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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

IV Semester
Scheme & Syllabus of B.E. Programme
Mechanical Engineering
(2025 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

GOLD

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



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Post Box #20, B.B. Road, Chikkaballapur - 562 101, Karnataka

Estd.:1986

4th Semester, B.E. programme

Scheme of Teaching and Examinations 2025

Outcome-Based Education (OBE) and Choice-Based Credit System (CBCS)

(Effective from the academic year 2025-26)



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B.E. in Mechanical Engineering Scheme of Teaching and Examinations-2025

Outcome-Based Education (OBE) and Choice-Based Credit System (CBCS) (Effective from the academic year 2025-26)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching and Learning Scheme					Examination				Credits
					CI		LI	TW & SL	Total Hours per sem	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	SL						
1	PCC	1BME401	Mechanical Measurements and Metrology	ME	42	0	0	48	90	3	50	50	100	3
2	IPCC	1BME402	Fluid Mechanics and Machinery	ME	42	0	28	50	120	3	50	50	100	4
3	PCC	1BME403	Theory of Machines	ME	42	28	0	50	120	3	50	50	100	4
4	IPCC	1BME404	Artificial Intelligence for Mechanical Engineers	ME	42	0	28	50	120	3	50	50	100	4
5	PCCL	1BMEL405	Metrology and Measurements Lab	ME	0	0	28	02	30	3	50	50	100	1
6	AEC	1BMEL406	Ability Enhancement Course Laboratory**	ME	0	0	28	02	30	2	50	50	100	1
7	BSC	1BBN407	Biology for Engineers (ME and CV STREAMS)	Biology	14	0	0	16	30	2	50	50	100	1
8	SDC	1BEP408	Environmental Science Project	Respective Engineering Dept.	0	0	0	30	30	2	50	50	100	1

9	HSSM	1BME409	Metaphysical Science	Respective Engineering Dept.		14	0	0	16	30	2	50	50	100	1
10	NCMC	1BNS410	National Service Scheme	Campus	NSS coordinator	0	0	0	28	28	--	100	---	100	PP
		1BPE410	Physical Education		Physical Education Director										
		1BYO410	Yoga		Yoga Teacher										
		1BMU410	Music		Music Teacher										
		1BNC410	National Cadet Corps – II		NCC coordinator										
11	NCMC	1BCE411	Competency Enhancement Course-2	CDCAC		14	0	0	14	28	--	100	---	100	PP
12	NCMC	1BMATDIP412	Additional Mathematics - II	Mathematics		14	0	0	14	28	3	100	---	100	PP
Total												**750**	**450**	**1200**	**20**

Ability Enhancement Course (Laboratory) 1BMEL406x			
1BMEL406A	Advanced Material Characterization and Casting Techniques	1BMEL406C	MATLAB For Mechanical Engineers
1BMEL406B	Digital Manufacturing Lab	1BMEL406D	Simulation of Kinematic Systems

Semester: IV					
Mechanical Measurements & Metrology					
Course Code	:	1BME401	**Credits**	:	4
Hours/Semester (L:T:P:SL)	:	42:0:0:48	**CIE**	:	50 Marks
Total Hours	:	90	**SEE**	:	50 Marks
Course Type	:	PCC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Engineering Physics, Engineering Mathematics
Knowledge on Fundamental Concepts	Vernier Calipers & Micrometers
Knowledge on Connected Tools (If any)	Computer-Aided Engineering Drawing (CAED)

Course Learning Objectives: This course will enable the students to	
CLO1	Understand metrology, its advancements & measuring instruments.
CLO2	Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements, Screw thread and Gear measurement & comparators.
CLO3	Equip with knowledge of limits, fits, tolerances and gauging.
CLO4	Acquire knowledge of measurement systems and methods with emphasis on different transducers.
CLO5	Understand the measurement of Force, Torque, Pressure, Temperature and Strain.

Module – 1	**08 Hrs**

Introduction to Metrology:

Definition, objectives of metrology, Material Standards, Wavelength Standards, Classification of standards, Line and End standards, Calibration of End bars. Numerical examples.

Liner measurement and angular measurements:

Slip gauges-Indian standards on slip gauges, Adjustable slip gauges, Wringing of slip gauges, Problems on building of slip gauges (M87, M112), Measurement of angle-sine bar, Sine centre, Angle gauges, Optical instruments for angular measurements. Autocollimator-Applications for measuring straightness and squareness.

Text Book 1 :Ch 1.1,1.2 Text Book 2 :Ch 1.2 Text Book 3 :Ch 1.1,1.2

Module – 2	**08 Hrs**

System of Limits, Fits, Tolerance and Gauging:

Definitions, Tolerance, Tolerance analysis (addition & subtraction of tolerances) Inter changeability & Selective assembly. Class &grade of tolerance, Fits, Types of fits, Numerical on limits, fit and tolerance. Hole base system & shaft base system. Taylor's principle, Types of limit gauges, Numerical on limit gauge design.

Comparators:

Functional requirements, Classification, Mechanical- Johnson Mikrokator, Sigma comparators, Dial indicator, Electrical comparators, LVDT, Pneumatic comparators- Principle of back pressure, Solex comparators, Optical comparators- Zeiss ultraoptimeter.

Text Book 1 :Ch 2.1 Text Book 2 :Ch 2.1 Text Book3 :Ch 2.1

Module – 3	08 Hrs

Measurement of screw thread and gear:

Terminology of screw threads, Measurement of major diameter, Minor diameter, Pitch, Angle and Effective diameter of screw threads by 2- wire and 3-wire methods, Best size wire. Screw thread gauges, Toolmaker's microscope.

Gear tooth Measurements:

Tooth thickness measurement using constant chord method, Addendum, Comparator method and Base tangent method, Measurement of pitch, Concentricity, Run out and In volute profile. Gear roll tester for composite error.

Text Book 1 :Ch 3.1 Text Book 2 :Ch 3.1 Text Book 3 :Ch 3.1,3.2

Module – 4	08 Hrs

Measurement system and basic concepts of measurement methods:

Definition, Significance of measurement, Generalized measurement system, Static characteristics- Accuracy, Precision, Calibration, Threshold, Sensitivity, Hysteresis, Repeatability, Linearity, Loading effect, Dynamic characteristics- System response, Time delay. Errors in measurement, Classification of errors.

Transducers:

Transfer efficiency, Primary and Secondary transducers, Electrical transducers, Mechanical, Electronic transducers, Relative comparison of each type of transducers.

Intermediate Modifying and Terminating Devices:

Mechanical systems, Inherent problems, Electrical intermediate modifying devices, Input circuitry, Ballast circuit, Electronic amplifiers. Terminating devices, Cathode ray oscilloscope, Oscillographs.

Text Book 1 :Ch 4.1 Text Book 2 :Ch 4.1,4.2 Text Book3 :Ch 4.1

Module – 5	08 Hrs

Applied Mechanical Measurement:

Measurement of force, Torque, Pressure, Types of Dynamometers, Absorption dynamometer, Prony brake and Rope brake dynamometer, and Power Measuring Instruments. Use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge.

Electrical Test & Measurement

Measurement of Strain and Temperature:

Theory of strain gauges, Types, Electrical resistance strain gauge, Preparation and mounting of Strain gauges, Gauge factor, Methods of strain measurement, temperature compensation, Resistance thermometers, Thermocouple, Law of thermocouple, Pyrometer, Optical pyrometer.

Text Book 1 :Ch 5.1 Text Book 2 :Ch 5.1 Text Book 3 :Ch 5.1,5.2

Topics for Self learning	
Module – 1	Modern Coordinate Measuring Machine (CMM) and its applications, Digital Vernier Caliper and Digital Micrometer, Industrial applications of Autocollimator
Module – 2	Geometric Dimensioning and Tolerancing (GD&T), Go and No-Go Gauges in mass production, Applications of LVDT in precision measurement
Module – 3	CNC-based thread measurement techniques, Gear Measurement using Computerized Gear Testers, Applications of 3D scanning in gear inspection
Module – 4	MEMS Sensors and their engineering applications, ata Acquisition Systems (DAQ), Wireless Sensor-Based Measurement Systems
Module – 5	Load Cells and Electronic Weighing Systems, Digital Torque Measurement and Torque Sensors, Modern Pressure Sensors and Industrial Applications

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters.
CO2	Apply principles of dimensional tolerances, fits, and geometric specifications to design and evaluate precision components using gauges and comparators for quality.
CO3	Evaluate measurement of major & minor diameter, pitch, angle and effective diameter of screw threads.
CO4	Asses measurement systems, transducers, intermediate modifying devices and terminating devices.
CO5	Interpret the functioning of force, torque, pressure, strain and temperature measuring devices.

Text Books	
1	Mechanical Measurements, Beckwith Marangoni and Lienhard, Pearson Education 6th Ed., 2006.
2	Instrumentation, Measurement and Analysis, B C Nakra and K K Chaudhry, McGraw–Hill 4th Edition.
3	Engineering Metrology, R.K. Jain, Khanna Publishers, 2009.

Reference Books	
1	Engineering Metrology and Measurements, Bentley, Pearson Education, 2012
2	Theory and Design for Mechanical Measurements, III edition, Richard S Figliola, Donald E Beasley WILEY India Publishers, 2017

Web links and Video Lectures (e – Resources)	
1	**Mechanical Measurements and Metrology (Prof. S. P. Venkateshan, IIT Madras):** Covers error analysis, temperature, pressure, force, and flow measurements. http://www.digimat.in/nptel/courses/video/112106138/L01.html
2	**Engineering Metrology (Prof. J. Ramkumar, IIT Kanpur):** Focuses on standards, limits, fits, tolerances, and surface finish. https://www.google.com/search?q=https://swayam.gov.in/explorer%3FsearchText%3Dmetrology

CO – PO MAPPING

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

Semester: IV					
Course Title: Fluid mechanics and hydraulic machines (Common to the Branches: ME)					
Course Code	**:**	BME403	**Credits**	**:**	4
Hours/Semester (L:T:P:SL)	**:**	42:0:28:50	**CIE**	**:**	50 Marks
Total Hours	**:**	120	**SEE**	**:**	50 Marks
Course Type	**:**	IPCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**Physics and Mathematics**
Knowledge on Fundamental Concepts	**Integration and differentiation.**
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Have a knowledge of the basic properties of fluids and understand the continuum approximation.
CLO2	Calculate the forces exerted by a fluid at rest on submerged surfaces
CLO3	Understand the flow characteristic and dynamics of flow field for various engineering applications.
CLO4	Know how velocity changes and energy transfers in fluid flows are related to forces and to understand why designing for minimum loss of energy in fluid flows is so important.
CLO5	Discuss the main properties of laminar and turbulent pipe flow and appreciate their differences and the concept of boundary layer theory.

Module – 1	**08 Hrs**
Basics of fluids: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapor pressure, compressibility and bulk modulus. Concept of continuum, types of fluids, pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, Absolute, gauge, atmospheric and vacuum pressures, pressure measurement by simple, differential manometers. (Simple problems) **Fluid Statics:** Total pressure and center of pressure for horizontal plane, vertical plane surface and inclined plane surface submerged in static fluid. (No numerical) **Textbook-1: Chapter 1,2,3**	
Module – 2	**08 Hrs**
Fluid Kinematics: Types of Flow-steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrational, stream lines, path lines, streak lines, velocity components, convective and local acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates, simple Problems. **Textbook-1: Chapter 5**	
Module – 3	**08 Hrs**
Fluid Dynamics: Euler's equation, Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's theorem such as venture meter, orifice meter, pitot tube, rectangular and triangular notch. (Related numerical) **Loss of head due to friction in pipes:**	

Major and minor losses, pipes in series and parallel. **Textbook-1: Chapter 6,8,11**	
Module – 4	**09 Hrs**
Basics of Turbo Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes. Hydraulic Turbines: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine -working, efficiencies. Draft tube - functions and efficiency. Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, cavitation, surge tank, water hammer. (Simple problems). **Textbook-1: Chapter 18, 18.1 to 18.8 , 18.10 to 18.12**	
Module – 5	**09 Hrs**
Centrifugal Pumps: Classification, working, work done – monomeric head and efficiencies specific speed- performance characteristic curves, NPSH. (Simple problems). **Reciprocating Pumps**: Working, Discharge, slip, (simple problem). **Textbook-1: Chapter 19, 19.1 to 19.11, chapter 20, 20.1 to 20.6**	

Practical component	
Module – 1	Determine the viscosity of oil using Red wood viscometer and Say-bolt viscometer.
	Measurement of pressure using different Manometers for high and low pressure measurements (Manometers using different monomeric fluids).
Module – 2	
Module – 3	Determination of head loss in pipes and pipe fittings having different diameters, different materials and different roughness
	Determine co-efficient of discharge of venture meter, orifice meter and notches by the principle of Bernoulli equation.
Module – 4	Impact of jet on inclined and curved plates
	Performance test on Francis turbine.
Module – 5	Determine the performance of Centrifugal pump.
	Determine the performance of Reciprocating pump.

Topics for Self learning	
Module – 1	Total pressure and center of pressure on curved surface submerged in static fluid.
	Hydrostatic Paradox
Module – 2	Lagrangian and Eulerian approach for describing fluid motion.
	Newton's law of motion, flow Net.
Module – 3	Reynolds number, Trapezoidal notch, stepped notch
	Hydraulic gradient line and Total energy line.
Module – 4	Units and dimensions, and Kaplan turbine.

Module – 5	Types of positive and non-positive displacement pumps.
	Engineering applications of positive and non-positive displacement of pumps.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the knowledge of fluid properties to determine shear force, power lost in bearing, hydrostatic force and center of pressure acting on immersed body.
CO2	Analyze different types of fluid flow and apply kinematic relationships to solve flow-related problems.
CO3	Apply principles of fluid motion to real systems using Bernoulli's theorem and evaluate losses in pipes
CO4	Evaluate the performance of hydraulic turbines and analyze energy transfer in turbo machinery.
CO5	Determine the performance of centrifugal and reciprocating pumps.

Text Books	
1	Fluid Mechanics and Hydraulic Machines, 2017, Dr. R K Bansal, Laxmi publishers,ISBN:978-81-318-0815-3
2	Fluid Mechanics,2015, Yunus A Cengel, McGraw- Hill, Third Edition, ISBN:978933920468

Reference Books	
1	Fluid Mechanics, Frank M White., (2016), 8thEdition , McGraw-Hill
2	Introduction to Fluid Mechanics, Fox, R. W., Pitchard,P.J.,and McDonald, A. T., (2010), 7thEdition, John Wiley & Sons Inc.
3	Fundamentals of Fluid Mechanics, Munson, Young, Okiishi & Hebsch, , 7th Edition John Wiley Publications.

Web links and Video Lectures (e – Resources)	
1	http://nptel.ac.in/courses/112104117
2	http://nptel.ac.in/courses/105103192
3	http://nptel.ac.in/courses/112105269

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1													
3	3	2								1	1	1	1
3	3	2								1	1	1	1
3	3	2	1	1					1	1	2	2	1
3	3	2	1	1	1	1	1	1	1	1	2	2	1
3	3	2	1	2	1	1	1	1	1	1	2	2	1

Semester: III					
Theory of Machines					
Course Code	**:**	1BME403	**Credits**	**:**	3
Hours/Semester (L:T:P:SL)	**:**	42:0:0:48	**CIE**	**:**	50 Marks
Total Hours	**:**	90	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	**Engineering Mechanics**
Knowledge on Fundamental Concepts	**Mechanics**
Knowledge on Connected Tools (If any)	**NIT**

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts of kinematics, including links, kinematic pairs, degrees of freedom, and inversions of mechanisms
CLO2	Analyze friction in various machine elements and evaluate the performance of belt drives.
CLO3	Apply balancing techniques for rotating masses in static and dynamic conditions.
CLO4	Analyze gear terminology, interference, and gear trains including epicyclic gear trains.
CLO5	Design cam profiles for different follower motions and types of followers.

Module – 1	**08 Hrs**
Introduction: Definitions Link or element, kinematic pairs, Degrees of freedom, Grubler's criterion Kinematic chain, Mechanism, Structure, Mobility of Mechanism, Inversions of Four bar chain; Single slider crank chain and Double slider crank chain-Simple Problems	
Module – 2	**08 Hrs**
Friction and Belt Drives: Definitions: Types of friction: laws of friction, Friction in pivot and collar bearings. Belt drives: Flat belt drives. Ratio of belt tensions, centrifugal tension and power transmitted. V-Belt Drive: Ratio of belt tensions, power transmitted.	
Module – 3	**08 Hrs**
Balancing of Rotating Masses: Static and Dynamic balancing, Balancing of several masses in the same plane, Balancing of several revolving masses in different planes with Problems	
Module – 4	**08 Hrs**
Gears: Classification of gears, Spur gear terminology, Fundamental law of gearing, Interference and methods to avoid interference, Derivation of Length of Path of contact and Arc of contact, Contact ratio, Determination of minimum number of teeth to avoid interference, Numericals on spur gears. **Gear Trains:** Epicyclic gear train, Methods to find velocity ratio or train value (Tabular column method only), Torque in an Epicyclic gear train, Numericals on epicyclic gear trains.	
Module – 5	**08 Hrs**
Cams: Types of cams and followers, Procedure for drawing cam profile, Follower motion: Uniform acceleration and deceleration, Simple harmonic motion. Cam profiles: Disc cam with reciprocating follower having knife-edge, roller follower (Radial and offset).	

Topics for Self learning	
Module – 1	Straight line mechanisms (Peaucellier, Hart's), Pantograph, and applications of inversions in real machines.
Module – 2	Friction clutches, braking systems, rope drives, and chain drives.
Module – 3	Balancing of reciprocating masses, V-engines, and balancing machines.
Module – 4	Helical, bevel, and worm gears; gear manufacturing methods; differential gearbox of automobiles.
Module – 5	Cycloidal motion, polynomial cam profiles, and cam design software applications.

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the fundamental concepts, kinematic pairs, inversions, and mobility criteria of mechanisms.
CO2	Solve numerical problems related to spur gear geometry, interference, and velocity ratios of epicyclic gear trains.
CO3	Construct motion profiles and draw cam profiles for various follower displacement motions.
CO4	Analyze static forces in mechanisms and determine balancing required for rotating masses in single and multiple planes.
CO5	Evaluate gyroscopic couples and their stability effects on aeroplanes, ships, and two-wheeled vehicles.

Text Books	
1	Theory of Machines Rattan R.S. Khurmi, J.K.Gupta S. Chand & Company 3rd edition/2016
2	Theory of Machines Rattan R.S. Khurmi, J.K.Gupta S. Chand & Company 3rd edition/2016

Reference Books	
1	Theory of Machines: Kinematics and Dynamics. Sadhu Singh Pearson 3rd edition/2019
2	Theory of Machines by Thomas Bevan Thomas Bevan CBS 2nd edition/2010
3	Mechanism and Machine Theory G.Ambekar PH 2nd edition/2014

Web links and Video Lectures (e – Resources)	
1	Kinematics of Machines: nptel.ac.in/downloads/112101096
2	Dynamics of machines: www.nptel.ac.in/courses/112104121/1
3	Kinematics of Machines: https://freevideolectures.com/course/2359/kinematics-of-machines

CO – PO MAPPING

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

Semester: IV						
Artificial Intelligence for Mechanical Engineers						
Course Code	**:**	1BME404		**Credits**	**:**	03
Hours/Week (L:T:P)	**:**	3:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	40L+12P		**SEE**	**:**	50 Marks
Course Type	**:**	IPCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Basic Mathematics, Python Programming
Knowledge on Fundamental Concepts	Linear Algebra, Probability
Knowledge on Connected Tools (If any)	Python

Course Learning Objectives: This course will enable the students to	
CLO1	Gain the Knowledge about different types of AI & Applications of AI.
CLO2	Understand different types of Machine learning & to know about data Preparation
CLO3	Know about the basic concepts and techniques of machine learning and the need for Machine learning techniques for real world problem
CL04	Gain Knowledge about various Machine learning algorithms and the way to evaluate the performance of ML algorithms
CL05	Gain hands-on experience with AI tools and libraries

Module – 1	**08 Hrs**
Introduction to Artificial Intelligence: Definition, history, Evolution of AI, Artificial Intelligence (AI), Machine Learning and Deep Learning, AI problems, Agents and Environments, Structure of Agents, Approaches to AI - Hard or Strong AI, Soft or Weak AI and Applications of AI in Mechanical Engineering, AI in Industry 4.0	
Module – 2	**08 Hrs**
Data Analytics for Mechanical Systems: Engineering data types, Data Preprocessing, Feature extraction and feature selection, Data visualization for engineering datasets, Applications- Sensor signal analysis and Vibration data interpretation.	
Module – 3	**08 Hrs**
Supervised Learning - Definition, basic concepts, applications, Linear Regression, Logistic Regression, Decision Trees, Naive Bayes Classifiers, Support Vector Machines (SVM), Simple Examples.	
Module – 4	**08 Hrs**
Unsupervised learning- Definition, basic concepts, applications, Nearest neighbor models-Kmeans Clustering. **Reinforcement Learning (RL**) - Framework, Component of RL Framework. **Artificial Neural Network:** Perceptron and MLP, FFN and Back propagation	
Module – 5	**08 Hrs**
AI Applications in Mechanical Engineering: Predictive maintenance and condition monitoring, Tool wear prediction, Defect detection in manufacturing, Process parameter optimization, AI in CAD/CAM, AI in robotics and automation and AI in thermal systems and energy management, AI ethics and challenges.	

Topics for Self learning	
Module-1	Python basics for AI applications
Module-2	Data acquisition from sensors and industrial systems. Analyze a predictive maintenance dataset from Kaggle
Module-3	Linear Regression for Mechanical Applications

Module-4	Fundamentals of Hierarchical Clustering
Module-5	AI in electric vehicles and Autonomous Vehicles

Sl. No.	Lab Components
1	**Python & Data Preprocessing:** Introduction to Python for ML (NumPy, Pandas basics), Importing datasets and data preprocessing, handling missing data and feature scaling, data visualization using Matplotlib/Seaborn
2	Implementing AO* Search algorithm.
3	Introduction to logic for programming Write a program to implement Water jug program using AI.
4	**Supervised Learning:** • Linear Regression for engineering data (e.g., stress-strain prediction) • Multiple Regression model implementation • Classification using K-Nearest Neighbors (KNN) • Decision Tree for fault classification
5	**Unsupervised Learning:** • K-Means clustering for grouping mechanical data • Dimensionality reduction using PCA
6	**Neural Networks & Applications:** • Basics of Artificial Neural Networks (using simple libraries) • Case study: Predictive maintenance using ML

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the role of AI in modern mechanical engineering systems.
CO2	Illustrate the mechanical engineering datasets for AI model development.
CO3	Apply suitable supervised machine learning methods to engineering problems.
CO4	Elucidate the concepts of unsupervised machine learning techniques and reinforcement learning.
CO5	Analyze industrial applications of AI in mechanical systems.

Text Books	
1	Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Prentice Hall, Third Edition, 2009.
2	Machine Learning an Algorithmic Perspective, Stephen Marsland, Taylor & Francis Group, LLC, 2nd Edition, ,2015,
3	Artificial Intelligence for Engineers, S. Kaushik, Cengage Learning India Private Limited, 2nd Edition,2023

Reference Books	
1	Nature-Inspired Optimization in Advanced Manufacturing Processes and Systems, y Ganesh M, Kakandikar and Dinesh G. Thakur, CRC press, First edition, 2021.
2	Artificial Intelligence: Concepts and Applications, Lavika Goel, Kindle Edition, Wiley, 2021.
3	Artificial Intelligence, Ela Kumar, Wiley, 2021

Web links and Video Lectures (e-Resources)	
1	https://onlinecourses.nptel.ac.in/noc21_ge20/preview
2	https://onlinecourses.nptel.ac.in/noc24_ce107/preview

CO – PO MAPPING

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

Semester: IV					
Mechanical Measurements and Metrology Lab					
Course Code	**:**	1BMEL405	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	PCCL	**SEE Duration**	**:**	2 Hours

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

Course Learning Objectives: This course will enable the students to	
CLO1	*Calibrate* pressure gauges, thermocouples, LVDTs, and load cells using standard procedures to *verify* measurement accuracy and error analysis.
CLO2	*Determine* material properties (e.g., modulus of elasticity) and geometric parameters (angles, screw threads) using strain gauges, optical projectors, and precision tools (sine bar, bevel protractor).
CLO3	*Compare* the accuracy of different measurement techniques (e.g., gear tooth vernier vs. micrometer) and *justify* the selection of methods for specific applications.
CLO4	*Design* a calibration protocol for an instrument (e.g., LVDT or thermocouple) and *document* uncertainty sources in measurements.
CLO5	*Enumarate* the working principles of mechanical comparators, optical tools, and strain gauges in metrology applications.

Experiments	
Sl. No.	**MECHANICAL MEASUREMENTS**
1.	Calibration of Pressure Gauge
2.	Calibration of Thermocouple
3.	Calibration of LVDT
4.	Calibration of Load cell
5.	Determination of modulus of elasticity of a mild steel specimen using strain gauges.
	METROLOGY
1.	Measurements using Optical Projector
2.	Measurements using Toolmaker Microscope.
3.	Measurement of angle using Sine Center

4.	Measurement of angle using Sine bar
5.	Measurement of angle using bevel protractor

Open Ended Experiments	
1	Measurements of Screw thread Parameters using two wire method.
2	Measurements of Screw thread Parameters using Three-wire method.
3	Measurement of gear tooth profile using Gear tooth Vernier.
4	Measurement of gear tooth profile using Gear tooth micrometer.
5	Measurements of Surface roughness using Mechanical Comparator.

Course Outcomes: After completing the course, the students will be able to	
CO1	Perform calibration of instruments (pressure gauge, thermocouple, etc.) and analyze measurement errors against standard references.
CO2	Compare angle measurement methods (Sine Bar vs. Bevel Protractor) and justify the optimal technique for a given tolerance requirement.
CO3	Operate optical measurement tools (projector, microscope) to evaluate dimensional accuracy of engineering components.
CO4	Design a measurement protocol for screw threads/gear teeth and critique the impact of wire selection on measurement uncertainty.
CO5	Interpret surface roughness data and correlate it with manufacturing process parameters (e.g., machining speed).

CO – PO MAPPING

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

Semester: IV					
Advanced Material Characterization and Casting Techniques					
Course Code	**:**	1BME406A	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Mechanical Metallurgy/Manufacturing Processes
Knowledge on Fundamental Concepts	Crystal structure and lattice systems
Knowledge on Connected Tools (If any)	Sample preparation techniques

Course Learning Objectives: This course will enable the students to	
CLO1	Gain Knowledge about casting techniques such as die casting and centrifugal casting to fabricate components and analyze their quality.
CLO2	Learn preparing metallographic specimens using grinding and polishing techniques for microstructural examination.
CLO3	Gain the knowledge about metallurgical methods and interpretation of microstructures related to materials.
CLO4	Learn to evaluate the mechanical properties of materials through hardness testing methods such as Brinell and Vickers hardness tests.
CLO5	Gain the knowledge about characterization wear charterstics and frequency analysis.

Experiments	
Sl. No.	**List of problems for which student should study and execute in the Laboratory**
1.	Preparation of metal component using die casting process
2.	Casting of cylindrical component using centrifugal casting
3.	Metallographic specimen preparation by mechanical polishing.
4.	Characterization of materials through metallurgical techniques
5.	Determination of hardness using Micro Brinell hardness testing machine
6.	Determination of microhardness using Micro Vickers hardness tester
7.	Perform Annealing process for materials using resistance furnace
8.	Analysis of chemical composition using an optical spectrometer

Open Ended Experiments	
1	Determination wear coefficients using computerized wear test Rig.
2	Natural Frequency Analysis of Composite plate using FFT Analyzer.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the different casting techniques produce the precise metal component.
CO2	Determine the micro hardness values of different ferrous and non-ferrous alloys
CO3	Prepare metallographic specimens and analyze microstructures of metals.
CO4	Apply heat treatment techniques and perform elemental composition analysis using an optical spectrometer.
CO5	Demonstrate the wear characterization and frequency analysis experiments.

Text Books	
1	P. N. Rao, Manufacturing Technology – Foundry, Forming and Welding, McGraw-Hill Education.
2	R. K. Jain, Production Technology, Khanna Publishers.

Reference Books	
1	George E. Dieter, Mechanical Metallurgy, McGraw-Hill.
2	Sidney H. Avner, Introduction to Physical Metallurgy, McGraw-Hill.
3	V. Raghavan, Materials Science and Engineering: A First Course, PHI Learning.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=0oibUY8KUQM
2	https://www.youtube.com/watch?v=3G2sBqXkRT8
3	https://www.youtube.com/watch?v=HP4JNXkb9ag&list=PLHdBWO2_r66DJfM_fZxTPdq6CITosJJwB
4	https://www.youtube.com/watch?v=EJoUQP5g7g&list=PLbMVogVj5nJRbajyOAp_GHxTW9tQEqd0W
5	https://www.youtube.com/watch?v=RJXJpeH78iU
6	https://www.youtube.com/shorts/p898-ah-egg
7	https://www.youtube.com/watch?v=9kWWKgiBh-Q
8	https://www.youtube.com/watch?v=HYJ6ASuP5Ls

CO – PO MAPPING

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

Semester: IV					
Digital Manufacturing Lab					
Course Code	**:**	1BMEL406B	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	PCCL	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Computer Aided Design & Drafting and Engineering Materials
Knowledge on Fundamental Concepts	Printing physical objects
Knowledge on Connected Tools (If any)	Solid edge, Solid work

Course Learning Objectives: This course will enable the students to	
CLO1	Gain knowledge and skills related to 3D printing technologies.
CLO2	Learn the selection of material, equipment and development of a product for Industry 4.0 environment.
CLO3	Understand the various software tools, process and techniques for digital manufacturing.
CLO4	Apply these techniques into various applications.

Experiments	
Sl. No.	**List of problems for which student should study and execute in the Laboratory**
1.	**Introduction Session:** • Overview of Prototyping and its importance in Digital Manufacturing. • Working principle of FDM 3D Printers • Classification and comparison of various 3D Printing Technologies (FDM, SLA, SLS, DED, etc.) • Applications of 3D printing in modern manufacturing industries
2.	**Modelling of Engineering Components and Conversion to STL Format** • CAD Modelling of a basic mechanical component using CAD software (e.g., SolidWorks/Fusion 360) Exporting and validating STL files for 3D printing compatibility
3.	**Slicing of STL File and Study of Process Parameters Using Slicer Software:** • Slicing using Cura/Prusa Slicer Effect of Layer Thickness, Part Orientation, and Infill Density on Estimated Build Time and Quality
4.	**3D Printing with Variation in Layer Thickness:** • Print the same component with 2–3 different layer thicknesses (e.g., 0.1 mm, 0.2 mm, 0.3mm) Compare surface finish and build time.
5.	**3D Printing with Variation in Build Orientation** • Print component in horizontal, vertical, and angled orientations. Study mechanical behavior, support material usage, and finish.
6.	**3D Printing with Variation in Infill Density** • Print the same component with different infill settings (e.g., 20%, 50%, 80%)

	Analyze weight, print time, and structural strength.

Open Ended Experiments	
1	Working of DLP (Digital Light Processing) 3D Printing – Understanding the principle, machine setup, and sample fabrication.
2	Laser Cutting and Engraving – Demonstration of laser machine setup, parameter selection (power, speed), and sample cutting/engraving on different materials.

Course Outcomes: After completing the course, the students will be able to	
CO1	Develop CAD models for 3D printing.
CO2	Identify specific material required for printing as per the given application.
CO3	Select a suitable 3D printing process for a given application.
CO4	Create a given object using 3D Printing or Additive Manufacturing (AM) Technique.

Text Books	
1	Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing, Lan Gibson, David W. Rosen and Brent Stucker: Springer, 2010.
2	3D Printing and Rapid Prototyping- Principles and Applications, CK Chua, Kah Fai Leong, “”, World Scientific, 2017.

Reference Books	
1	Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing, Andreas Gebhardt, Hanser Publisher, 2011.
2	3D Printing and Design, Khanna Editorial, Khanna Publishing House, Delhi.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/112103306
2	https://nptel.ac.in/courses/112105211

CO – PO MAPPING

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

Semester: IV					
MAT Lab for Mechanical Engineers					
Course Code	:	1BME406C	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	0:0:28:02	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	Mechanics of Materials, Kinematics of Machines, Fluid Mechanics and Engineering Mathematics
Knowledge on Fundamental Concepts	Linear Equations, Differentiations and Integrations, Numerical methods
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Know the fundamentals and importance of MATLAB and Application of MATLAB in Solving Engineering problems.
CLO2	Provide an overview to program curve fitting & solve Linear and Nonlinear Equations.
CLO3	Write the MATLAB programs on related to mechanical systems.
CLO4	Review how to make plots and interactive plots, analyze test data.
CLO5	Gain knowledge about MATLAB Simulink & Solve engineering problems

Experiments	
Sl. No.	**List of problems for which student should study and execute in the Laboratory**
1.	Introduction to MATLAB Programming: Basics of MATLAB Programming, array operations in MATLAB, loops and execution of control, working with files: Scripts and functions, plotting and programming output, examples.
2.	Numerical Methods and their applications: Curve Fitting: Straight line fit, Polynomial fit.
3.	Numerical Integration and Differentiation: Trapezoidal method, Simpson method.
4.	Linear and Nonlinear Equations: Eigen values, Eigen vectors, Solution of linear algebraic equations using Gauss Elimination and LU decomposition, Solution of nonlinear equation in single variable using Gauss Siedal and Newton Raphson method.
5.	Ordinary Differential Equations: Introduction to ODE's, Euler's method, second order Runga Kutta method, MATLAB ODE's algorithm in single variable and multivariable. Transforms: Discrete Fourier Transforms,
6.	Application of MATLAB to analyses problems in basic Engineering Mechanics, Mechanical Vibrations, Control system, Statistics and Dynamics of different circuits.

Open Ended Experiments	
1	MATLAB Simulink: Introduction to MATLAB Simulink, Simulink libraries, development of basic models in Simscape Power Systems

Course Outcomes: After completing the course, the students will be able to	
CO1	Elucidate the basics of MATLAB applications in Solving Engineering problems.
CO2	Perform the mathematical operations used in engineering applications with the help of MATLAB.
CO3	Write the MATLAB programs on Mechanics, Machine Design, Fluid Mechanics, Thermal Science, Heat Transfer, Vibrations and Control Systems.
CO4	Construct and analyse the charts, interactive plots and test data.

Text Books	
1	MATLAB for Mechanical Engineers, Rao V Dukkipati, New Age Science Limited 2009, ISBN: 978-1-906574-13-0
2	MATLAB and Simulink for Engineers, Agam Kumar Tyagi, OXFORD Higher Education, 2011.
3	Modelling & Simulation using MATLAB – Simulink", Dr. Shailendra Jain, Wiley – India.
4	Applied Numerical Methods Using MATLAB", Won Y.Tang, Wemun Cao, TaeSang Ching and John Morris, A John Wiley & Sons.
5	Introduction to Simulink with Engineering Applications", Steven T. Karris, Orchard Publications.

Reference Books	
1	MATLAB for Engineers, Holly Moore, Pearson.
2	Introduction to MATLAB for Engineers, William J. Palm III, McGraw-Hill. 3. Applied Numerical Methods with MATLAB for Engineers and Scientists, Steven C. Chapra, McGraw-Hill.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=IuEOMyGuuIg&list=PLRWKj4sFG7-6_Xr9yqg6SMr_F80KdFVhN
2	https://skill-lync.com/mechanical-engineering-courses/matlab-mechanical-engineers
3	https://www.udemy.com/course/matlab-basics-for-mechanical-engineers/?srsltid=AfmBOorKdIuXDt1k2xpVi1Cj300isb6UwSfRhGF2X9vD1fuwPvK7bC24
4	https://www.youtube.com/watch?v=5A9sEaEt3Z4&list=PLcgIaTuuWp3kWI8d1C1wZDl0SfQDxm-CK

CO – PO MAPPING

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

Semester: IV					
Simulation of Kinematic Systems					
Course Code	:	1BME406D	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	0:0:28:02	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	Theory of Machines / Kinematics of Machinery Engineering Mechanics, Basic knowledge of Engineering Mathematics
Knowledge on Fundamental Concepts	Basic concepts of mechanisms and kinematic pairs, Degrees of freedom and constraints Position, velocity and acceleration analysis Basic understanding of linkages, cams and gears, Basic computer-aided modelling concepts
Knowledge on Connected Tools (If any)	Basic knowledge of CAD software

Course Learning Objectives: This course will enable the students to	
CLO1	Create and simulate kinematic models using commercial multibody dynamics software.
CLO2	Apply kinematic constraints, joints, and motion drivers to model engineering mechanisms.
CLO3	Analyze displacement, velocity, and acceleration characteristics of planar and spatial mechanisms.
CLO4	Interpret simulation results and validate the kinematic behavior of mechanical systems.
CLO5	Evaluate the performance of common engineering mechanisms such as linkages, cams, gears, and robotic systems.

Experiments	
Sl. No.	**List of problems for which student should study and execute in the Laboratory**
1.	Introduction to Kinematic Simulation Software and Mechanism Modelling
2.	Simulation of a Four-Bar Linkage Mechanism
3.	Position Analysis of a Slider-Crank Mechanism
4.	Velocity Analysis of a Slider-Crank Mechanism
5.	Acceleration Analysis of a Slider-Crank Mechanism
6.	Simulation of Quick Return Mechanism
7.	Simulation of Whitworth Quick Return Mechanism
8.	Simulation of Cam and Follower Mechanism
9.	Simulation of Gear Pair Mechanism
10.	Simulation of Geneva Mechanism

Open Ended Experiments	
1	Kinematic Analysis of an Industrial Robotic Manipulator
2	Simulation of Differential Mechanism

Course Outcomes: After completing the course, the students will be able to	
CO1	Create and simulate kinematic models of mechanical mechanisms using commercial multibody dynamics software.
CO2	Apply appropriate joints, kinematic constraints and motion drivers to model mechanical mechanisms.
CO3	Analyze displacement, velocity and acceleration characteristics of planar and spatial mechanisms using simulation tools.
CO4	Interpret and validate simulation results to evaluate the kinematic behavior and performance of mechanical systems.

Text Books	
1	Rattan S S, "Theory of Machines", 5th Ed., McGraw Hill Education, 2022.
2	Uicker J J, Pennock G R, and Shigley J E, "Theory of Machines and Mechanisms", 4th Ed., Oxford University Press, 2017
3	Thomas Bevan, "Theory of Machines", 3rd Ed., CBS Publishers, 2019.

Reference Books	
1	Amitabha Ghosh and Ashok Kumar Mallik, "Theory of Mechanisms and Machines", 3rd Ed., EastWest Press, 2019
2	Robert L Norton, "Design of Machinery", 6th Ed., McGraw Hill Education, 2020.
3	MSC Adams User Manual
4	SolidWorks Motion Analysis User Guide

Web links and Video Lectures (e – Resources)	
1	Khan Academy – Differential Equations and Mechanical Motion
2	https://hexagon.com/products/adams
3	SolidWorks Motion Analysis Tutorials https://help.solidworks.com
4	Autodesk Inventor Dynamic Simulation Tutorials https://help.autodesk.com/view/INVNTOR
5	MIT OpenCourseWare – Mechanical Engineering Courses https://ocw.mit.edu

CO – PO MAPPING

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

Semester: IV					
Biology for Engineers (ME and CV Streams)					
Course Code	:	1BBN407	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	14:0:0:16	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	BSC	**SEE Duration**	:	1 Hour

Prerequisites:	
Courses	Biology and Chemistry
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the structure and functions of cells, biomolecules, stem cells, enzymes, vitamins, and hormones, and their significance in engineering.
CLO2	Relate human organ systems to engineered devices such as prosthetics, bionic eyes, pacemakers, ventilators, and dialysis systems.
CLO3	Understand bio-inspired designs and emerging bioengineering technologies, including tissue engineering, bioprinting, self-healing materials, and bioremediation.

Module – 1	**05 Hrs**
Fundamentals of Biology and Biomolecules - Cell structure and functions, Plant and Animal cells, Prokaryotic and Eukaryotic cells, Stem cells and applications, Biomolecules: Carbohydrates, Proteins, Lipids and Nucleic acids, Enzymes, Vitamins and Hormones. **Text book -1, Ch-1 and Text book -2, Ch-1.**	
Module – 2	**05 Hrs**
Human Organ Systems and Engineering Designs - Brain as CPU and prosthetic devices, Eye as camera and bionic eye, Heart as pump: ECG, pacemakers and stents, Lungs as purification system: Ventilators and spirometer, Kidney as filtration system: Dialysis technologies. G-Forces, Effects of Positive and Negative G-forces, Microgravity Effects on Bones, Muscles and Blood Circulation **Text book -1, Ch-2-3 and Text book -2, Ch-2-3.**	
Module – 3	**04 Hrs**
Nature-Inspired Engineering and Bioengineering Trends - Echolocation and Sonar, Photosynthesis and Solar Cells, Lotus Leaf Effect and Self-cleaning Surfaces, Bird Flight and Aircraft Design, Velcro inspired by Plant Burrs, Kingfisher Beak and Bullet Train Design, Tissue Engineering and Bio printing, Self-healing Bio concrete and Bioremediation. Applications of Bio mimic in UAVs and Modern Aircraft. **Text book -1, Ch-4-5 and Text book -2, Ch-4-5.**	

Topics for Self-learning	
Module – 1	Stem Cells and Their Applications in Regenerative Medicine
	Role of Biomolecules in Healthcare and Industrial Applications
Module – 2	Prosthetic Devices and Recent Advances in Bionic Organs
	Bionic Eye and Advanced Vision Restoration Technologies
Module – 3	Tissue Engineering and Bio printing
	Self-Healing Bio concrete

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts of biology, biomolecules, and their engineering applications.
CO2	Relate the structure and functions of human organ systems to biomedical devices and engineering solutions.
CO3	Apply bio-inspired principles and discuss emerging bioengineering technologies for sustainable and innovative engineering applications.

Text Books	
1	**Biology for Engineers** – Rajendra Singh C. and Rathnakar Rao N., Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
2	**Biology for Engineers** – S. Thyagarajan, N. Selvamurugan, M.P. Rajesh, R.A. Nazeer, W. Thilagaraj, S. Barathi and M.K. Jaganathan, Tata McGraw-Hill Education, New Delhi, 2012.

Reference Books	
1	**Biology for Engineers** – Arthur T. Johnson, CRC Press, Taylor & Francis Group, 2011.
2	**Biomimetics: Nature-Based Innovation** – Yoseph Bar-Cohen, CRC Press, 2012.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/121106008?utm_source=chatgpt.com
2	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009/?utm_source=chatgpt.com
3	https://onlinecourses.nptel.ac.in/noc22_bt18/preview?utm_source=chatgpt.com

CO – PO MAPPING

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

Semester: IV						
Metaphysical Science **Streams: CSE/ECE/CV/ME**						
Course Code	**:**	1BMP409		**Credits**	**:**	1
Hours/Week(L:T:P:SL)	**:**	14:0:0:16		**CIE**	**:**	50 Marks
Total Hours	**:**	30 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	HSSMC		**SEE Duration**	**:**	1 Hr.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basic concepts of metaphysics, ontology, and epistemology.
CLO2	Explain metaphysical perspectives on the universe, mind, and consciousness.
CLO3	Explore the relationship between quantum metaphysics, healing and modern science.

Module 1	**05 Hrs**
Foundations of Metaphysics, Ontology and Epistemology **Introduction to Metaphysics:** Definition, scope and historical roots (Aristotle, Plato, Kant). Distinction between Metaphysics, Physics and Spirituality. **Branches of Metaphysics:** Ontology, Cosmology and Epistemology. **Fundamental metaphysical questions:** Reality, existence, abstract entities, morality. **Ontology (Study of Being):** Materialism, Idealism and Dualism, Problem of Universals: Realism vs. Nominalism **Epistemology (Study of Knowledge):** Rationalism (Descartes) and Empiricism (Locke, Hume), Theories of Truth: Correspondence, Coherence and Pragmatic, Skepticism and Constructivism, Simulation Theory and Descartes' Evil Demon **Textbook2, Ch.1-5**	
Module 2	**05 Hrs**
Cosmology, Mind and Consciousness **Metaphysical Cosmology:** Philosophical and Physical Cosmology, Time, Space and Origin of the Universe, Anthropic Principle and Fine-Tuning Debate, Creation, Causality and Infinite Regress, Multiverse Theory and its Metaphysical Implications, Ancient Cosmologies: Vedic, Taoist and Indigenous Perspectives. **Mind and Consciousness:** Nature of Mind and Consciousness, Mind-Body Problem: Dualism vs. Physicalism, Theories of Consciousness: Integrated Information Theory (IIT), Global Workspace Theory and Panpsychism, Eastern and Western Perspectives on Self and Consciousness, Artificial Intelligence and Machine Consciousness, Role of Consciousness in Observation and Decision Making **Textbook1, Ch.1-2, Textbook2, Ch.6-8**	
Module 3	**05 Hrs**
Quantum Metaphysics, Healing and Engineering Perspectives Basics of quantum mechanics (superposition, entanglement, observer effect), Quantum Theory and Consciousness, Quantum Healing: Deepak Chopra's Model, Biofield Theory, Chakras and Subtle Energy Systems, Placebo Effect, Intention and Non-local Healing,	

Applications and Engineering Perspectives of Bio-resonant Technologies, Scientific evidence, limitations and ethical considerations in Quantum Healing. **Textbook1, Ch. 3-15**

Topics for Self-learning	
Module – 1	• Indian Perspectives on Metaphysics (Advaita Vedanta, Buddhism and Jainism) • Philosophy of science and scientific realism
Module – 2	• Consciousness in meditation and mindfulness practices • AI ethics and machine consciousness • Latest developments in neuroscience and consciousness research
Module – 3	• Emerging biofeedback and wearable health technologies • Engineering applications of meditation and neurotechnology

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts of metaphysics, ontology and epistemology in understanding reality and existence.
CO2	Analyze metaphysical perspectives on cosmology, consciousness and the nature of the universe.
CO3	Evaluate the relationship between quantum theory, consciousness, healing practices and their relevance to emerging engineering applications.

Text Books	
1	Quantum Metaphysics, Tarja Kallio-Tamminen, ISBN 952-10-1927-1 Otamedia, Oy 2004.
2	Metaphysics-A Very Short Introduction, Stephen Mumford, Sl. No. 20129780191640261, 0191640263, OUP Oxford, 2012

Reference Books	
1	Deepak Chopra M.D., Quantum Healing (Revised and Updated): Exploring the Frontiers of Mind/Body Medicine, 2015.
2	Deepak Chopra M.D., Quantum Body: The New Science of Living a Longer, Healthier, More Vital Life, 2023.

Weblinks	
1	https://www.yogajournal.com/meditation/
2	https://youtube.com/shorts/JgCVh6wwgNg?si=R87-PGIrUSII774w
3	https://www.youtube.com/watch?v=XvyuUqlX7fE
4	https://core.ac.uk/download/pdf/14914967.pdf
5	https://www.youtube.com/watch?v=_ba0yIAZ9ok
6	https://www.youtube.com/watch?app=desktop&v=fzxohf49loU
7	https://www.youtube.com/watch?v=SSGKowtXS3Y
8	https://www.youtube.com/watch?v=r_piRatnFlY

CO–PO Mapping

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

Semester: IV					
NATIONAL SERVICE SCHEME (Common to the Branches)					
Course Code	**:**	**1BNS410**	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	0:0:0:28	**CIE**	**:**	100 Marks
Total Hours	**:**	28	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	**---**
Knowledge on Fundamental Concepts	Basic understanding of social responsibility, environmental awareness, community welfare, sustainable development, ethics, teamwork, and communication skills.
Knowledge on Connected Tools (If any)	Basic use of smartphones, internet, digital communication tools (email, WhatsApp, Google Forms), presentation software (PowerPoint/Canva), video recording tools, and office productivity software (MS Word/Google Docs) for documentation and report preparation.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the community, identify its needs and problems, and apply knowledge to develop practical solutions for sustainable community development and welfare.
CLO2	Develop social and civic responsibility, leadership, teamwork, communication, and community participation skills through collaborative and service-oriented activities.
CLO3	Demonstrate ethical values, democratic attitudes, effective group-living skills, and responsible citizenship while contributing to social service and community development.

Activity– 1	**10 Hrs**
Environmental Sustainability: Plantation and adoption of plants (Know Your Plants), water conservation techniques, role of stakeholders, and implementation of sustainable environmental practices.	
Activity – 2	**09 Hrs**
Community Development and Rural Entrepreneurship: Organize National Integration and Social Harmony programs (minimum two), prepare actionable business proposals to enhance village income, and support community-based development initiatives.	
Activity – 3	**09 Hrs**
Educational and Social Welfare Initiatives: Government school rejuvenation, improving infrastructure, enhancing student academic performance and enrolment in higher/technical/vocational education through awareness and mentoring activities.	

Topics for Self learning	
Activity – 1	Plantation, biodiversity conservation, and sustainable water management practices.
	Climate change, environmental protection, and the role of citizens in

	conservation.
Activity– 2	National integration, social harmony, and community leadership.
	Rural entrepreneurship, village development, and government support schemes.
Activity – 3	School development, educational awareness, and mentoring for higher education.
	Social responsibility, volunteerism, and community engagement for sustainable development.

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution

Sl. No.	Topic	Group Size	Location	Activity Execution	Reporting	Evaluation of the Topic
1.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.....	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.....	Group selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
3.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers/ etc.....	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities for 4th Semester)

Sl. No.	Practice Session Description
1.	Lecture session by NSS Officer
2.	Selection of topic, Commencement of activity and its progress
3.	Execution of Activity
4.	Case study based Assessment, Individual performance
5.	Sector wise study and its consolidation
6.	Video based seminar for 10 minutes by each student At the end of semester with Report.

- In the 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of the semester student performance has to be evaluated by the NSS Officer for the assigned activity progress and its completion.
- At the end of the 4th semester, consolidated report of all activities compiled report should be submitted as per the instructions.

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze environmental and societal issues and propose practical, sustainable solutions by demonstrating social responsibility and civic awareness.
CO2	Evaluate and implement government and community-driven initiatives to address societal challenges and promote community development and welfare.
CO3	Demonstrate ethical values, teamwork, leadership, effective communication, and civic responsibility while participating in social service and community engagement activities.

Assessment Details for CIE (100 Marks)

Weightage	**CIE- 100 Marks**
Selection of Topic, Commencement of activity and its progress	**40 Marks**
Case study based Assessment	**20 Marks**
Sector wise study and its consolidation	**20 Marks**
Video based seminar for 10 minutes by each student at the end of semester with Report	**20 Marks**
Total Marks for the course in each semester	**100 Marks**

Suggested Learning Resources: **Books:**	
1	NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2	Government of Karnataka, NSS cell, activities reports and its manual.
3	Government of India, NSS cell, Activities reports and its manual.

CO – PO MAPPING

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

Semester: IV						
Physical Education **Common to All Branches**						
Course Code	:	1BPE410		**Credits**	:	0
Hours/Week(L:T:P:SL)	:	20:0:0:16		**CIE**	:	**100 Marks**
Total Hours	:	24		**SEE**	:	-
Course Type	:	NCMC		**SEE Duration**	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Develop an understanding of ethical principles and moral values and their importance in sportsmanship, fair play, and personal conduct in games and athletic activities.
CLO2	Acquire practical skills and demonstrate technical proficiency in selected sports or athletic events through structured physical training and performance.
CLO3	Understand the role of effective organization, administration, and management in the successful conduct of sports events and athletic programs.

Module – 1	**4 Hrs**
Ethics and Moral Values A. Ethics in Sports B. Moral Values in Sports and Games	
Module – 2	**16 Hrs**
Specific Games (Any one to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground	
Module-3	**4 Hrs**
Role of Organization and administration	

Topics for Self-learning	
Module – 1	Sportsmanship, Fair Play and Ethical Decision-Making in Sports
Module – 2	Rules, Techniques and Performance Analysis of Volleyball / Track Events
Module – 3	Planning, Organization and Management of Sports Events

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the ethical principles, moral values, and sportsmanship essential for responsible participation in sports and games.
CO2	Perform the fundamental skills and techniques of the selected game or athletic event with discipline and teamwork.
CO3	Discuss the role of sports organizations and administration in the promotion and management of sports activities.

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes – 2, each of 15 marks	30
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	50
	Total	**100**

CO – PO MAPPING

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

Semester: IV					
Yoga **Streams: CSE/ECE/CV/ME**					
Course Code	**:**	1BYO410	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	---
Course Type	**:**	NCMC	**SEE Duration**	**:**	---

Prerequisites:	
Courses	**--**
Knowledge on Fundamental Concepts	• Basic understanding of physical fitness, health and personal hygiene. • Awareness of body posture, breathing, and general wellness practices.
Knowledge on Connected Tools (If any)	**--**

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the philosophy and principles of Patanjali's Ashtanga Yoga for holistic well-being.
CLO2	Demonstrate the correct techniques of Surya Namaskar, Yogasanas, Kriyas, and Pranayama with appropriate safety measures.
CLO3	Practice Yogic techniques to enhance physical fitness, mental wellness, and healthy lifestyle habits.

Module - 1	**04 Hrs**
Foundations of Ashtanga Yoga: Patanjali's Ashtanga Yoga: Introduction, need and importance, Eight Limbs of Yoga – Overview, Yama: Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha, Niyama: Shoucha, Santosha, Tapa, Svaadhyaya, Eshvarapranidhana. **T-1: Ch. 4**	
Module - 2	**05 Hrs**
Surya Namaskar and Yogasanas: Surya Namaskar: Concept, significance, 12-step sequence, breathing coordination, posture alignment, and practice of four rounds, Asanas: Meaning, need, importance, classification, Practice of Sitting, Standing, Prone, and Supine Asanas (Sukhasana, Paschimottanasana, Ardhakati Chakrasana, Parshva Chakrasana, Dhanurasana, Halasana, Karna Peedasana) with techniques, precautions and benefits. **T-1: Ch. 3, 4**	
Module - 3	**05 Hrs**
Kriyas and Pranayama: Kriyas: Introduction to Shatkarmas, Kapalabhati – meaning, importance, technique, precautions, and benefits, Pranayama: Meaning, need, importance, techniques, precautions, and benefits, Types of Pranayama: Suryanuloma–Viloma, Chandranuloma–Viloma, Suryabhedana, Chandrabhedana, Nadishodhana. **T-1: Ch. 5, T-2: Ch. 2**	

Topics for Self learning	
Module – 1	Role of Yama and Niyama in personal and professional ethics
Module – 2	Scientific benefits of Surya Namaskar and Yogasanas in stress management and lifestyle disorders
Module – 3	Advanced Pranayama, Meditation, and Yoga for mental health and holistic wellness

Course Outcomes: After completing the course, the students will be able to	
CO1	Summarize the philosophy, principles, and significance of Patanjali's Ashtanga Yoga and its role in healthy living.
CO2	Demonstrate Surya Namaskar, selected Yogasanas, Kapalabhati and Pranayama using proper techniques and precautions.
CO3	Practice appropriate Yogic techniques to improve physical fitness, mental concentration, emotional balance, and overall wellness.

Text Book	
1	Light on Yoga, B.K.S. Iyengar, HarperCollins Publishers India, 2006, ISBN: 978-81-7223-501-7.
2	Asana Pranayama Mudra Bandha, Swami Satyananda Saraswati, Yoga Publications Trust, Bihar School of Yoga, Munger, 2008, ISBN: 978-81-86336-14-4

Reference Books	
1	Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4th Edition, Kaivalyadhama Publishers, ISBN-10 : 9788189485245
2	Yoga Instructor Course hand book published by SVYASA University, Bengaluru
3	Raja Yoga, Swami Vivekananda, Advaita Ashrama, Kolkata, 2018, ISBN: 978-81-7505-151-5.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/playlist?list=PLzF4lOyPf_Z9yQ_Gphjh1wZ5fEhMg6hmP
2	https://www.youtube.com/playlist?list=PLOzRYVm0a65cCcY4qKX5MIyJxBt7hJgQY
3	https://youtu.be/KB-TYlgd1wE
4	https://youtu.be/aa-TG0Wg1Ls

CO – PO MAPPING

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

Semester: IV					
Music **Stream: CSE/ECE/ME/CV**					
Course Code	**:**	1BMU409	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	Familiarity with school-level cultural or music activities is beneficial
Knowledge on Fundamental Concepts	Basic awareness of vocal music and musical instruments.
Knowledge on Connected Tools (If any)	Metronome or Tala application for rhythm practice. Audio playback device (mobile phone/laptop) for listening to compositions.

Course Learning Objectives: This course will enable the students to	
CLO1	Interpret the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
CLO2	Contrast the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
CLO3	Demonstrate basic vocal proficiency through the practice of Sarale Varase exercises, notations for Suladi Sapta Tala in Mayamalavagowla raga and performance of selected compositions such as Geethe, Jathi Swara and Krithi.

Module – 1	**05 Hrs**
Composers Biography and contributions of Purandaradasaru, Thyagarajaru, Mysuru vasudevacharyaru, Kanakadasaru. **T-3** Ch. 2-5	
Module – 2	**05 Hrs**
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. **T-1**,V-4 – Ch. 2-6	
Module – 3	**04 Hrs**
Abhyasa Gana Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase andsulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathi swara, oe krithi in a mela raga. **T-1**, V-1&2 **T-2** Ch.2-4	

Topics for Self learning	
Module – 1	Contributions of the trinity of Carnatic music (Thyagaraja, Muthuswami Dikshitar, Syama Sastri)
	Women composers and their contributions to Indian Classical Music
Module – 2	Modern electronic musical instruments used in Indian Music
	Evolution and global influence of traditional Indian musical instruments
Module – 3	Voice culture techniques and vocal health for singers
	Introduction to digital music learning tools (Shruthi Box, Tala Apps, and Online Music Platforms)

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend the contributions of composers.
CO2	Classify Indian musical instruments and describe their construction and use.
CO3	Illustrate basic Carnatic vocal skills through selected exercises and compositions.

Text Books	
1	South Indian Music – Vol. I to VI, Prof. P. Sambamoorthy, 2019thEdition,2021. The Indian Music Publishing House, Chennai, ASIN : B093Y3TL52 Chapters:2,3,4,5,6
2	A Textbook of Carnatic Music, Dr. S. Bhagyalekshmy, 4th Edition ,2008,CBH Publications , ISBN 81 85 381 50 Chapters:2,3,4
3	Karnataka Sangeetha Charitre, Dr. V. S. Sampathkumaracharya, Kannada University, Hampi Chapters:2,3,4,5

ReferenceBooks	
1	History of South Indian (Carnatic) Music (From Vedic Times to the Present) , R Rangaramanuja ayyangar ,2019 edition ,Vipanchi charitable trust publisher ISBN: 9788187723158.
2	Music of India, B. Chaitanya Deva, 2nd edition , 1995 Munshiram Manoharlal Publishers. ISBN-10 : 8121501954
3	Essentials of Musicology in South Indian Music, Prof. S. R. Janakiraman, 2013 Edition, Asian Educational Services
Web links and Video Lectures (e – Resources)	
1	https://youtu.be/DZA_cSb0Zo8?si=55M6QAC2T8VqZN39
2	https://www.youtube.com/live/RfM4lAJQgCc?si=xfK0b6exvkBujugr
3	https://youtu.be/DZA_cSb0Zo8?si=55M6QAC2T8VqZN39

CO – PO MAPPING

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

Semester: IV					
National Cadet Corps – II **(General Awareness – Common Subjects) (Common to all Branches)**					
Course Code	:	1BNC410	**Credit**	:	0
Hours/Semester (L:T:P:SL)	:	14:0:0:16	**CIE**	:	100 Marks
Total Hours	:	30	**SEE**	:	NA
Course Type	:	NCMC	**SEE Duration**	:	NA

Prerequisites:	
Courses	National Cadet Corps (NCC) – I (1BNC309), if NCC was the option chosen in III Semester
Knowledge on Fundamental Concepts	NCC, National Integration, Disaster Management, Social Awareness
Knowledge on Connected Tools (If any)	**-**

Course Learning Objectives: This course will enable the students to	
CLO1	Acquire general knowledge of health, hygiene and preventive well-being practices prescribed for NCC cadets
CLO2	Gain awareness of environmental conservation and natural-resource management as taught to NCC cadets
CLO3	Understand the elements of personality development and leadership traits expected of a responsible citizen

Module – 1	**05 Hrs**
Health and Hygiene – General Awareness Structure and Functioning of the Human Body; Hygiene and Sanitation (Personal and Food Hygiene). Physical and Mental Health (general awareness); Infectious and Contagious Diseases and their Prevention. First Aid in Common Medical Emergencies (awareness only); Introduction to Yoga Exercises.	
Module – 2	**05 Hrs**
Environment Awareness and Conservation – General Awareness Natural Resources – Conservation and Management; Water Conservation and Rain Water Harvesting. Waste Management; Pollution Control – Water, Air, Noise and Soil. Energy Conservation; Wildlife Conservation and Projects in India.	
Module – 3	**04 Hrs**
Personality Development and Leadership – General Awareness Introduction to Personality Development; Factors Influencing Personality (Physical, Social, Psychological and Philosophical); Self-Awareness. Interpersonal Relationship and Communication Skills; Leadership Traits and Types of Leadership. Attitude – Assertiveness and Negotiation; Time Management; Stress Management Skills; Interview Skills.	

Topics for Self learning	
Module – 1	Reading on personal hygiene/sanitation practices; a short note on common infectious diseases and their prevention
Module – 2	Short report on a local water-conservation or waste-management initiative; awareness reading on a wildlife conservation project in India
Module – 3	Preparation of a short self-awareness/communication-skills reflection note; practice of a mock interview with peers

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the structure and functioning of the human body and describe common health, hygiene and preventive practices
CO2	Describe key concepts of environmental conservation, natural-resource management and pollution control
CO3	Exhibit an understanding of personality development, leadership traits, communication and stress/time-management skills

Text Books	
1	Cadet's Handbook – Common Subjects (SD/SW), Directorate General NCC, Ministry of Defence, Government of India, Edition dated 06 May 2013 (or latest edition).
2	NCC Handbook for 'A', 'B' and 'C' Certificate Examinations, Upkar Prakashan, Latest Edition.

Reference Books	
1	Personality Development and Leadership – A Cadet's Guide, published by DGNCC, Latest Edition.
2	Ministry of Environment, Forest and Climate Change – awareness publications on conservation, Latest Edition.
3	NCC Directorate/Group HQ training literature and circulars, as issued from time to time.

Web links and Video Lectures (e – Resources)	
1	Directorate General National Cadet Corps – https://www.nccindia.gov.in/
2	Ministry of Environment, Forest and Climate Change – https://moef.gov.in

CO – PO MAPPING

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

Semester: IV						
Competency Enhancement Course-II **Stream: CSE/ECE/ME/CV**						
Course Code	:	1BCE411		**Credits**	:	0
Hours/Week(L:T:P: SL)	:	36:0:0:24		**CIE**	:	100 Marks
Total Hours	:	50		**SEE**	:	-
Course Type	:	NCMC		**SEE Duration**	:	-

Prerequisites:	
Courses	Competency enhancement course-1
Knowledge on Fundamental Concepts	Arithmetic operations, fractions, decimals and elementary algebra. comprehension of basic English
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Enhance Quantitative Problem-Solving Skills
CLO2	Master Data Interpretation and Visual Analysis
CLO3	Strengthen Logical Reasoning and Spatial Intelligence
CLO4	Develop Advanced Verbal Aptitude and Communication Accuracy
CLO5	Sharpen Critical Thinking through Assumptions and Analytical Judgement

Module – 1	**6 Hrs**

Data Interpretation

Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data– Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs

T-1, C-36

Module – 2	**6 Hrs**

Pipes & Cisterns

Speed, Time, and Distance, Core concepts of speed, time, and distance with formula-based problem-solving techniques. Understanding the relationships between speed, time, and distance, and applying them to real-world scenarios.

Relative Speed

Calculating relative speed in scenarios involving objects moving in the same or opposite directions. Application of relative speed in solving problems on overtaking, crossing, and meeting points.

Average Speed

Techniques for calculating average speed over multiple journeys or varying speeds. Application in mixed-distance and mixed-speed problems.

Problems on Trains

Solving problems involving trains, including crossing stationary and moving objects. Concepts of platform length, tunnel length, and calculating crossing times for accurate results.

Boats and Streams

Understanding upstream and downstream speeds, including the effect of current on

boat movement. Solving problems based on effective speed in both still water and flowing water scenarios.

Races

Concepts of time, distance, and lead in competitive races. Analyzing head-starts, leads, and gaps between racers, and calculating who wins and by how much.

T-1, C-14-18

Module-3	**6 Hrs**

Cubes and Dice

Introduction to the properties and visualizations of cubes and dice. Understanding different orientations and views of cubes and dice, including adjacent and opposite faces. Solving problems related to numbering, coloring, and arranging cubes and dice. Techniques to quickly analyze and answer questions on folding/unfolding and rotation. Application in spatial reasoning and enhancing 3D visualization skills.

Puzzles

Developing logical thinking and problem-solving skills through a variety of puzzles. Types of puzzles, including number puzzles, pattern recognition, arrangement, and logical deduction. Strategies for approaching and solving puzzles efficiently. Practice with common puzzle formats found in competitive exams and aptitude tests. Enhancing analytical abilities, critical thinking, and creative problem-solving through diverse puzzle exercises.

Verbal Aptitude

Reading Comprehension

Introduction to Reading Skills, Emphasizing the importance of regular reading for comprehension, vocabulary, and overall verbal aptitude. Understanding how strong reading skills benefit areas beyond comprehension, like analytical thinking and verbal reasoning. Establishing a daily reading habit to improve focus and retention.

Para Jumbles

Techniques for logically ordering jumbled sentences into a coherent paragraph. Understanding linkages between sentences, transitional words, and thematic flow.

Sentence Completion

Strategies for filling in the blanks with appropriate words or phrases. Developing skills to recognize context, tone, and logical flow for accurate sentence completion.

Antonyms/Synonyms

Building a strong vocabulary by mastering antonyms and synonyms. Practice with context-based word selection to improve vocabulary and precision in language.

T-2, C6-9,13-16

Module-4	**6 Hrs**

Verbal Aptitude

Error in Sentences

Identifying common grammatical errors in sentences, including subject-verb agreement, tense consistency, and pronoun usage. Understanding sentence structure and common pitfalls in grammar for error detection.

Sentence Rearrangement

Techniques to rearrange words or phrases to form coherent and grammatically correct sentences. Focus on grammar, context, and logical structure for rearrangement accuracy.

Idioms and Phrases

Understanding and correctly using idioms and phrases in context. Building familiarity

with common idioms to enhance comprehension and verbal accuracy.

Verbal Analogies

Solving analogies by identifying the relationships between words or phrases. Developing logical thinking to understand and complete analogy-based questions.

T-1, C28-29

Module-5	**6 Hrs**

Permutation and Combination

Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of 2n, Arrangement in a circle.

Probability

Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes.

Crypt arithmetic

Basic concepts, addition, subtraction, multiplication of coded alphabets, Types of cryptarithm.

Statements and Assumptions

Identifying implicit assumptions within a statement. Developing the ability to read between the lines and recognize underlying premises.

Statements and Conclusions

Analyzing a given statement to derive logical conclusions. Differentiating between valid and invalid inferences based on the provided information.

Cause and Effect

Understanding cause-effect relationships and identifying causation or correlation between events. Analyzing statements to determine whether one event directly influences another.

R-1, C1-6

Topics for Self learning	
Module – 1	Data sufficiency, caselet DI and interpretation of radar/scatter graphs.
Module – 2	Circular track problems, unit conversions and applications in transportation and logistics.
Module – 3	Mirror images, paper folding, advanced puzzles and vocabulary building through reading.
Module – 4	Cloze tests, critical reasoning, workplace vocabulary and commonly confused words.
Module – 5	Set theory, Venn diagrams, conditional probability and decision-making case studies.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply arithmetic and logical reasoning to solve problems.
CO2	Develop spatial and logical skills to solve cube, dice, puzzle and seating arrangement questions.
CO3	Improve reading, vocabulary, and grammar through para jumbles, sentence completion and idioms.
CO4	Enhance verbal reasoning by solving analogies, rearranging sentences and identifying assumptions and conclusions.
CO5	Apply combinatorics and probability to solve permutation, combination and crypt arithmetic problems.

Text Books	
1	**Quantitative Aptitude for Competitive Examinations** by R.S. Aggarwal Chand Publishing. – 2023.
2	**Word Power Made Easy** by Norman Lewis (ISBN- 978-0143424680), , Published by PENGUIN INDIA - 2015
3	**How to Prepare for Quantitative Aptitude for the CAT** by Arun Sharma (ISBN- 978-9339205126), 6th Edition, McGraw-Hill Education - 2014

Reference Books	
1	**Puzzle Test & Seating Arrangements** by K. Kundan (ISBN: 9789394666023),1st Edition, BSC Publishing Company Pvt Ltd. - 2023
2	**A Modern Approach to Verbal & Non-Verbal Reasoning** by R.S. Aggarwal, 2025-26 Edition, S. Chand Publishing -2024

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/KWZ0lR8cCwc
2	https://youtu.be/mBtBD1N7ywQ
3	https://youtu.be/B9MhxmcwnpQ
4	https://youtu.be/VaEbefWFIlc
5	https://youtu.be/3AL_6EQmnkY

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	2	2										
CO3	1	1								3		
CO4	2	2								2		1
CO5	3	3										1

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

An Autonomous Institution under VTU from 2024-25

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