Jump and ramp of cam, Determination of cam profiles for a given follower motion, Circular arc cam, Tangent cam, Cycloidal cam

Flywheel: Turning moment diagram, Fluctuation of energy and speed, Determination of flywheel size for different types of prime movers and machines.

Unit 5: Balancing **(09 Hours)**

Balancing of rotating masses in one and several planes, Balancing of reciprocating masses in single and multi-cylinder engine viz., inclined, radial and v-type engines, Primary and secondary balancing analysis, Swaying couple, Hammer Blow, Concept of direct and reverse cranks, Balancing of locomotive engines, Effect of partial balancing, Static and dynamic balancing.

Textbooks and References:

1. **Thomas Beven**, "Theory of Machines", CBS Publishers and Distributors, Delhi.
2. **J. E. Shigely, J. J. Uicker**, "Theory of Machines and Mechanisms", Tata McGraw Hill Publications, New York, International Student Edition, 1995.
3. **V. P. Singh,** "Theory of Machines", Dhanpat Rai & Co. Publication, New Delhi, 4th edition 2016
4. **A. Ghosh, A. K. Malik,** "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
5. **S. S. Rattan**, "Theory of Machines", Tata McGraw Hill, New Delhi.

Subject Code	Manufacturing Techniques-I	Teaching Scheme	Credits
BTME25PC402		03L - 00T - 00P	03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks/ Internal Assessment:

Course objective:

1.	To understand various manufacturing processes
2.	To make students aware of various casting and metal forming processes as per the application
3.	To teach principles of advanced welding processes and their applications
4.	To understand the fundamentals of metal cutting and the parameters of cutting forces
5.	To acquire skills to produce a composite job by manual process.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify castings processes, working principles and applications and list various defects in metal casting
CO2	Develop Understand the various metal forming processes, working principles and applications
CO3	Classify the basic joining processes and demonstrate principles of welding, brazing and soldering.
CO4	Study center lathe and its operations including plain, taper turning, work holding devices and cutting tool.
CO5	Understand drilling their types, reaming, milling machines and operations.

Mapping of course outcomes with program outcomes

Course Outcomes	ProgramOutcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	1	-	-	-	-	1
CO2	3	1	-	-	-	-	-	-	-	-	1
CO3	3	1	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	1

Course Contents:

Unit 1 **(09 Hours)**

Introduction and Casting Processes :

Introduction to casting processes, Patterns: Pattern materials, types of pattern, allowances pattern design, Moulding sand, Properties of moulding sands, Core making, Melting practices and furnaces, Pouring and Gating system design, Numerical estimation to find mold filling time, Riser design and placement, Principles of cooling and solidification of casting, Directional and Progressive solidification Estimation of solidification rate, Cleaning and Finishing of casting, Defects and remedies, Principle and equipments of Permanent mould casting, Investment casting, Centrifugal casting, Continuous casting

Unit 2 **(09 Hours)**

Metal Forming: Rolling and Forging Processes

Introduction to Rolling; Flat-rolling Process: Roll Force, Torque, and Power Requirements, Geometric Considerations; Flat-rolling Practice: Defects in Rolled Plates and Sheets; Rolling Mills; Various Rolling Processes and Mills.

Introduction to forging, Open-die forging; Impression-die and Closed-die forging; various forging Operations; Forging Defects; Die Materials and lubrication; Forging Machines.

Unit 3 **(09 Hours)**

Extrusion, Drawing:

Introduction; Extrusion Process; Hot Extrusion; Cold Extrusion: Impact extrusion, Hydrostatic Extrusion; Extrusion Defects; Extrusion Equipment; Drawing Process; Drawing Practice; Drawing Defects and Residual Stresses; Drawing Equipment.

Introduction to sheet metal forming, press working operations, types of bending, presses for sheet metal drawing, press accessories.

Unit 4 **(09 Hours)**

Joining Processes:

Oxy-fuel-gas Welding; Arc-Welding Processes: Non consumable Electrode; Arc-welding Processes: Consumable Electrode, Shielded Metal-arc Welding, Submerged-arc Welding, Gas Metal-arc Welding; Electrodes for Arc Welding; The Weld joint, Quality, and Testing: Weld Quality, Weldability, Testing of Welds.

Introduction to solid state welding, Friction Welding, Resistance Welding: Spot, Seam, Projection welding. Introduction to brazing and soldering.

Unit 5 **(09 Hours)**

Machining Processes: Turning, Hole Making and Milling:

Introduction; The Turning Process; Lathes and Lathe Operations: Lathe Components, Work holding Devices and Accessories, Lathe Operations, Types of Lathes. Types of chips, Boring and Boring Machines; Drilling Machines: Drills, Drill Materials and Sizes, Drilling Practice, Drilling Machines, Reaming operation and Reamers; Tapping and Taps.

.

Texts/References:

1. Serope Kalpak Jain and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6th edition, 2009
2. 2. P. N. Rao, "Manufacturing Technology Vol. I & II" , Tata McGraw-Hill Publishers.
3. 3. R. K. Jain, "Production Technology", Khanna Publishers
4. 4. Hajara Choudhary, Bose S K, Elements of Workshop Technology Vol I and II, Asia Publishing House
6. B. S. Raghuvanshi , Workshop Technology Vol.I and Vol.II Dhanpat Rai Publications,2009.
7. Ben Milkell P. Groover, " Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.
8. P. C. Sharma A Textbook of Production Technology, S. Chand & Company. Ltd.

Subject Code BTME25PC403	Engineering Fluid Mechanics	Teaching Scheme 02L - 00T - 00P	Credits 02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objective

1.	To introduce fundamental fluid properties and principles of hydrostatics including pressure and buoyancy
2.	To develop understanding of fluid kinematics and dynamics through flow classification and application of Bernoulli's equation
3.	To analyze viscous and turbulent flow behavior in pipes and channels
4.	To apply dimensional analysis and evaluate energy losses in pipe systems
5.	To understand the construction, working, and performance parameters of centrifugal pumps

Course Outcomes: At the end of course, students will be able to:

CO1	Explain fluid properties and calculate hydrostatic forces on various surfaces including floating bodies
CO2	Classify types of fluid flow and apply Bernoulli's equation to practical devices like Venturi and Pitot tubes
CO3	Analyze viscous and turbulent flow in pipes and determine associated losses
CO4	Perform dimensional analysis and assess energy transmission and losses in complex pipe networks
CO5	Describe the working of centrifugal pumps and evaluate their performance based on head, efficiency, and speed

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	-	-	-	-	-	-	-	-	1
CO3	3	3	-	2	-	-	-	-	-	-	1
CO4	3	3	2	-	-	-	-	-	-	-	1
CO5	3	3	2	2	-	-	-	-	-	-	1

Course Contents:

Unit 1: Fluid properties & Hydrostatic [06 Hours]

Fluid properties & its definitions, definition of fluid, Viscosity, Bulk modulus of elasticity, Vapour pressure, Surface tension, Capillarity, Manometers (No numerical on manometers), Pascal's law, Hydrostatic law its derivation, Total pressure & Centre of pressure on vertical, horizontal, inclined, curved surface its derivation.

Unit 2: Fluid Kinematics and Dynamics [06 Hours]

Types of flow, Definition of steady, Unsteady, Uniform, Non uniform, Laminar, Turbulent, Compressible, incompressible, rotational, Irrotational flow, 1D flows, Stream line, Streak line, concept of Velocity, potential & stream function flow net (no numerical treatment), Continuity equation for steady, Unsteady, Compressible incompressible, Bernoulli's equation along a stream line for incompressible flow

Unit 3: Viscous Flow and Turbulent Flow [06 Hours]

Introduction to flow of viscous fluid through circular pipes, two parallel plates derivation and numerical.
Turbulent Flow**:** Reynolds's experiment, frictional loss in pipe flow, shear stress in turbulent flow, major and minor losses.

Unit 4: Dimensional Analysis and Flow through Pipes [06 Hours]

Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers. (No numerical treatment), Loss of energy in pipes, loss of energy due to friction, minor energy losses, flow through pipes in series or compound pipes, equivalent pipe, parallel pipes, branched pipes.

Unit 5: Centrifugal Pump [06 Hours]

Introduction to main parts of centrifugal pump, working & construction of centrifugal pump, types of impellers, types of casings, priming, Work done on centrifugal pump, various heads and efficiencies of centrifugal pump, minimum starting speed of a centrifugal pump, multistage centrifugal pump.

Texts / Reference:

1) P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10th edition,1991.
2) Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons, 5thedition.
3) V. L. Streeter, K. W. Bedfordand E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill, 9thedition, 1998.
4) S. K. Som, G.Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2ndedition, 2003.

Subject Code	Reliability Engineering	Teaching Scheme	Credits
BTME25OE405A		02L - 00T - 00P	02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week	Continuous Assessment: 20 Marks
Tutorial :	Mid-Semester Exam: - 20 Marks
Practical:	End Semester Exam: - 60 Marks

Course objective:

1	Understand the basic concepts and importance of reliability engineering in product and system design
2	Learn various reliability models and probability distributions used in reliability analysis.
3	Analyze system reliability using different configurations and failure rate models.
4	Apply statistical methods for reliability testing, maintenance planning, and life estimation.
5	Develop the ability to design reliable systems and make informed decisions to improve product performance and safety

Course Outcomes: At the end of the course, the student will be able to:

CO1	Explain the fundamental concepts of reliability, maintainability, and availability
CO2	Apply probability theory to model and evaluate the reliability of components and systems.
CO3	Analyze and calculate system reliability for different configurations using reliability modeling techniques.
CO4	Perform reliability testing and interpret data to estimate product life and failure characteristics
CO5	Formulate strategies for maintenance and design improvements to enhance system reliability and performance

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	1
CO3	3	3	2	-	-	-	-	-	-	-	1
CO4	3	2	-	3	-	-	-	-	-	-	1
CO5	2	2	3	-	-	1	-	-	-	2	2

Course Contents:

Unit 1 Introduction to Reliability Engineering (06 Hours)

Definition and importance of reliability, Concepts of failure, failure rate, and life characteristics of products, Reliability, availability, and maintainability (RAM) concepts, Types of failures: random, wear-out, and infant mortality.

Unit 2 Probability Concepts in Reliability (06 Hours)

Basic probability theory and rules, Conditional probability and Bayes' theorem, Reliability function, probability density function (PDF), and cumulative distribution function (CDF), Common lifetime distributions: Exponential distribution, Weibull distribution, Normal and Log-normal distributions.

Unit 3 System Reliability Analysis (06 Hours)

Series, parallel, and mixed system configurations, Block diagram representation and reliability calculations, Redundancy and its types (active, standby, k-out-of-n systems), Fault tree analysis (FTA) and reliability block diagrams (RBD).

Unit 4 Reliability Testing and Data Analysis (06 Hours)

Types of reliability tests: life testing, burn-in, accelerated life testing, Estimation of reliability from test data, Parametric methods for reliability estimation, Censoring and truncated tests, Goodness-of-fit tests and chi-square analysis, Use of statistical software for reliability data analysis.

Unit 5 Maintainability, Availability, and Reliability Improvement (06 Hours)

Maintainability concepts and measures, Availability models: inherent, achieved, and operational availability, Preventive and corrective maintenance planning, Reliability centered maintenance (RCM), Case studies and applications in industrial systems

Text/Reference Books:

1. **Charles E. Ebeling**, An Introduction to Reliability and Maintainability Engineering, McGraw Hill.
2. **L.S. Srinath**, Reliability Engineering, Affiliated East-West Press.
3. **A. K. Govil**, Reliability Engineering, Tata McGraw Hill.
4. **Ireson, Coombs & Moss**, Handbook of Reliability Engineering and Management, McGraw Hill.
5. **O'Connor & Kleyner**, Practical Reliability Engineering, Wiley.
6. **Dhillon, B.S.**, Engineering Reliability: New Techniques and Applications, CRC Press.
7. **Modarres, Kaminskiy & Krivtsov**, Reliability Engineering and Risk Analysis, CRC Press

Subject Code	Biomechanics	Teaching Scheme	Credits
BTME25OE405B		02L - 00T - 00P	02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week	Continuous Assessment: 20 Marks
Tutorial :	Mid-Semester Exam: - 20 Marks
Practical:	End Semester Exam: - 60 Marks

Course Objective:-

1.	To review fundamental mechanics principles and apply them to biomechanical systems
2.	To understand the structure, function, and mechanical behavior of skeletal joints under various loads
3.	To explore fluid mechanics concepts as applied to biological systems like blood flow and respiration
4.	To analyze the mechanical properties and behavior of hard tissues such as bones.
5.	To study soft tissue mechanics and the design principles of biomechanical implants and biomaterials

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply principles of mechanics to analyze forces, motion, and energy in biomechanical systems
CO2	Perform biomechanical analysis of major human joints and evaluate stress distribution
CO3	Explain rheological properties of blood and describe fluid flow in cardiovascular and respiratory systems
CO4	Assess mechanical and viscoelastic properties of hard tissues and interpret anisotropic behavior
CO5	Evaluate soft tissue mechanics and design considerations for prosthetic implants and biomaterials

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	-	1	-	-	-	-	-	-	1
CO3	3	2	-	-	-	2	-	-	-	-	1
CO4	3	3	-	1	-	-	-	-	-	-	1
CO5	2	2	3	-	-	2	-	-	-	-	2

Course Contents:

Unit 1: Introduction **[06 Hours]**

Review of principle of mechanics, vector mechanics-resultant forces of coplanar and noncoplanar and concurrent and non-concurrent forces, parallel forces in planes, equilibrium of coplanar forces, Newton's law of motion, work and energy, moment of inertia.

Unit 2: Biomechanics of Joints **[06 Hours]**

Skeletal joints, forces and stresses in human joints, type of joints, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

Unit 3: Bio-fluid Mechanics **[06 Hours]**

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, cardiovascular and respiratory system.

Unit 4: Hard Tissues **[06 Hours]**

Bone structure and composition, Mechanical properties of bones, cortical and cancellous bones, visco-elastic properties, Maxwell and Vigot model – Anisotropy

Unit 5: Soft Tissues and Biomechanics of Implant **[06 Hours]**

Structure and functions of soft tissue: cartilage, tendon, ligament and muscle, Material properties of cartilage, tendon and ligament and muscle

Biomechanics of Implant: Specification for prosthetic joints, biocompatibility, requirement of biomaterial, characterization of different type of biomaterials, fixation of implants.
To review fundamental mechanics principles and apply them to biomechanical systems

Texts/References:

1. Y. C. Fung, "Biomechanics: Mechanical properties of living tissues", Springer-Verlag, 2nd edition, 1993.
D. J. Schneck, J. D. Bronzino, "Biomechanics: Principle and Applications", CRC Press, 2nd edition, 2000.

Subject Code	Strength and Mechanics of Material	Teaching Scheme	Credits
BTME25OE405C		02L - 00T - 00P	02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week	Continuous Assessment: 20 Marks
Tutorial :	Mid-Semester Exam: 20 Marks
Practical:	End Semester Exam: 60 Marks

Course objective:

1.	Develop analytical skills to determine stresses, strains, and deformations in structural and mechanical components
2.	Introduce concepts of elasticity, plasticity, and material toughness, preparing students for advanced study in structural and mechanical engineering
3.	Apply fundamental concepts of stress-strain relationships, material properties, and failure theories
4.	Analyze and design structural members like beams, shafts, columns, and pressure vessels for safe and efficient performance
5.	Understand the mechanical behaviour of materials under different loading conditions, such as axial, Torsional, bending, and shear loads

Course Outcomes: At the end of the course, the student will be able to:

CO1	State the basic definitions of fundamental terms such as axial load, eccentric load, stress, strain, E, μ, principle stresses, etc.
CO2	Analyze the stresses and strain energy in different load cases
CO3	Design the columns based on deflection
CO4	Analyze given beam for calculations of SF and BM
CO5	Design a shafts based on torsion and find the stresses in thin and thick cylinder

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	1
CO2	3	3	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	1
CO4	3	3	-	-	-	-	-	-	-	-	-
CO5	3	2	3	-	-	-	-	-	-	-	1

Unit 1 Simple Stresses and Strains [06 Hours]

Mechanical properties of materials, simple stresses and strains, stress strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants. Principal Stresses and Strains Uni-axial stress, simple shear, principal stresses and principal planes, principal strains, shear strains.

Unit 2:

Strain energy, resilience and Combined Stresses [06 Hours]

Strain energy, resilience: Load-deflection diagram, proof resilience, stresses due to gradual, sudden and impact loadings, shear resilience, Combined axial and flexural loads, middle third rule, kernel of a section, eccentrically applied load.

Unit 3: Stresses in Beams [06 Hours]

Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections-rectangular, solid circular, I section.

Unit 4: Shear Force and Bending Moment Diagram [06 Hours]

Introduction to different types of beams, different types of supports & loads. Concept and definition of shear force and bending moment in determinant beams due to concentrated loads, UDL, UVL and couple. Relation between SF, BM and intensity of loading, construction of shear force and bending moment diagram for cantilever, simple beams, defining critical and maximum value and position of point of contra flexure. Construction of BMD and load diagram from SFD,

Unit 5: Torsion [06 Hours]

Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders.

Texts/Reference Books:

1. S. Ramamrutham, “Strength of Materials”, Dhanpat Rai and Sons, New Delhi.
2. F. L. Singer, Pytle, “Strength of Materials”, Harper Collins Publishers, 2002. S.
3. Timoshenko, “Strength of Materials: Part-I (Elementary Theory and Problems)”, CBS Publishers, New Delhi.
4. E. P.Popov, “Introduction to Mechanics of Solid”, Prentice Hall, 2nd edition, 2005.
5. S. H. Crandall, N. C. Dahl, T. J. Lardner, “An introduction to the Mechanics of Solids”, Tata McGraw Hill Publications, 1978.

3. S. B. Punmia, “Mechanics of Structure”, Charotar Publishers, Anand

Subject Code	Product Design Engineering	Teaching Scheme	Credits
BTME25OE405D		02L - 00T - 00P	02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week	Continuous Assessment: 20 Marks
Tutorial :	Mid-Semester Exam: 20 Marks
Practical:	End Semester Exam: 60 Marks

Course objective:

1.	To impart foundational knowledge of product design engineering, including product life cycle and innovative design thinking.
2.	To enable students to analyze material selection and ergonomics principles for efficient and user-friendly product design.
3.	To develop skills in engineering tools and computer-aided design software for product modeling and validation.
4.	To teach principles of design for manufacturing, sustainability, cost estimation, and reliability in product development.
5.	To build capabilities in project management, effective communication, teamwork, and integrating sustainability and safety in product design

Course Outcomes: At the end of the course, the student will be able to:

CO1	Explain key concepts of product design, development stages, and application of design thinking for innovative solutions.
CO2	Apply material selection, ergonomics, cost analysis, and safety standards in mechanical product design.
CO3	Use CAD and simulation tools for creating, validating, and presenting product models.
CO4	Evaluate product designs for manufacturing feasibility, sustainability, cost-effectiveness, and reliability.
CO5	Demonstrate project management skills, effective teamwork, and communication in product design projects emphasizing sustainability and safety.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	3	-	-	2	-	-	-	-	2
CO2	3	2	3	-	-	2	-	-	-	1	1
CO3	2	-	-	-	3	-	-	-	2	-	-
CO4	2	3	3	-	-	3	-	-	-	2	2
CO5	-	-	-	-	-	2	2	3	3	3	2

Course Contents:

Unit 1 **(06 Hours)**

Introduction to Product Design and Development

Overview of product design engineering: importance and scope. Stages of product Development: concept, planning, design, testing, and launch. Concept generation and selection, product architecture, modularization. Design thinking and creative problem-solving techniques. Customer needs analysis and quality function deployment (QFD).

Unit 2 **(06 Hours)**

Material Selection and Ergonomics in Design

Material properties and selection criteria for mechanical components. Factors affecting product design: strength, durability, cost, aesthetics. Ergonomics principles for user-friendly design. man–machine interaction, comfort, aesthetics. Value Analysis and Engineering, basic costing methods.

Unit 3 **(06 Hours)**

Engineering Tools and Computer-Aided Design

Introduction to CAD software for product modeling (e.g., SolidWorks, AutoCAD). Creating 2D sketches and 3D models. Rapid prototyping and additive manufacturing basics. Simulation and analysis tools for design validation, report generation.

Unit 4 **(06 Hours)**

Design for Manufacturing, Sustainability, and Cost

Design for manufacturing and assembly (DFM/DFA) principles, Life cycle assessment (LCA) and sustainability in product design. Cost estimation and economic analysis in design decisions. Safety and reliability considerations in mechanical product design. Concurrent engineering, rapid prototyping, additive manufacturing overview.

Unit 5 **(06 Hours)**

Project Management and Communication in Product Design

Basics of project management in product development. Teamwork and leadership in multidisciplinary design teams. Effective communication: technical reports, presentations, and documentation. Emphasis on sustainability, cost, safety, and aesthetics in final design proposals.

Texts/References:

1. Product Design and Manufacturing, Avinash K. Chitale, R.C. Gupta, PHI Learning (7th Edition, 2023)
2. Product Design and Value Engineering, Dr. M. A. Bulsara, Dr. H. R. Thakkar, Charotar Publishing (2nd Edition, 2015)
3. Product Design for Engineers, Devdas Shetty, Cengage India (1st Edition, 2016)
4. Product Design and Development, Karl T. Ulrich, Steven D. Eppinger, McGraw-Hill (6th Edition, 2015)
5. Engineering Design: A Systematic Approach, G. Pahl, W. Beitz, Springer (3rd Edition, 2007)

Subject Code	Mechanics of Machines-II Lab	Teaching Scheme	Credits
BTME25AE406L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objective

1.	To study the working principles and applications of gear boxes, governors, gyroscopes, and dynamometers.
2.	To develop skills in generating gear and cam profiles using graphical and analytical techniques.
3.	To understand dynamic behavior of rotating systems through balancing experiments.
4.	To analyze gyroscopic effects and apply them to real mechanical systems.
5.	To enhance technical reporting, teamwork, and problem-solving abilities in laboratory settings.

Course Outcomes: At the end of course, students will be able to:

CO1	Identify and study different types of gear boxes, governors, gyroscopes, and dynamometers.
CO2	Generate cam and gear tooth profiles and examine phenomena such as undercutting and rack shift.
CO3	Analyze the characteristic behavior of governors and evaluate performance parameters.
CO4	Demonstrate understanding of gyroscopic principles and their effects on mechanical systems.
CO5	Perform dynamic balancing of rotating components using a balancing machine and interpret results.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	3	-	-	-	-	-	-
CO3	-	3	-	3	-	-	-	-	-	-	-
CO4	3	-	-	3	-	-	-	-	-	-	-
CO5	2	-	-	3	-	-	-	3	2	-	-

Course Contents

List of Practical's/Experiments/Assignments (Any 8)

Term work should consist of total 8 experiments from the below given list.

1. Study of various types of gear boxes such as Industrial gear box, Synchromesh gear box, Differential gear box, etc.
2. To draw conjugate profile for any general shape of gear tooth
3. To generate gear tooth profile and to study the effects under cutting and rack shift using models
4. To draw cam profile for various types of follower motions (on drawing sheet)
6. To study various types of dynamometers
7. To determine speed vs. lift characteristic curve of a any governor and to find its coefficient of insensitiveness and stability.
8. Verification of principle of gyroscope and gyroscopic couple using motorized gyroscope
9. Study of any tow gyro-controlled systems
10. To study the dynamic balancing machine and to balance a rotor such as a fan or the rotor of electric motor or disc on the machine
11. Study of epicyclic gear train and find holding torque.

Subject Code BTME25AE407	Engineering Fluid Mechanics Lab	Teaching Scheme 00L - 00T - 02P	Credits 01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objective

1.	To provide practical exposure to fundamental concepts of fluid mechanics through laboratory experiments.
2.	To visualize and understand different flow regimes and fluid behavior.
3.	To experimentally verify important laws and principles of fluid mechanics.
4.	To develop competence in using fluid mechanics laboratory instruments and measurement techniques.
5.	To analyze experimental data and draw meaningful engineering conclusions

Course Outcomes: At the end of course, students will be able to:

CO1	Demonstrate understanding of fluid flow characteristics such as laminar, turbulent flow, and hydraulic jump.
CO2	Verify fundamental principles of fluid mechanics including Bernoulli's theorem, Reynolds number, and momentum equation.
CO3	Measure and analyze flow parameters like pressure, discharge, viscosity, and velocity using laboratory equipment.
CO4	Conduct experiments, analyze data, and interpret results to draw valid conclusions.
CO5	Use appropriate fluid mechanics instruments and modern engineering tools effectively and safely.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	3	2	-	-
CO5	-	-	-	-	3	-	-	-	-	-	-

List of Practicals/Experiments/Assignments (Any 8)

1. Flow visualization technique: characteristics of laminar and turbulent flow patterns using Helleshaw Apparatus.
2. Verification of Bernoulli's theorem
3. Determination of Critical Reynolds number using Reynolds Apparatus
4. Determination of pressure drop in pipes of various cross-sections
5. Determination of pressure drops in pipes of various pipe fittings etc.
6. Viscosity measurement using viscometer (at least one type)
7. Verification of momentum equation using impact of jet apparatus.
8. Determination of metacentric height of a floating body
9. Calibration of a selected flow measuring device and Bourdon pressure gauge
10. Pressure measurements using various types of manometers, Bourdon type pressure gauge.
11. Study of hydraulic jump.

Subject Code	Reliability Engineering Lab	Teaching Scheme	Credits
BTME25OE408L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Understand domain-specific concepts and applications
2	Apply analytical and engineering principles
3	Develop problem-solving ability
4	Use modern tools and techniques
5	Enhance communication and teamwork

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply engineering knowledge in practical context
CO2	Analyze and solve domain-specific problems
CO3	Design or evaluate engineering systems
CO4	Use modern tools effectively
CO5	Communicate technical information clearly

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

Course Contents

1. Study of Reliability Concepts in Engineering Systems
2. Study of Reliability, Availability, and Maintainability (RAM)
3. Study of Types of Failures in Systems
4. Study of Probability Concepts in Reliability
5. Study of Reliability Functions and Distributions
6. Study of System Reliability Using Configurations
7. Study of Redundancy Techniques in Reliability Improvement
8. Study of Fault Tree Analysis (FTA)
9. Study of Reliability Testing and Data Analysis
10. Study of Maintainability and Reliability Improvement

Subject Code	Biomechanics Lab	Teaching Scheme	Credits
BTME25OE408L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Understand domain-specific concepts and applications
2	Apply analytical and engineering principles
3	Develop problem-solving ability
4	Use modern tools and techniques
5	Enhance communication and teamwork

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply engineering knowledge in practical context
CO2	Analyze and solve domain-specific problems
CO3	Design or evaluate engineering systems
CO4	Use modern tools effectively
CO5	Communicate technical information clearly

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

Course Contents

1. Study of Fundamental Mechanics in Biomechanical Systems
2. Study of Work, Energy, and Moment of Inertia in Human Movement
3. Study of Biomechanics of Human Joints
4. Study of Biomechanical Analysis of Major Joints
5. Study of Rheological Properties of Blood
6. Study of Bio-fluid Mechanics in Human Systems
7. Study of Mechanical Properties of Bone
8. Study of Viscoelastic Behavior of Hard Tissues
9. Study of Soft Tissues and Their Mechanical Properties
10. Study of Biomechanics of Implants and Biomaterials

Subject Code	Strength and Mechanics of Materials Lab	Teaching Scheme	Credits
BTME25OE408L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Provide hands-on experience in testing the mechanical properties of materials.
2	Develop practical skills in using laboratory equipment such as universal testing machines, torsion testing machines, and hardness testers.
3	Validate theoretical concepts through experimental observation of stress, strain, elasticity, and failure in materials.
4	Enhance understanding of material behavior under various loading conditions, including tension, compression, bending, and torsion.
5	Promote accurate data collection, analysis, and interpretation to evaluate material performance.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Perform experiments to determine mechanical properties such as tensile strength, compressive strength, hardness, and impact resistance of engineering materials.
CO2	Analyze stress-strain behavior and interpret key material characteristics like modulus of elasticity, yield strength, and ultimate strength.
CO3	Conduct and evaluate tests on beams, columns, and shafts to understand bending, buckling, and torsion behavior.
CO4	Use testing machines and measuring instruments correctly and safely according to standard procedures.
CO5	Record experimental data accurately and prepare technical reports with proper interpretation of results.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	3	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	3	2	3	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	-

Course Contents

1. Tension test on ferrous and nonferrous alloys (mild steel/ cast iron/ aluminum).
2. Compression test on mild steel, aluminum, concrete and wood.
3. Shear test on mild steel and aluminum (single and double shear test).
4. Flexure test on timber and cast iron beams.
5. Graphical solution method for principal stress problem.
6. Impact test on mild steel, brass, aluminum, and cast iron specimens.
7. Torsion test on mild steel and cast iron solid bars and pipes.
8. Study of Plotting and Analysis of Stress–Strain Curve
9. Study of determination of Principal Stresses and Planes
10. Study of Construction of Shear Force and Bending Moment Diagram
11. Bending Stress Analysis using CAD/Simulation
12. Study of an Analysis of Torsion and Combined Loading.

Subject Code	Product Design Engineering Lab	Teaching Scheme	Credits
BTME25OE408L		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: - 50 Marks

Course Objectives:

1	Understand domain-specific concepts and applications
2	Apply analytical and engineering principles
3	Develop problem-solving ability
4	Use modern tools and techniques
5	Enhance communication and teamwork

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply engineering knowledge in practical context
CO2	Analyze and solve domain-specific problems
CO3	Design or evaluate engineering systems
CO4	Use modern tools effectively
CO5	Communicate technical information clearly

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

Course Contents (use any 3D CAD software to perform the following practical's)

1. 2D Sketch of Simple Product
2. Basic Product Assembly
3. Material Assigning to machine Parts.
4. Ergonomic Handle Design
5. 3D Modeling of Mechanical Part
6. Assembly of Nut and Bolt
7. Rendering of Product Model
8. Design for Manufacturing Modification
9. Sustainable Product Redesign

Subject Code	Workshop	Teaching Scheme	Credits
BTME25VS409		00L - 00T - 02P	01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 02 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: -

Course Objective

1.	To identify basic manufacturing process.
2.	To understand the basic of joining process.
3.	To understand the different forming process.
4.	To understand the fundamentals of metal cutting and parameters of cutting forces

Course Outcomes: At the end of course, students will be able to:

CO1	Choose casting process of various applications
CO2	Illustrate different forming process
CO3	Make use of various welding operations in various engineering applications.
CO4	Understand drilling their types, reaming, milling machines and operations
CO5	Understand shearing and blanking operations.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	1	-	-	-	-	1
CO2	2	-	-	-	-	-	-	-	-	-	1
CO3	3	-	-	-	-	-	-	-	-	-	1
CO4	2	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	-	-	-	1

Course Contents: (Any four)

1. Practical on pattern making
2. Practical on arc welding
3. Practical on soldering
4. Practical on gas welding
5. Mini project / fabricated model using arc welding (Group of 4-5 students)
6. Mini project / fabricated model using various machining process. (Group of 4-5 students)
7. Cutting of a steel plate using oxyacetylene flame cutting /plasma cutting.
8. Making a job with a process plan involving plain, step and taper turning as well thread cutting, chamfering, grooving, drilling etc. as operations on a Centre lathe.
9. An experiment on shearing operation
10. An experiment on blanking operation

Note:

1. Candidates are required to finish the job to the following limits
   Machine Shop: + 0.5mm or -0.5mm
2. Workshop book to be submitted comprising of Job drawing, process sheet for a given job along with the sketches of tools used for operations.

Details of online laboratory resource material instructions / Operating manuals	
1	Virtual labs – Metal forming lab http://msvs-dei.vlabs.ac.in/msvs-dei/
2	Virtual labs – Fab lab http://fab-coep.vlabs.ac.in
3	Virtual lab – General purpose Production shop simulation lab http://qssl.iitk.ac.in/pssl/

Subject Code	Universal Human Values-II	Teaching Scheme	Credits
BTME25VEC410		03L - 00T - 00P	03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: - 20 Marks End Semester Exam:- -60 Marks

Course objective:

1	To understand the importance of value education in technical and professional life.
2	To develop self-awareness and harmony within oneself.
3	To promote harmony in family, society, and professional relationships.
4	To understand the interrelationship between human beings and nature.
5	To cultivate ethical responsibility and holistic vision in engineering practice

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the significance of Universal Human Values and self-exploration
CO2	Develop harmony within self by understanding human aspirations and needs
CO3	Promote ethical and harmonious relationships in family and society
CO4	Recognize the importance of sustainable development and environmental responsibility
CO5	Apply ethical principles in professional contexts, showing competence in humanistic values and sustainable practice

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	1	-	-	2	1	2	1	1	–
CO2	-	-	1	-	-	2	1	2	1	1	–
CO3	-	-	2	-	-	3	1	3	2	2	1
CO4	-	-	2	-	-	2	3	2	1	1	–
CO5	-	-	2	-	-	3	2	3	2	2	1

Course Contents:

Unit I : Introduction to Value Education **(09 Hours)**

Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity, the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness
and Prosperity, Current Scenario, Method to Fulfill the Basic Human Aspirations.

Unit II: Harmony in the Human Being (Self) **(09 Hours)**

Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to Ensure self-regulation and Health.

Unit III: Harmony in the Family and Society **(09 Hours)**

Family as the basic unit of human interaction, Values in human-human relationships: Trust, Respect, Affection, Care, Guidance, Gratitude, Justice and equality in society, Mutual happiness and mutual prosperity, Social responsibility of engineers.

Unit IV: Harmony with Nature and Existence **(09 Hours)**

Understanding nature as coexistence, Interconnectedness of human beings, society, and nature, Sustainable development, Ethical use of natural resources, Environmental responsibility of engineers, Role of technology in ecological balance.

Unit V: Holistic Vision of Life and Profession **(09 Hours)**

Ethical responsibility in engineering profession, Value-based decision making, Professional ethics and social accountability, Holistic vision of life, Role of engineers in nation building, Case studies related to ethics and values.

Text Books:

1. A Foundation Course in Human Values and Professional Ethics – R. R. Gaur, R. Asthana, and G. P. Bagaria, Excel Books, New Delhi.
2. Human Values – A. N. Tripathi, New Age International Publishers.

Reference Books:

1. Human Values and Professional Ethics – M. K. Dixit, Vikas Publishing House.
2. Value Education – S. B. Lall & N. N. Tripathi, Vikas Publishing House.
3. Ethics in Engineering – Subhash Sharma, Galgotia Publications.
4. Handbook on Universal Human Values – AICTE.

NPTEL Course : Exploring Human Values: Visions of Happiness and Perfect Society, IIT Kanpur, by Prof. A.K. Sharma.

Link : https://nptel.ac.in/courses/109104068

Subject Code	Mini Project/ Case Study/ EDP Program/ Startup Activity	Teaching Scheme	Credits
BTME25HM411		00L - 00T - 04P	02

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 4 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: -

Course Objectives

1	Encourage experiential learning through hands-on projects and real-world case studies
2	Develop entrepreneurial thinking and problem-solving skills
3	Expose students to business planning, market analysis, and startup ecosystems
4	Enhance teamwork, leadership, and communication through collaborative activities
5	Enable students to conceptualize, design, and present viable business or social solutions

Course Outcomes: At the end of the course, the student will be able to:

CO1	Demonstrate the ability to apply theoretical knowledge to practical challenges.
CO2	Analyze and present case studies with critical insights and strategic recommendations
CO3	Design and execute mini projects with measurable outcomes
CO4	Develop entrepreneurial ideas and articulate viable business models
CO5	Exhibit teamwork, leadership, and presentation skills in project and startup contexts

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	-	-	-	-	-	2	2
CO2	-	3	-	-	-	2	-	-	2	-	-
CO3	-	-	3	-	-	-	-	2	-	3	-
CO4	-	-	-	-	-	-	-	-	2	3	2
CO5	-	-	-	-	-	-	-	3	3	1	-

Mini Project

- Project planning and execution
- Research, prototyping, and testing
- Evaluation and feedback mechanisms

Case Study

- Selecting and analyzing real-world cases
- Identifying challenges and proposing solutions
- Presentation and documentation techniques

Entrepreneurship Development Program (EDP)

- Business model canvas and lean startup principles
- Market research and feasibility analysis
- Funding, pitching, and scaling strategies

Startup Activity and Incubation

- Ideation and validation
- Building MVPs (Minimum Viable Products)
- Networking, mentorship, and incubation support

Subject Code	Life of Shri Sant Gadge Baba	Teaching Scheme	Credits
BTME25VEC12		01L - 00T - 00P	01

Teaching Scheme	Examination Scheme
Theory: 1 hr./week Tutorial : Practical:	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: -

Course Objectives

1	Understand the early life, background, and spiritual journey of Sant Gadge Baba
2	Explore his contributions to social reform, sanitation, and upliftment of marginalized communities
3	Analyze the philosophical and ethical principles guiding his actions and teachings
4	Appreciate his role in promoting cleanliness, education, and humanitarian values
5	Reflect on the relevance of his legacy in contemporary social and civic contexts

Course Outcomes : : At the end of the course, the student will be able to

CO1	Describe the life events and spiritual evolution of Sant Gadge Baba
CO2	Identify his key contributions to social reform and public welfare
CO3	Interpret the ethical and philosophical foundations of his teachings
CO4	Evaluate the societal impact of his work and its historical significance.
CO5	Apply his values to current civic and educational initiatives

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	-	-	-	1
CO2	-	-	-	-	-	3	2	-	-	-	-
CO3	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	3	2	-	-	-	-
CO5	-	-	-	-	-	2	3	2	-	-	1

Unit 1: Early Life and Background **(03 Hours)**

- Birth and childhood in Shendgaon, Maharashtra
- Personal hardships and spiritual awakening
- Influence of Bhakti movement and saint traditions

Unit 2: Social Reform and Public Service **(03 Hours)**

- Village sanitation campaigns and shramdaan (voluntary labor)
- Promotion of education, dharmashalas, and public welfare institutions
- Advocacy for equality and justice

Unit 3: Philosophical and Ethical Teachings **(03 Hours)**

- Emphasis on service over rituals
- Ethical values: humility, compassion, and selflessness
- Kirtans and public discourses as tools for reform

Unit 4: Legacy and Impact **(03 Hours)**

- Influence on leaders like Dr. B.R. Ambedkar
- Enduring inspiration for NGOs and civic movements
- Recognition by government and society

Unit 5: Contemporary Relevance **(03 Hours)**

- Cleanliness drives and Swachh Bharat parallels
- Moral education and civic responsibility
- Integration of Gadge Baba’s values in modern curriculam

Textbooks / Reference Books

1. Sant Gadge Baba. (2015). Pune: Government of Maharashtra, Directorate of Cultural Affairs.
2. Sant Gadge Baba: Vyakti ani Karya. (2012). Nagpur: Maharashtra Rajya Sahitya ani Sanskruti Mandal.
3. Gadge Baba: Samajik Krantiche Praneta. (2016). Amravati: Sant Gadge Baba Amravati University Press.
4. Samaj Sudharak Sant Gadge Baba. (2014). Mumbai: Popular Prakashan.
5. Saints of Maharashtra. (2010). New Delhi: National Book Trust, India.
6. Bhakti Movement in India. (2009). New Delhi: Oxford University Press.

Subject Code	Moral & Ethical Development	Teaching Scheme	Credits
BTME25VEC413		02L - 00T - 00P	02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week Tutorial : Practical:	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: -

Course Objectives

1	Understand the basic concepts and significance of morality and ethics
2	Explore major theories of moral and ethical development
3	Examine the role of social, emotional, and cultural influences on moral behaviour
4	Apply ethical frameworks to analyze real-life dilemmas.
5	Promote moral reasoning and ethical awareness in personal and professional contexts

Course Outcomes: Upon successful completion of this course, students will be able to:

CO1	Define key concepts in morality and ethics
CO2	Describe and compare major theories of moral development
CO3	Analyze factors influencing ethical behaviour
CO4	Evaluate ethical dilemmas using appropriate frameworks
CO5	Demonstrate strategies to foster moral and ethical growth

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-
CO3	-	-	-	-	-	2	3	-	-	-	-
CO4	-	-	-	-	-	2	3	-	-	-	1
CO5	-	-	-	-	-	-	3	-	-	-	2

Course Contents

Unit 1: Introduction to Morality and Ethics **(06 Hours)**
- Definitions and distinctions
- Importance in society and education
- Sources of moral values

Unit 2: Theories of Moral Development **(06 Hours)**
- Piaget, Kohlberg, Gilligan
- Social learning and moral reasoning

Unit 3: Influences on Moral Development **(06 Hours)**
- Role of family, peers, culture
- Emotional and cognitive factors

Unit 4: Ethical Frameworks and Application **(06 Hours)**
- Utilitarianism, Deontology, Virtue Ethics
- Case studies and ethical decision-making

Unit 5: Contemporary Ethical Issues and Moral Education **(06 Hours)**
- Ethics in technology, environment, and society
- Strategies for moral education

Textbooks / Reference books

1. Pande, G. (2023). Ethics, Integrity and Aptitude. New Delhi: Pearson Education.
2. Rachels, J., & Rachels, S. (2020). The Elements of Moral Philosophy (9th ed.). New York: McGraw-Hill.

3. Kohlberg, L. (1981). Essays on Moral Development: The Philosophy of Moral Development, Volume One. San Francisco: Harper & Row.
4. Piaget, J. (1965). The Moral Judgment of the Child. London: Routledge & Kegan Paul.
5. Gilligan, C. (1993). In a Different Voice: Psychological Theory and Women's Development (2nd ed.). Cambridge, MA: Harvard University Press.
6. Lickona, T. (1991). Educating for Character: How Our Schools Can Teach Respect and Responsibility. New York: Bantam Books.
7. Sekhar, M. G. (2019). Ethics and Human Values. Chennai: Oxford University Press.