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||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

III Semester
Scheme & Syllabus of B.E. Programme
Mechanical Engineering
(2024 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

NAAC A+

QS I-GAUGE GOLD

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from2024 – 2025

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SCHEME OF TEACHING AND EXAMINATION – B.E. – Mechanical Engineering

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

3rd Semester

Mechanical Engineering												
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**TD/ PSB**	**Teaching Hours / Week**			**Examination**				
					L	**T**	**P**	**SEE Duration (Hrs)**	**CIE Marks**	**SEE Marks**	**Total Marks**	**Credits**
1	BMATM301	Mathematics-III Mechanical Stream	ASC	MAT	3	2	0	**3**	**50**	**50**	**100**	**4**
2	BME302	Material Science & Engineering	IPCC	ME	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BME303	Manufacturing Process & Technology	IPCC	ME	3	0	2	**3**	**50**	**50**	**100**	**4**
4	BME304	Mechanics of Materials	PCC	ME	3	0	0	**3**	**50**	**50**	**100**	**3**
5	BMEL305	Computer Aided Machine Drawing	PCCL	ME	0	0	2	**3**	**50**	**50**	**100**	**1**
6	BME306x	ESC/ETC/PLC	ESC	ME	If the course is a Theory: 3	0	0	**3**	**50**	**50**	**100**	**3**
					If the course is a Laboratory: 2	0	2					
7	BSC307	Social Connect and Responsibility	UHV	ANY DEPT	0	0	2	**-**	**100**	**-**	**100**	**1**
8	BME308x	Ability Enhancement Course/Skill Enhancement Course – III	AEC/ SEC	ME	If the course is a Theory: 1	0	0	**1**	**50**	**50**	**100**	**1**
					If the course is a Laboratory: 0	0	2	**2**				

9	BES309	Environmental Studies	MC	Civil	1	0	0	**1**	**50**	**50**	**100**	**1**
10	BNS310	National Service Scheme (NSS)	NCMC	NSS Coordinator	0	0	2	**-**	**100**	**-**	**100**	**0**
	BPE310	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO310	Yoga		Yoga Teacher								
	BMU310	Music		Music Teacher								
11	BCE311	Competency Enhancement Course-1	NCMC	CDCAC	0	2	0	**-**	**100**	**-**	**100**	**0**
									700	**400**	**1100**	**22**

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)

Course Code	Course Name	Course Code	Course Name
BME306A	Electric and Hybrid Vehicle Technology	BME306C	Internet of Things
BME306B	Sustainable Engineering	BME306D	Waste handling and Management

Ability Enhancement Course/Skill Enhancement Course – III

Course Code	Course Name	Course Code	Course Name
BME308A	Technical writing using LATEX (0:0:2)	BME308C	Spreadsheet for Engineers
BME308B	Introduction to Virtual Reality	BME308D	Python for Mechanical Engineers

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2024-25 may please be referred.

National Service Scheme /Physical Education/Yoga/Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga and Music with the concerned coordinator / teacher of the course during the first week of 3rd semester. Activities shall be carried out between 3rd semester to the 6th semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Semester: III						
Mathematics-III for Mechanical Stream **Stream: ME**						
Course Code	**:**	BMATM301		**Credits**	**:**	4
Hours/Week (L:T:P)	**:**	3:2:0		**CIE**	**:**	50Marks
Total Hours	**:**	50 Hrs		**SEE**	**:**	50Marks
Course Type	**:**	ASC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**Basic Mathematics**
Knowledge on Fundamental Concepts	**Basic Differentiation, Integration**
Knowledge on Connected Tools (If any)	**Basic computer knowledge**

Course Objectives: This course will enable the students to	
CLO1	Introduce integral transforms such as Laplace, Fourier, and Z-transforms, and apply them to solve engineering problems related to dynamics, control systems, and heat conduction.
CLO2	Develop the ability to model and analyze dynamic systems such as mass-spring-damper and aircraft transfer functions using Laplace transforms.
CLO3	Apply probability theory and statistical methods for modelling uncertainty in aerospace systems, including turbulence simulation and reliability assessment.
CLO4	Enable students to perform statistical inference and hypothesis testing for data analysis, supporting decision-making in experimental and simulation-based aerospace research
CLO5	Equip students with numerical techniques for solving partial differential equations, especially those relevant to heat and wave propagation in aerospace structures.

MODULE - 1	**10 Hrs**
Curve fitting and Statistical Analysis: Curve fitting by method of least squares: y = ax+b, y = ax^2 +bx+c and $y=ax^b$. Correlation–Karl Pearson's coefficient of correlation, Rank correlation, Regression analysis – lines of regression (without proof)-problems. **Applications**: Vibrational Modal Analysis, Machining and Manufacturing. **Self-Study:** Angle between regression lines. **Text book 3:** Ch 11: 11.1 - 11.3, Ch 12	
MODULE - 2	**10 Hrs**
Probability Distributions: Random Variables (Discrete and Continuous). Probability mass and density functions. Mathematical expectation, Mean and variance. Discrete probability distributions: Binomial, Poisson, Normal distributions (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples.	

Applications: Quality control and Manufacturing.

Self-Study: Exponential Mean-problems.

Text Book 1: Ch 26: 26.7, 26.8, 26.9, 26.13, 26.14, 26.15, 26.16, 26.18.

MODULE -3	10 Hrs

Introduction to Laplace Transform:

Definition, basic properties and simple problems. Laplace transforms of Periodic functions (statement only), Inverse Laplace transform, Problems using partial fractions, Solving ODEs using Laplace transform.

Applications: Modelling mass-spring-damper systems**,** Transient response of mechanical systems.

Self-Study: Unit step function.

Text Book 1 : Ch 21: 21.1,21.,2,21.3,21.4,21.5,21.7,21.8,21.9,21.10,21.11,21.12,21.15,
Text Book 2: Ch 4: 4.1,4.2,4.3,4.4,4.5,4.6, 4.7,4.9,4.10,4.13

MODULE - 4	10 Hrs

Fourier series and practical harmonic analysis:
Fourier series expansion of functions Periodic functions, Dirichlet's condition. Fourier series expansion of functions with period 2π and with arbitrary period: Half-range Fourier series. Practical harmonic analysis.

Applications: Aircraft autopilot sampling systems.

Self-Study: periodic rectangular wave, Half-wave rectifier, rectangular pulse, Saw tooth wave.

Text Book 1: Ch 10: 10.2,10.3,10.5,10.6,10.7,10.11
Text Book 2: Ch 5: 5.2,5.3,5.4,5.5,5.6,5.7,5.9,5.11,5.12,5.15

MODULE - 5	10 Hrs

Applications of Partial Differential Equations:
Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method.

Applications: Vibration analysis (wave equation) – in structures like aircraft fuselage and turbine blades.

Self-Study: Solution of the Wave equation Problems.

Text Book 1: Ch 18: 18.1,18.2,18.3,18.4,18.9,18.
Text Book 2: Ch 6: 6.6,6.7,6.8,6.9,6.11,6.12

Course Outcomes: After completing the course, the students will be able to	
CO1	**Apply** the principles of least squares to perform curve fitting and Analyze data using correlation and regression techniques.
CO2	**Solve** problems involving uncertainties in engineering systems by utilizing probability distributions and random variable concepts.
CO3	**Apply** Laplace transform techniques to solve ordinary differential equations and model dynamic systems such as mass-spring-damper and heat conduction problems relevant to aerospace and mechanical engineering.
CO4	**Analyze** signals using Fourier and Z-transforms to interpret frequency-domain behaviour in structural vibrations, heat transfer, and sampled control systems in aircraft.
CO5	**Solve** partial differential equations numerically using finite difference methods to analyze physical phenomena such as heat conduction and wave propagation in aerospace structures.

Text Books	
1	Higher Engineering Mathematics, B. S. Grewal,43rd Edition,2015, Khanna Publishers, ISBN:978-81-933284-9-1.
2	Advanced Engineering Mathematics, E. Kreyszig, 10th Ed, 2018, John Wiley & Sons.

Reference Books	
1	Higher Engineering Mathematics, B. V. Ramana, 11th Ed., 2017, McGraw-Hill Education
2	A Textbook of Engineering Mathematics, N.P Bali and Manish Goyal, 10th Ed, 2022, Laxmi Publications.

Web links and Video Lectures (e – Resources)	
1	http://nptel.ac.in/courses.php?disciplineID=111
2	http://www.class-central.com/subject/math(MOOCs)

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**3**	**3**	**3**	**2**					**2**	**2**	
CO2	**3**	**3**	**2**	**2**					**2**	**2**	
CO3	**3**	**3**	**3**	**3**		**1**			**2**	**2**	
CO4	**3**	**3**	**3**	**2**		**1**			**2**	**2**	
CO5	**3**	**3**	**3**	**2**		**1**			**2**	**2**	

Semester: III						
Material Science and Engineering						
Course Code	**:**	BME304		**Credits**	**:**	04
Hours/Week(L:T:P)	**:**	3:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	40L+12P Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	IPCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engineering Physics, Elements of Mechanical Engineering
Knowledge on Fundamental Concepts	Understanding of concepts of Applied Physics and Mechanical Engineering
Knowledge on Connected Tools (If any)	NIL

Course Learning Objectives: This course will enable the students to	
CLO1	Gain the Knowledge of Engineering materials and their detailed classifications, properties and apply the method of materials selection.
CLO2	Know the basic concepts of geometrical crystallography, crystal structure and imperfections in Solids.
CLO3	Construct the phase diagrams to know the phase transformations and concept of diffusion in solids.
CL04	Identify the heat treatment, cooling methods for controlling the microstructure and plastic deformation to modify their properties.
CL05	Explore the powder metallurgy process, types and surface modifications.

Module – 1	**08 Hrs**
Engineering Materials, and Applications: Classification, **Ferrous materials:** Properties, Compositions and uses of Grey cast iron and steel. **Non-Ferrous materials:** Properties, Compositions and uses of Copper, Brass, Bronze. **Organic and Inorganic materials:** Properties and their applications, **Composite materials** - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber- reinforced composites, Applications of composite materials. Smart materials, Functional Graded Materials (FGM). **Text book 1: Ch 1 and Text book 2: Ch 1**	
Module – 2	**08 Hrs**
Structure of Materials Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding: Ionic Bonding and Metallic bonding. **Crystal Structure:** Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density, Coordination number, atomic Packing Factor of all the Cubic structures and Hexagonal Close Packed structure. Classification and Coordination of voids, Bragg's Law. **Imperfections in Solids:** Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Concept of free volume in amorphous solids. Slip, Twinning. **Text book 1: Ch 3, Ch4 and Text book 2: Ch 5**	

Module – 3	08 Hrs
Physical Metallurgy **Alloy Systems:** Classification of Solid solutions, Hume- Rothery Rules **Diffusion:** Diffusion Mechanisms: Vacancy Diffusion and Interstitial Diffusion, Fick's laws of diffusion, Factors affecting diffusion. **Phase Diagrams:** Gibbs Phase Rule, Solubility limit, phase equilibrium and Phase Diagrams: Isomorphous systems, Invariant Binary Reactions: Eutectic reaction, Eutectoid reaction and Peritectic reaction, Lever Rule, Iron-Carbon Diagram. Effect of common alloying elements in steel. Numerical on Lever rule. **Text book 3: Ch 9, Text book 1: Ch5, Ch 9**	
Module – 4	**08 Hrs**
Heat treatment: Annealing, Normalizing, hardening, Tempering, Nitriding, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology. TTT diagram, Recovery-Recrystallization-Grain Growth. Strengthening mechanisms: Strain hardening, Precipitation hardening (Solid-Solution Strengthening), Grain refinement. **Surface coating technologies**: Introduction, coating materials, coating technologies, types of coating: Electro-plating, Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD), High Velocity Oxy-Fuel Coating, advantages and disadvantages of surface coating. **Text book 3: Ch 4, Text book 1: Ch 9**	
Module – 5	**08 Hrs**
Powder metallurgy: Introduction, Powder Production Techniques: Different Mechanical methods: Chopping or Cutting, Abrasion methods, Machining methods, Ball Milling and Chemical method: Chemical reduction method. **Characterization of powders (Particle Size & Shape Distribution), Powder Shaping:** Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process, Sintering and Application of Powder Metallurgy. **Text book 4: Ch 1, 2, 3, 4 and 7**	

PRACTICAL COMPONENT OF IPCC (May Cover all / Major Modules)

Sl. No.	Experiments
1	Determine the hardness values of Mild Steel/ Aluminium by Rockwell hardness/Vickers Hardness.
2	Determine the hardness values of Copper/ Brass by Brinell's Hardness testing machine.
3	Determine the tensile strength, modulus of elasticity, yield stress, % of elongation and % of reduction in area of Mild Steel/Brass/ Aluminium and to observe the necking.
4	Determine the Compressive strength, modulus of elasticity, yield stress, % of reduction and % of increase in area of Cast Iron.
5	Determine the Shear strength (Single and Double Shear) of Mild Steel/Brass/ Aluminium.
6	Determine the bending strength of wood.
7	Determine the Impact strength of the mild steel using Izod test and Charpy test.
8	Conduct a wear test on Mild steel/ Cast Iron/Aluminium/ Copper to find the volumetric wear rate and coefficient of friction.
9	Preparation of Specimen for macro and micro structural examinations and study the macrostructure and microstructure of a sample metal/ alloys.

10	Study the heat treatment processes (Hardening and tempering) of steel/Aluminium specimens.

Course Outcomes: After completing the course, the students will be able to	
CO1	Elucidate the basics of Engineering materials and their detailed classifications, properties and the method of materials selection.
CO2	Explain the basic concepts of geometrical crystallography, crystal structure and imperfections in Solids.
CO3	Construct the phase diagrams to know the phase transformations and concept of diffusion in solids.
CO4	Identify the suitable heat treatment process, cooling method for controlling the microstructure and plastic deformation to modify their properties.
CO5	Explore the powder metallurgy process, types and surface modifications.

Text Books	
1	Materials Science and Engineering: An Introduction, Callister Jr, W.D., Rethwisch, D.G., 10th Edition, 2018, Hoboken, NJ: Wiley. ISBN-13: 9781119321590
2	Engineering Materials 1: An Introduction to Properties, Application and Design, Jones, D.R.H., and Ashby,M.F., 4th Edition, 2011, Butterworth-Heinemann, ISBN: 978-0-08-096665-6
3	Introduction to Physical Metallurgy, Avner, S.H., 2nd Edition, 2017, McG aw Hill Education. ISBN: 0-07-y85018-6
4	Powder Metallurgy- Science, Technology and Applications, P. C. Angelo and R. Subramanian, 2008, PHI, New Delhi, ISBN : 9789391818487

Reference Books	
1	Physical Metallurgy Principles, Abbaschian, R., Abbaschian, L., Reed-Hill, R. E., 4th Edition, 2009, Cengate Learning. ISBN-13: 978-0-495-08254-5
2	Introduction to Solids, Azaroff, L V, 1st Editions, 2001, McGraw Hill Book Company.

Web links and Video Lectures (e-Resources)	
1	Bhattacharya,B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/
2	Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Materials, https://nptel.ac.in/courses/113102080

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3							3	3		3	3	
CO2	3	3						3	3		2	2	
CO3	3	2											
CO4	3							2	2		2	2	
CO5	3												

Semester: III						
Manufacturing Process & Technology						
Course Code	**:**	BME303		**Credits**	**:**	04
Hours/Week(L:T:P)	**:**	3:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	40L + 12-14P Hrs.		**SEE**	**:**	50 Marks
Course Type	**:**	IPCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**Elements of Mechanical Engineering**
Knowledge on Fundamental Concepts	**Foundry**
Knowledge on Connected Tools (If any)	**-**

Course Learning Objectives: This course will enable the students	
CLO1	Provide knowledge of various casting process in manufacturing.
CLO2	Provide in-depth knowledge on metallurgical aspects during solidification of metal and alloys, also to provide detailed information about the moulding processes.
CLO3	Impart knowledge of various joining process used in manufacturing.
CLO4	Acquaint with the basic knowledge on metal working processes.
CLO5	Impart knowledge about behaviour of materials during welding, and the effect of process parameters in welding.

Module – 1	**08 Hrs**
Introduction & basic materials used in foundry: Introduction: Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. **Patterns:** Definition, classification, materials used for pattern, various pattern allowances and their importance. **Sand moulding:** Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds. Molding machines- Jolt type, squeeze type and Sand slinger. **Cores:** Definition, need, types. Method of making cores, Concept of gating (top, bottom, parting line, horn gate) and risers (open, blind) Functions and types. **Textbook :1 Ch 1:1.2 Textbook: 2 Ch 1.12**	
Module – 2	**08 Hrs**
Casting using metal moulds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixo casting, and continuous casting processes. Casting defects, their causes and remedies. **Melting furnaces:** Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace. **Textbook :1 Ch 1,2 Textbook: 2 Ch 1,2**	

Module – 3	08 Hrs
Joining Processes: Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding. **Textbook :7 Ch 4,5 Textbook: 2 Ch 1,2**	
Module – 4	**08 Hrs**
Metal Working Processes: Fundamentals of metal working, Analysis of bulk forming processes like forging, rolling, extrusion, wire drawing by slab method. **Sheet metal processes:** Sheet metal forming processes (Die and punch assembly, Blanking, piercing, bending etc., Compound and Progressive die), High Energy rate forming processes. **Textbook :3 Ch 3 Textbook: 4 Ch 2**	
Module – 5	**08 Hrs**
Weldability and thermal aspects: Concept of weldability of materials; Thermal Effects in Welding (Distortion, shrinkage and residual stresses in welded structures); Welding defects and remedies. **Allied processes:** Soldering, Brazing and adhesive bonding, Submerged arc welding. **Advance welding processes:** Resistance welding processes, friction stir welding (FSW). **Textbook :5 Ch 5,6 Textbook: 6 Ch 4,5**	

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)	
Sl.NO	**Experiments**
1	Preparation of sand specimens and conduction of the following tests: Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2	Determine permeability number of green sand, core sand and raw sand.
3	Determine AFS fineness no. and distribution coefficient of given sand sample.
4	Use of Arc welding tools and welding equipment Preparation of welded joints using Arc Welding equipment L-Joint, T-Joint, Butt joint, Lap joints on M.S. flats
5	Foundry Practice: Use of foundry tools and other equipment for Preparation of molding sand mixture. Preparation of green sand molds kept ready for pouring in the following cases: 1. Using two molding boxes (hand cut molds). 2. Using patterns (Single piece pattern and Split pattern).
6	Forging Operations: Use of forging tools and forging equipment. Preparing minimum two forged models involving upsetting and drawing.

Course Outcomes: After completing the course, the students will be able to	
CO1	**Comprehend** the classification of manufacturing processes and the significance of casting; classify the metals used in foundry and identify the key factors influencing the selection of casting alloys.
CO2	**Illustrate** various casting processes using metal mould sand identify common casting defects along with their causes and remedies.
CO3	**Outline** the operating principles, equipment, flame characteristics, advantages, and applications of fusion welding processes.
CO4	**Expound** the fundamentals of metal working and analyze bulk deformation processes, describe various sheet metal forming operations and high energy rate forming processes.
CO5	**Know** weldability and thermal effects in welding; identify welding defects and remedies; explain allied and advanced welding processes.

Text Books	
1	Manufacturing Science, Ghosh, A. and Mallik, A. K., (2017), East-West Press,
2	Parmar R. S., Welding Processes and Technology, (2007), Khanna Publishers,
3	Welding and Welding Technology, Little R. L.,(1989) Tata McGraw Hill Publishing Company Limited, New Delhi,
4	Metallurgical Modelling of Welding, Grong O, 2nd Edition (1997), The Institute of Materials,
5	Welding Metallurgy, Kou S, John Wiley Publications, 2nd Edition (2003) New York.
5	Manufacturing Engineering and Technology, Serope Kalpakjian and Steven R. Schmid, 7th Edition (2013), Prentice Hall,
6	Principles of foundry technology, P L Jain, 4th edition, 2006, Tata McGraw Hill,
7	Advanced Welding Processes technology and process control, John Norrish, 2006, Wood Head Publishing,

Web links and Video Lectures (e-Resources)	
1	http://www.springer.com/us/book/9781447151784http://nptel.ac.in/courses/112105127/)
2	http://www.astm.org/DIGITAL_LIBRARY/MNL/SOURCE_PAGES/MNL11.htm
3	http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/COMPTECH/PAGES/CTR10654J.htm
4	http://nptel.ac.in/courses/112105126/

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2			3			3			2
CO2	3	2			3			3			2
CO3	3	2			3			3			2
CO4	3	2			3			3			2
CO5	3	2			3			3			2

Semester: 3rd						
Mechanics of Materials						
Course Code	**:**	BME304		**Credits**	**:**	03
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engg. Physics and Fundamentals of Civil Engg.
Knowledge on Fundamental Concepts	Concepts like force, moment, equilibrium, and stress-strain relationships.
Knowledge on Connected Tools (If any)	---

Course Learning Objectives: This course will enable the students to	
CLO1	Summarize the basic concepts of stress, strain and relations based on linear elasticity and also the material behavior due to different types of loading.
CLO2	Identify the different types of beams and able to calculate SF & BM and draw the SFD & BMD for various applications and also calculate the bending stresses for different cross-sectional beams.
CLO3	Understand the structural behavior of member subjected to torque, calculate twist and stress induced in shafts subjected to bending and torsion.
CLO4	Interpret the stability and buckling phenomena and design the columns using Euler's formula.
CLO5	Understand the concepts of failure theories and FOS in structural members.

Module – 1	**08 Hrs**
Simple stress and strain: Definition/Introduction of normal stress, shear stress, and normal strain and shear strain – Stress strain diagram for brittle and ductile materials - Poisson's ratio & volumetric strain of a rectangular bar and cylindrical bar subjected to axial load– Elastic constants – relationship between elastic constants and Poisson's ratio – Deformation of simple and compound bars, Resilience, Gradual, sudden, impact and shock loadings – thermal stresses in simple and compound bars. **Text Book 1: Ch 1, Ch 2, Text Book 2: Ch 1, Text Book 3: Ch 1**	
Module – 2	**08 Hrs**
Bi-axial Stress system: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, graphical method - Mohr's circle for plane stress. **Text Book 1: Ch 7, Text Book 2: Ch 2, Text Book 3: Ch 3**	
Module – 3	**08 Hrs**
Bending moment and Shear forces in beams: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads – Point of contra flexure. **Text Book 1: Ch 6, Ch 8, Text Book 3: Ch 4, Text Book 3: Ch 6**	

Module – 4	08 Hrs
Theory of simple bending: Assumptions – Derivation of bending equation - Neutral axis – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T and Channel sections – Design of simple beam sections, Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections. **Torsion of circular shafts:** Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. **Text Book 1: Ch 3, Ch 4, Text Book 2: Ch 5, Text Book 3: Ch 7, Ch 16**	
Module – 5	**08 Hrs**
Theories of Failure: FOS, Maximum Principal stress theory, Maximum shear stress theory, Maximum Strain theory, Simple numerical. **Theory of columns** – Long column and short column - Euler's formula. **Thick and Thin cylinders:** Stresses in thin cylinders, Lame's equation for thick cylinders subjected to internal and external pressures, Simple numerical. **Text Book 1: Ch 7 – 7.5, Ch 10, Text Book 2: Ch 3, Text Book 3: Ch 17, Ch 18, Ch 19, Ch 24**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explore the mechanical behavior and elastic constants of materials and stress-strain relationships, and various components.
CO2	Determine the simple, compound, thermal stresses and strains induced on Mechanical elements such as bars, beams, cylinders, columns and shafts.
CO3	Apply the basic equation of simple torsion in designing of circular shafts & Columns.
CO4	Analyze the SFD and BMD for different types of beams subjected to different loads.
CO5	Evaluate stresses induced in different cross-sectional members subjected to shear loads and Suitability of failure theories.

Text Books	
1	Mechanics of Materials, S.I. Units, Ferdinand Beer & Russell Johnstan, 7th Edition, TATA McGrawHill-2014, ISBN 978-0-07-339823-5
2	Mechanics of Materials, K.V.Rao, G.C.Raju, Subhash Stores, First Edition, 2007
3	Strength of Materials by Dr. R.K. Bansal, Laxmi Publications 2010.

Reference Books	
1	Strength of Materials by S S Ratan, Tata McGraw Hill, 2nd Edition, 2008.
2	Mechanics of Materials by R C Hibbeler, Pearson, Latest Edition

Web links and Video Lectures (e-Resources)	
1	Statics and Strength of Materials, Shehata, 2nd edition, 1994. http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/TESTEVAL/PAGES/JTE12637J.%20htm
2	https://www.youtube.com/playlist?list=PL1LjPgjWt_IYJxqopL3fDi4bvI0f48RHK

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	-	-	-							3	-
CO2	3	3	2	1	1				1			3	1
CO3	3	3	2	-	-				-			3	-
CO4	3	3	2	1	1				1		2	3	1
CO5	3	2	-	-	1				1			3	-

Semester: III						
Computer Aided Machine Drawing						
Course Code	**:**	BMEL305		**Credits**	**:**	01
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	50 Marks
Total Hours / Sessions	**:**	12 - 15 hrs		**SEE**	**:**	50 Marks
Course Type	**:**	PCCL		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engineering Graphics / Engineering Drawing
Knowledge on Fundamental Concepts	• Projection methods (First-angle and Third-angle) • Orthographic and isometric drawing techniques
Knowledge on Connected Tools (If any)	Solid Edge Software

Course Learning Objectives: This course will enable the students to	
CLO1	Introduce the principles of Geometric Dimensioning and Tolerancing (GD&T), weld symbols, and surface roughness indications as per industry standards.
CLO2	Inculcate understanding of the theory of projection and make drawings using orthographic projections and sectional views.
CLO3	Impart fundamental knowledge of drawing of different machine parts.
CLO4	Enable the students with concepts of dimensioning and standards related to drawings.
CLO5	Facilitate the students to draw the assembly of various machine components by using limits, tolerance and fits and indicate them on machine drawings

PART - A	**04 Hrs**

Introduction: Review of 2D Sketching, Parametric Solid Modeling, Assembly creation and product rendering.

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Industry Standards.

Geometrical Dimensioning and Tolerances (GD&T): Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.

Text Book 1: Part -1

Text Book 2: Part -1

PART - B	05 Hrs
Fasteners: 3D & Section views - Hexagonal headed bolt and nut with washer, Square headed bolt and nut with washer. **Joints:** Cotter joint (socket and spigot), knuckle joint (pin joint). **Couplings:** Flanged coupling, Universal coupling. **Text Book 1: Part -2** **Text Book 2: Part - 2**	
PART - C	**15 Hrs**
1. Lifting Device (Screw Jack) 2. Bearings (Plumber Block) 3. Machine Tool Component (Machine Vice Or Tailstock) 4. I C Engine Components (Piston Or Connecting Rod) 5. Valves (Ram's Bottom Safety Valve) (Self Study) **Text Book 1: Part – 3** **Text Book 2: Part - 3**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand 2D sketching and Solid Modeling
CO2	Explore the significance of GD&T, types of tolerances, and types of views used in engineering drawings.
CO3	Create assembly drawings of mechanical fasteners like hexagonal bolt and square bolt.
CO4	Design assembly drawings of Joints and couplings.
CO5	Create detailed assembly drawing of various mechanical equipment's.

Text Books	
1	'Machine Drawing', N.D.Bhat & V.M.Panchal, Published by Charotar Publishing House, 51st Edition, ISBN – 9385039563, 2022.
2	'Machine Drawing', K.R. Gopala Krishna, Subhash publication.

Reference Books	
1	"A Text Book of Computer Aided Machine Drawing", S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2019.
2	'Machine Drawing', N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2017.
3	K L Narayana, P Kannaiah, K Venkata Reddy, "Machine Drawing", New Age International, 3rd Edition. ISBN-13: 978-8122440546, 2016
4	Ajeet Singh, "MACHINE DRAWING", Tata McGraw-Hill Education, ISBN: 0071072942, 2017

Web links and Video Lectures (e-Resources)	
1	https://www.autodesk.com/learn/ondemand/course/learn-fusion-360-in-90-minutes
2	https://www.autodesk.com/certification/learn/course/fusion360-intro-modeling-designprofessional

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	1	-
CO2	2	3	2	-	2	-	-	-	-	-	-	2	-
CO3	2	2	3	-	3	-	-	-	2	-	-	3	3
CO4	3	2	3	-	2	-	-	-	2	-	-	3	3
CO5	2	3	3	2	3	-	-	2	3	2	2	2	3

Semester: III						
Fundamentals of Electric and Hybrid vehicle Technology						
Course Code	:	BME306A		**Credits**	:	03
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 Hrs		**SEE**	:	50 Marks
Course Type	:	ESC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	**Basic Electrical Engineering**
Knowledge on Fundamental Concepts	**I C engines**
Knowledge on Connected Tools (If any)	**NIL**

Course Learning Objectives: This course will enable the students to	
CLO1	Gain the Knowledge of Electric and Hybrid vehicle drive train and their advantages and limitations.
CLO2	Know the basic concepts of Energy storage for EV and HEV
CLO3	Learn the DC and AC Machines which is used in EV and HEV drives.
CLO4	Know about Design considerations of EV and HEV
CLO5	Gain knowledge about power electronic converter for Battery Charging

Module – 1	**08 Hrs**
Introduction to Electric Vehicle (EV) & Hybrid Vehicle (HV): A brief history of Electric and Hybrid Vehicles, I C Engine Power drive train, General Architecture of Electric and Hybrid vehicle drive train, Advantages and Limitations of Electric Vehicles over I C Engine, Types of Electric vehicles, Impact on Environment of EV and HV technology. **Text book-1,Chapter1,1.1,1.6,1.2,1.8.1,1.8.2,**	
Module – 2	**08 Hrs**
Energy storage for EV and HEV: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Super capacitors. **Text Book-1, Chapter-5, and 6,5.1,5.2,5.3,5.6, 6.1,6.1.1,6.1.2**	
Module – 3	**08 Hrs**
DC and AC Machines & Drives in EV & HV: Various types of Motors, Selection and Size of Motors, Induction Motor Drives and Control Characteristics, Permanent Magnet Motor Drives and Characteristics, Brushed & Brushless DC Motor Drive and Characteristics, Switched Reluctance Motors and Characteristics, IPM Motor Drives and Characteristics, Mechanical and Electrical Connections of Motors. **Text book-1, Chapter-7, 7.1,7.12,7.3,7.4.5,7.5,7.6,7.7,7.8**	

Module – 4	**08 Hrs**

Components & Design Considerations of EV & HV:
Design Parameters of Batteries, Aerodynamic Considerations, Calculation of the Rolling Resistance and the Grade Resistance, Calculation of the Acceleration Force, Total Tractive Effort, Torque Required on the Drive Wheel,
Transmission Efficiency, Consideration of Vehicle Mass.

Text book-1,Chapter-2, 2.1,2.2,2.3,2.4,2.6,2.7

Module – 5	**08 Hrs**

Power Electronic Converter for Battery Charging:
Charging methods for battery, Termination methods, charging from grid, The Z- converter, Isolated bidirectional DC- DC converter, Design of Z- converter for battery charging, High-frequency transformer based isolated charger Topology, Transformer less topology.

Text Book-1, Chapter-12, 12.1,12.2,12.3,12.3.2

Course Outcomes: After completing the course, the students will be able to

CO1	**Summarize** the I C engine, Electric and Hybrid drive train on technical and Environmental Perspective.
CO2	**Analyze** the power management systems for electric and hybrid vehicles
CO3	**Compare** different types of motors used in electric and hybrid vehicles
CO4	**Evaluate** the performance EV and HEV by considering the different Aerodynamic forces.
CO5	**Apply** knowledge of power electronic converters to design battery charging systems for electric and hybrid electric vehicles.

Text Books	
1	, "Electric and Hybrid Vehicles Design Fundamentals", Iqbal Husain, 3rd Edition, CRC Press2021, ISBN-978-1-032-31298-9
2	"Electric Vehicle Technology Explained", James Larminie, John Lowry, 1st Edition, John Wiley and Sons, 2003.
3	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, CRC Press, 2004.

Web links and Video Lectures (Online Resources)	
1	Web course on "Introduction to Hybrid and Electric Vehicles" by Dr. Praveenkumar and Prof. S Majhi, IIT Guwahati available on NPTEL at https://nptel.ac.in/courses/108/103/108103009/
2	Video Course on "Electric Vehicles" by Prof. Amitkumar Jain, IIT Delhi available on NPTEL at https://nptel.ac.in/courses/108/102/108102121/

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	2						2		2		
CO2	3	3	2										
CO3	3	3	2										
CO4	3	3	2		3				2		2		
CO5	3	3	2		3				2		2		

Semester: III						
SUSTAINABILE ENGINEERING						
Course Code	**:**	BME306B		**Credits**	**:**	03
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	ESC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**NIL**
Knowledge on Fundamental Concepts	**NIL**
Knowledge on Connected Tools (If any)	**NIL**

Course Learning Objectives: This course will enable the students to	
CLO1	Have an increased awareness among students on issues in areas of sustainability
CLO2	Understand the role of engineering and technology with sustainable development.
CLO3	Know the methods, tools and incentives for sustainable products service system development.
CLO4	Establish clear understanding of the role and impact t of various aspects of engineering Decisions on environmental, societal and economic problems.
CLO5	Learn about Sustainable Practices and Habitates

Module – 1	**08 Hrs**
Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development. **Text book1, 1.1,1.2,1.3**	
Module – 2	**08 Hrs**
Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero Waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, legal provisions for environmental protection. **Text book1, 2.1,2.2,2.3**	
Module – 3	**08 Hrs**
Environmental Management Standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA). **Text book1, 3.1,3.2,3.3**	
Module – 4	**08 Hrs**

Resources and its Utilization: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels. **Text book1, 4.1,4.2,4.3**	
Module – 5	**08 Hrs**
Sustainability Practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport. **Text book1, 5.1,5.2,5.3**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the relevance and the concept of sustainability and the global initiatives in this direction.
CO2	Explain the different types of environmental pollution problems.
CO3	Discuss the environmental regulations and standards.
CO4	Outline the concepts related to conventional and non-conventional energy.
CO5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles.

Text Books	
1	Allen, D .T. and Shonnard, D .R. Sustainability Engineering: Concepts, Design and case studies, Prentice Hall.
2	Bradley, A.S; Adebayo, A.O; Maria, P, Engineering applications in sustainable design and development, Cengage learning.
3	Environmental Impact assessment guidelines, Notification of Govt. of India, 2006.
4	Mackenthun, K M; Basic concepts in Environmental management, Lewis publication, London 1998.
5	Ni bin Chang, Systems analysis for sustainable Engg. Theory and applications, Mcgraw Hill professional.

Web links and Video Lectures (e – Resources)	
1	VTU e-Shikshana Program
2	VTU EDUSAT Program

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2	3	3	2	-	3						
CO2	3	2	1	3	1	-	3						
CO3	1	2	1	3	2	-	3						
CO4	3	3	1	3	1	-	3						
CO5	1	3	1	2	1	-	3						

Note: High - 1, Medium – 2, and Low – 3

Semester:III						
Internet of Things						
Course Code	**:**	BME306C		**Credits**	**:**	03
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	ESC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**Internet of Things**
Knowledge on Fundamental Concepts	**NIL**
Knowledge on Connected Tools (If any)	**NIL**

Course Learning Objectives: This course will enable the students	
CLO1	Understand the basics of Internet of things and protocols.
CLO2	Understand some of the application areas where Internet of Things can be applied.
CLO3	Learn about the middleware for Internet of Things.
CLO4	Understand the concepts of Web of Things
CLO4	Analyze and apply IoT concepts to various industrial applications, including future factory concepts and smart applications.

Module – 1	**08 Hrs**
IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues. **Textbook-1: Chapter 1 Textbook-2: Chapter 1**	
Module – 2	**08 Hrs**
IoT Protocols - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security. **Textbook-1: Chapter 2 Textbook-3: Chapter 2**	
Module – 3	**08 Hrs**
IoT Architecture - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity: An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction. **Textbook-2: Chapter 3 Textbook-4: Chapter 3**	
Module – 4	**08 Hrs**
Web of Things - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.	

Textbook-1: Chapter 4 Textbook-3: Chapter 4	
Module – 5	**08 Hrs**
IoT Applications - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc. **Textbook-1: Chapter 5 Textbook-2: Chapter 5**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Enumarate the definition and usage of the term "Internet of Things" in different contexts.
CO2	Expound the key components that make up an IoT system
CO3	Recognize the differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.
CO4	Apply the knowledge and skills to work IoT system involving prototyping, programming and data analysis.
CO5	Emphasize where the IoT concept fits within the broader ICT industry and possible future trends

Text Books	
1	"The Internet of Things in the Cloud: A Middleware Perspective",Honbo Zhou, CRC Press,, 2012.
2	"Architecting the Internet of Things", Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Springer, 2011.
3	"Networks, Crowds, and Markets: Reasoning About a Highly Connected World",David Easley and Jon Kleinberg, Cambridge University Press, 2010.
4	"The Internet of Things – Key applications and Protocols", Wiley,Olivier Hersent, David Boswarthick, Omar Elloumi, 2012.

Reference Books	
1	Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3	CunoP fister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1- 4493-9357-1.

Web links and Video Lectures (e-Resources)	
1	Introduction: to IoT - https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE
2	https://www.coursera.org/learn/beginning-custom-projects-with-raspberry-pi
3	https://www.edx.org/course/introduction-to-the-internet-of-things-3

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2										1	2	
CO2		2	3	2							1		
CO3		2	2								1		
CO4	1	2	3								1	1	
CO5			3								1		

Semester:III						
Waste Handling & Management						
Course Code	**:**	BME306D		**Credits**	**:**	03
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	ESC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**Waste Management**
Knowledge on Fundamental Concepts	**YES**
Knowledge on Connected Tools (If any)	**NIL**

Course Learning Objectives: This course will enable the students to	
CLO1	Enrich the knowledge about Waste generation & effects
CLO2	Exploit the Solid waste management & challenges
CLO3	Hazardous waste management & challenges
CLO4	Innovative methods in practice to handle waste & its effects
CLO5	Laws governing the waste management

Module – 1	**08 Hrs**
Introduction to waste management: importance, methods of logistics, human components, technological components- waste handling equipment and technology, steps in waste management logistics. **Waste collection system and organization:** Environmental aspects of waste collection, role of public authority and private sector in waste collection, organizing collection of residential waste, fee schemes, public awareness programs. **Textbook-1: Chapter 1 Textbook-2: Chapter 1**	
Module – 2	**08 Hrs**
Engineering Systems for Solid Waste Management: Characteristics of solid waste, types of solid waste, Processing and Treatment of Solid Waste; Mechanical Treatment Material Recovery Facility, Recycling and Recovery, Types of Material Recovery Facilities, Biological Treatment & Biological methods for waste processing; Composting & methods. Biomethanation, Biodeisel, Biohydrogen, Mechanical Biological Stabilization, Thermal Treatment Incineration, Residues and its utilization, co-combustion, Pyrolysis, Gasification, Refuse Derived Fuel, solid recovered fuel. Engineering Disposal of SW: Dumping of solid waste; sanitary land fills – site selection. **Textbook-1: Chapter 2 Textbook-2: Chapter 2 Textbook-3: Chapter 2**	

Module – 3	08 Hrs
Hazardous Waste Management: Introduction, Hazardous waste definition, sources, identification and classification, Characteristics, Industrial waste & Plastic Waste; sources, environmental effects, challenges in handling Biomedical waste; Introduction to biomedical wastes, sources, classification, collection, segregation, treatment and disposal,E-waste; characteristics, generation, collection, transport, recycling and disposal, Effects on the society and environment, Transportation and Disposal, recycling and reuse,Nuclear waste; Characteristics, Types, Power reactors, Refinery and fuel fabrication wastes, Health and environmental effects, Decommissioning of Nuclear power reactors Hazardous waste landfills, Site selections. **Textbook-1: Chapter 3 Textbook-3: Chapter 3 Textbook-4: Chapter 3**	
Module – 4	**08 Hrs**
Innovations in waste management: Global and Indian Context, recycling, reuse, energy production, land filling, remediation of hazardous waste contaminated sites. Revenue models, Developing Networks, Entrepreneurship activities, Best practices in India and Abroad- Case studies, Waste management and waste handling entrepreneurs in India and other countries, Case studies of different municipalities waste handling techniques, domestic composting, medium & large scale composting, Centralized composting. **Textbook-1: Chapter 4 Textbook-2: Chapter 4 Textbook-4: Chapter 4**	
Module – 5	**08 Hrs**
Waste Management Laws in India: The Environmental Protection Act, The Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules, 2008, The Plastic Waste (Management and Handling) Rules, 2011, Bio-Medical Waste (Management and Handling) Rules, 1998, The E- Waste (Management and Handling) Rules, 2011, The Batteries (Management and Handling) Rules, 2001. Duties of constitutional bodies and Ministries. **Textbook-1: Chapter 5 Textbook-2: Chapter 5 Textbook-4: Chapter 5**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Classify different types of waste based on their properties and environmental impact.
CO2	Design and implement an effective waste segregation, collection, and disposal system for a given scenario.
CO3	Analyze waste management challenges and evaluate their impact on the environment and public health.
CO4	Assess and recommend appropriate remedial measures to mitigate waste-related hazards for environmental and living beings' protection.
CO5	Apply constitutional laws and civic responsibilities to propose sustainable waste management practices as an active citizen.

Text Books	
1	Handbook of Solid Waste Management, Tchobanoglous G and Kreith F, McGraw-Hill Education, 2nd Edition. 2002,

2	Hazardous Wastes - Sources, Pathways, Receptors, Richard J. Watts, John Wiley and Sons, 1st Edition. 1998,
3	Strategic Management,Hitt, M.A.,Hoskisson, R.E., Ireland, R.D. Cengage Learning, India. (2016).
4	Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel, CRC Press, 2nd Edition 2014.
5	Handbook of Solid Waste Management, Tchobanoglous G and Kreith F, McGraw-Hill Education, 2nd Edition. 2002.

Reference Books	
1	Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel 2nd Ed., CRC Press, USA. (2014).
2	Waste: A Handbook for Management, Letcher, T.M., Vallero, D.A. (2011)., 1st Ed, Academic Press, USA.
3	Waste Management Strategy and Action Plan,IGES, UNEP, CCET. (2018), Phnom Penh, Cambodia Phnom Penh 2018-2035..
4	National Environment Policy, 2006, Ministry of Environment and Forests, Government of India, Approved by the Union Cabinet on 18 May, 2006
5	Innovation and Entrepreneurship, Peter Drucker, Routledge Publishers, England UK. (2012)

Web links and Video Lectures (e-Resources)	
1	https://nptel.ac.in/content/storage2/courses/105106056/Introduction.pdf
2	https://nptel.ac.in/courses/105/103/105103205/
3	http://cpheeo.gov.in/cms/manual-on-municipal-solid-waste-management-2016.php
4	https://nptel.ac.in/courses/105/103/105103205/
5	https://nptel.ac.in/courses/120/108/120108005/

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1		1		2	3			1		2	3
CO2	3	2	3	2	2	3	3	1	2	2	2	3	3
CO3	2	3	1	3	1	3	3	2	1	2	1	2	3
CO4	2	3	2	3	2	3	3	2	1	2	1	2	3
CO5	1	1		1		3	2	3		2		1	2

Semester: III						
Technical Writing Using Latex						
Course Code	**:**	BME308A		**Credits**	**:**	01
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	30 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	**NIL**
Knowledge on Fundamental Concepts	**NIL**
Knowledge on Connected Tools (If any)	**NIL**

Course Learning Objectives: This course will enable the students to	
CLO1	*Construct* a LaTeX document with two sections, dummy text paragraphs, and formatted headers/footers (title, institute name, page number).
CLO2	*Generate* a LaTeX document featuring an Abstract/Summary section with proper typographical conventions.
CLO3	*Design* a title page for a VTU project report using logos, custom text formatting, and spatial organization.
CLO4	*Develop* a Certificate Page with predefined fields and blank spaces for signatures/dates using LaTeX commands.
CLO5	*Implement* side-by-side figures/graphics in a LaTeX document using subfigures (e.g., subcaption or subfigure).

Sl No.	**Experiments**
1	Develop a LaTeX script to create a simple document that consists of 2 sections [Section1, Section2], and a paragraph with dummy text in each section. And also include header [title of document] and footer [institute name, page number] in the document.
2	Develop a LaTeX script to create a document that displays the sample Abstract/Summary.
3	Develop a LaTeX script to create a simple title page of the VTU project Report [Use suitable Logos and text formatting].
4	Develop a LaTeX script to create the Certificate Page of the Report [Use suitable commands to leave the blank spaces for user entry]
5	Develop a LaTeX script to include the side-by-side graphics/pictures/figures in the document by using the subgraph concept
6	Develop a LaTeX script to demonstrate the presentation of Numbered theorems, definitions, corollaries, and lemmas in the document

7	Develop a LaTeX script to create a document that consists of two paragraphs with a minimum of 10 citations in it and display the reference in the section
8	Develop a LaTeX script to design a simple tree diagram or hierarchical structure in the document with appropriate labels using the Tikz library.

Course Outcomes: After completing the course, the students will be able to	
CO1	Recall and use basic LaTeX commands to create a structured document with sections, headers, and paragraphs.
CO2	Construct and organize tables and figures in a LaTeX document using appropriate environments (e.g., tabular, figure).
CO3	Formulate and display mathematical equations, theorems, and proofs using LaTeX (e.g., amsmath, amsthm packages).
CO4	Design and compile a full LaTeX report with proper citations (e.g., BibTeX) and a formatted bibliography.
CO5	Design and implement complex diagrams (TikZ) and algorithms (algorithm2e) in a LaTeX document.

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2		3							2	1
CO2	2	2			3							3	1
CO3	3	2	1		3							3	1
CO4	2	2	1	1	3							3	2
CO5	2	3	1		3							3	1

Semester: III						
Introduction To Virtual Reality						
Course Code	**:**	BME308B		**Credits**	**:**	01
Hours/Week(L:T:P)	**:**	1:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	12-15 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	1 Hour

Prerequisites:	
Courses	**NIL**
Knowledge on Fundamental Concepts	**NIL**
Knowledge on Connected Tools (If any)	**NIL**

Course Learning Objectives: This course will enable the students to	
CLO1	Describe how VR systems work and list the applications of VR.
CLO2	Understand the design and implementation of the hardware that enables VR systems to be built.
CLO3	Know the system of human vision and its implication on perception and rendering.
CLO4	Exploit the concepts of motion and tracking in VR systems.
CLO5	Deduce the importance of interaction and audio in VR systems.

Module – 1	**06 Hrs**
Introduction to Virtual Reality : Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality. **Textbook-1: Chapter 1 Textbook-2: Chapter 1**	
Module – 2	**06 Hrs**
Representing the Virtual World : Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR. **Textbook-1: Chapter 2 Textbook-3: Chapter 2**	
Module – 3	**06 Hrs**
The Geometry of Virtual Worlds &The Physiology of Human Vision: Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR. **Textbook-1: Chapter 3 Textbook-2: Chapter**	

Module – 4	06 Hrs
Visual Perception & Rendering: Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information. Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates . **Textbook-1: Chapter 4 Textbook-3: Chapter 4**	
Module – 5	**08 Hrs**
Motion & Tracking: Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies **Textbook-1: Chapter 5 Textbook-3: Chapter 5**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Exploit the architecture of VR systems and categorize their applications across industries.
CO2	Design and prototype hardware components (e.g., HMDs, sensors) for a VR system, justifying material/technology choices.
CO3	Analyze the human visual system and evaluate its impact on VR rendering techniques (e.g., FOV, stereoscopy).
CO4	Model motion tracking algorithms (e.g., IMUs, lighthouse) and assess their accuracy/latency trade-offs.
CO5	Design an interaction/audio subsystem for VR and critique its impact on user immersion.

Text Books	
1	Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.
2	Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002.
3	Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

Reference Books	
1	Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2	Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3	Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.

Web links and Video Lectures (e-Resources)	
1	http://lavalle.pl/vr/book.html
2	https://nptel.ac.in/courses/106/106/106106138/
3	https://www.coursera.org/learn/introduction-virtual-reality

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	1	2								3	
CO2	3	1	1	3								3	
CO3	3	1	1	2								3	
CO4	3	1	1	3								3	
CO5	3	1	1	1								3	

Semester: III						
Spreadsheet for Engineers						
Course Code	**:**	BME308C		**Credits**	**:**	01
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	50 Marks
Total Hours / Sessions	**:**	12 – 15 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	AEC/SEC		**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	**Microsoft Excel, Mathematical Functions**
Knowledge on Fundamental Concepts	**MS Word,**
Knowledge on Connected Tools (If any)	**MATLAB**

Course Learning Objectives: This course will enable the students to	
CLO1	Create different plots and charts
CLO2	Compute different functions, conditional functions and make regression analysis
CLO3	Carryout iterative solutions for roots, multiple roots, optimization and non-linear regression analysis
CLO4	Carryout matrix operations
CLO5	Understand VBA, UDF, VBA subroutines and macros

Sl. No	**Experiments**
1	Create an XY scatter graph, XY chart with two Y-Axes, add error bars to your plot, create a combination chart for the given problem.
2	Computing Sum, Average, Count, Max and Min, Computing Weighted Average for the given problem.
3	Trigonometric Functions, Exponential Functions, Using the CONVERT Function to Convert Units for the given problem.
4	Solve the given problem using Logical Expressions, Boolean Functions, IF Function
5	Creating a Quadratic Equation Solver, Table VLOOKUP Function, AND, OR and XOR functions for a given problem
6	Develop a Trendline, Slope and Intercept, Interpolation and Forecast, The LINEST Function, Multilinear Regression, Polynomial Fit Functions, Residuals Plot, Slope and Tangent, Analysis Tool Pack using Regression Analysis.
7	Adding Two Matrices, multiplying a Matrix by a Scalar, Multiplying Two Matrices, Transposing a Matrix, Inverting a Matrix and Solving System of Linear Equations using Matrix Operations in Excel.
8	Develop The IF Structure, The Select Case Structure, The for Next Structure, The Do Loop Structure, Declaring Variables and Data Types, An Array Function the Excel Object Model, For Each Next Structure using VBA User-Defined Functions (UDF)

Course Outcomes: After completing the course, the students will be able to	
CO1	Create different plots and charts
CO2	Compute different functions, conditional functions and make regression analysis
CO3	Carryout iterative solutions for roots, multiple roots, optimization and non-linear regression analysis
CO4	Carryout matrix operations
CO5	Understand VBA and UDF, VBA subroutines and Macros and Carryout numerical integration and solving differential equations using different methods

Web links and Video Lectures (e-Resources)	
1	Excel Resources - 600+ Self Study Guides, Articles & Tools (wallstreetmojo.com)
2	https://www.ictlounge.com/html/year_7/esafety_part7.htm
3	McFedries PaulMicrosoft Excel 2019 Formulas And Functions Microsoft Press, U.S, 2019 Edition

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	3	-	-	-	-	2	1	-	1
CO2	3	3	-	3	-	-	-	-	-	2	-	-	-
CO3	3	3	2	3	-	-	-	-	-	2	-	-	-
CO4	3	3	1	3	-	-	-	-	-	2	-	-	2
CO5	3	2	-	2	3	-	-	-	-	1	1	-	3

Semester: III						
Python for Mechanical Engineers						
Course Code	**:**	BME308D		**Credits**	**:**	01
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	24 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Mechanics of Materials, Kinematics of Machines, Fluid Mechanics, Machine Design, Mechanical Vibration and Heat Transfer.
Knowledge on Fundamental Concepts	Understanding of concepts in mechanical engineering, Basic math concepts, Programming fundamentals
Knowledge on Connected Tools (If any)	Text Editors, Integrated Development Environments (IDEs)

Course Learning Objectives: This course will enable the students to	
CLO1	Know the importance of Python and Application of python in Solving Engineering problems.
CLO2	Understand the important Libraries like SciPy, Numpy, Matplotlib ets used in Scientific computation.
CLO3	Write the Python programs on Mechanics, Machine Design, Fluid Mechanics, Thermal Science, Heat Transfer, Vibrations etc
CLO4	Review how to make plots and interactive plots, analyze test data.
CL05	Interpret the lots and interactive plots, analyze test data.

Sl. No.	**Experiments**
1	**Introduction to Python:** Basic Features, Installation of Anaconda and Spyder User Interface, Execution of Comments, Concept of List (Array), Concept of Append, Concept of POW( ), Execution of Loops (For, If and While), Modules in Python, Concept of Function.
2	**Numpy Library**- Working with Arrays/Matrices
3	**Plotting the data with Matplotlib Library for Python:** Matplot Library for plotting the data, Matplotlib: Figures and Axes, Subplots with Matplotlib, Grid Specs-Plot Layout, Contour Plots, Surface Plots, Polar Plots.
4	**Programs on Mechanics, Machine Design:** Projectile Motion, Von Mises Failure Theory Plots, Analysis of Beams- Shear force and Bending Moment Diagrams, Kinematic Analysis of Mechanisms, Fatigue Criteria.

5	**Programs on Mechanical Vibration:** Solving Ordinary Differential Equation with Scipy ODEINT, Analysis the simple spring mass system with python, Single Degree freedom of system with SciPy ODEINT, Plot the frequency of the spring mass system, Natural Frequency Calculation- Eigen Value problem,
6	**Programs on Thermal System:** Plot and Visualize the streamlines of the fluid flow, Analyse the Diesel Cycle with python program, One Dimensional Heat Equation with Animated Plot, Temperature Distribution-2D Heat transfer problems, Flow over Cylinder- Stream Line Plot and Pressure distribution.

Course Outcomes: After completing the course, the students will be able to	
CO1	**Elucidate** the basics of Python and Application of python in Solving Engineering problems.
CO2	**Explore** the important Libraries like SciPy, Numpy, Matplotlib ets used in Scientific computation.
CO3	**Write** the Python programs on Mechanics, Machine Design, Fluid Mechanics, Thermal Science, Heat Transfer and Vibrations.
CO4	**Exploit** the plots, interactive plots, Graphs and test data.
CO5	**Analyze** the data, plots and Graphs.

Text Books	
1	Python Programming for Mechanical Engineers, by Abdellatif M Sadeq, DOI: 10.13980/RG.2.2.33942.85972
	"Python for Programmers", Paul Deitel and Harvey Deitel, 1st Edition, 2021, Pearson Education,
2	"Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, 2019, No Starch Press.
3	"Python: The Complete Reference", 4th Edition, 2018, Mc-Graw Hill.

Reference Books	
1	"Python Data Analytics", Fabio Nelli, 1st Edition, 2015 .Apress, Publishing.
2	Zero To Mastery In Python Programming https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=MONU+SINGH+RAKESH+K.+YADAV%2C+SRINIVAS+ARUKOND A&search- alias=stripbook s. U Dinesh Kumar First Edition: 2019 ISBN: 978-81-265-7990-7 ISBN: 978-81-265-8855-8 (ebk) www.wileyindia.com
3	Al Sweigart,"Automate the Boring Stuff with Python",1 st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)

Web links and Video Lectures (e-Resources)	
1	https://www.udemy.com/course/python-for-mechanical-engineers/?couponCode=IND21PM
2	https://lms.decibelslab.com/courses/take/Python-for-Mechanical-Engineers/lessons/19476411-1-introduction
3	https://www.learnpython.org/
4	https://dineshkvs.wordpress.com/class-xics/

CO – PO MAPPING

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO12	PSO1	PSO2
CO1	3				3			2					2
CO2	2				3			2					2
CO3	2	3	2		3			2					3
CO4	2				3			2	3				2
CO5	2	3	2		3			2	3				3

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.
- Promoting Excellence in Teaching, Training, Research and Consultancy.
- Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.
- Developing Entrepreneurial acumen to venture into Innovative areas.
- Imparting Value based Professional Education with a sense of Social Responsibility.

Department Vision

Building Technically Competent Engineers to Serve the Society

Department Mission

- Imparting strong fundamental knowledge in Mechanical Engineering and allied fields.
- Fostering a culture of collaboration and propagating Industry institute interactions to enhance advances in latest technologies.
- Creating State-of-Art facilities benefitting students and faculty to carryout Research, Innovation and Consultancy.
- Providing conducive environment for both students and faculty to engage in lifelong learning activities.
- Inculcating Professional ethics, Leadership qualities and Entrepreneurial skills among students.

SJC INSTITUTE OF TECHNOLOGY

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P.B. No.20, B.B Road,

Chikkaballapur - 562 101, Karnataka