Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Technology and Science

Choice Based Credit System (CBCS) Scheme in light of NEP2020

B. Tech/B. Tech + MBA in Automobile Engineering

(2021-2025)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU701A	DE	AUTOMOTIVE AIR CONDITIONING	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

The objective of the course is to describe (A) Automotive AC fundamentals, (B) Automotive Cooling and Heating System, (C) AC controls and Automatic Temperature control (D) AC Maintenance and service.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes -

1. Students would be able to understand the automotive air-conditioning fundamentals.
2. Students would able to understand basics of refrigerants and its handling.
3. Students would be able to understand automotive cooling and heating system.
4. Students will be able to understand and describe various control systems.
5. Students would be able to maintenance and servicing of Automotive AC system.

Syllabus

Unit - I

Automotive Air-conditioning Fundamentals: purposes of heating, ventilation and air conditioning in automobiles; environmental concerns: ozone layer depletion, location of air conditioning components in a car: schematic layout of a vehicle refrigeration system, major components: -compressor, condenser and high-pressure service valve, thermostatic expansion valve, evaporator, controlling evaporator temperature. Psychrometry: basic terminology and psychrometric mixtures, psychrometric chart related problems.

Unit - II

Refrigerants

Classification of refrigerants, coding of refrigerants, desirable properties of refrigerants, substitutes for CFC refrigerants, containers, refrigerant handling: discharging, charging & leak detection, refrigeration system diagnosis: diagnostic procedure, ambient conditions affecting system pressures. Thermodynamic cycles, coefficient of performance,

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Unit – III

Automotive Cooling and Heating System

Types of compressors: compressor clutches, compressor clutch electrical circuit, compressor lubrication; condensers, evaporators, expansion devices, evaporator temperature and pressure controls, receiver, drier, accumulators, refrigerant hoses. Automotive heaters, manually controlled air conditioner and heater system, automatically controlled air conditioner and heater systems.

Unit – IV

AC Controls and Automatic Temperature Control

Types of control devices: preventing compressor damage, preventing damage to other systems, preventing overheating. Ram air ventilation: air delivery components, control devices, vacuum controls. Automatic temperature control: different types of sensors and actuators.

Unit-V

Maintenance and Service

Air conditioner maintenance and service, inspection using manifold gauge, servicing heater system, removing and replacing components, evacuation and refilling of refrigerant, trouble shooting of air controlling system, servicing of compressor, Safety devices: air conditioning protection & engine protection.

Note: Data Book and data tables are allowed in the examination hall as per instruction of exam cell.

Text and Reference Books:

1. *"Automotive Heating, Ventilation, and Air Conditioning systems" by Warren Farnell and James D. Halderman, Classroom Manual, Pearson Prentice Hall, 2004*

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Vishwavidyalaya, Indore	Vishwavidyalaya, Indore		

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2. *"Automotive Air conditioning" by William H. Crouse and Donald I. Anglin, McGraw-Hill, 1995.*
3. *"Refrigeration and Air Conditioning", by C. P. Arora, Tata McGraw Hill, 2006.*
4. *"Refrigeration and Air Conditioning Technology", by Whitman, Jhonson and Tomczyk, Thomson Delmer Learning, 1992.*
5. *"Refrigeration and Air Conditioning", by Abdul Ameen, Prentice Hall of India Ltd, 2006.*
6. *"Refrigeration and Air Conditioning", by Wilbert F. Stoecker and Jerold W. Jones, Tata McGraw Hill, 2008.*
7. *ASHRAE Handbook – Refrigeration 2010,*
8. *"Refrigeration and Air Conditioning" by G S Sawhney, valu education of India, 2015.*

List of Experiments:

1. To study the layout of car air conditioning system and its components.
2. To study the properties of different refrigerants.
3. To study different types of compressors used in automotive AC.
4. To study automatically controlled air conditioner and heater systems.
5. To study various control devices used in automotive AC system.
6. To study various sensors and actuators used for automatic temperature control.
7. To study common practice used for maintenance of car AC system.

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B. Tech/B. Tech + MBA in Mechanical Engineering

(2021-2025)

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BTAU701B	DE	ROBOTICS, MACHINE VISION AND IMAGE PROCESSING	60	20	20	30	20	3	0	2	**4**

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Course Educational Objectives (CEOs):

This course aims to provide a comprehensive (A) understanding of industrial robots, including their basics, applications, types and configurations. (B) Students will explore robotic motion, programming and AI techniques. Additionally, the course covers (C) machine vision systems and image processing knowledge to design and implement these systems in industrial applications.

Course Outcomes (COs):

After completion of this course the students are expected to be able to

1. Identify and describe different types of industrial robots.
2. Classify and configure robots based on various parameters.
3. Apply kinematic principles to solve robotic motion problems.
4. Develop and implement robot programs using AI techniques.
5. Design and implement machine vision systems for industrial applications.

Syllabus

Unit-I

Industrial Robots: Definition, History, Evolution and Applications. Types of Industrial Robots: Cartesian Robots, SCARA Robots, Articulated Robots, Cylindrical Robots, Polar Robots and Delta Robots. Classifications and Configurations; Based on Geometry and Structure, Degrees of Freedom (DoF), Work Envelope and Reach, Payload Capacity, Speed and Precision. Control Loops in Robotics, Coordinate Systems in Robotics, Basic Parts and Functions of Robots, Specifications of Industrial Robots, Robotic Motion: Types of Robot Motion, Trajectory Planning, Path Planning Algorithms. Kinematics of Robotic Motion, Homogeneous Transformation, Linkages and Joints, Mechanism for Location and Orientation of Objects, Drive Systems, End Effectors, Grippers.

Unit-II

Robotic Programming & AI Techniques: Types of Programming; Teach pendant programming; Basic concepts in AI techniques, Concept of knowledge representations, Expert system and its components; Robotic cell layouts, Inter locks, Humanoid robots, Micro-robots; Application of robots in surgery, Manufacturing industries, space and underwater. AI Techniques used in robotics.

Unit-III

Machine Vision : Human vision, Machine and Computer vision, Benefits, Block diagram and function; System implementation of industrial machine vision system; Light Physics and Interactions,

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Refraction at a spherical surface, Scene constraints, Lighting parameters and sources; Lighting selection techniques, Types and Selection; Machine Vision Lenses and Optical Filters, Specifications and Selection; Imaging Sensors, CCD and CMOS; Specifications Interface Architectures, Analog and Digital Cameras, Camera Computer Interfaces; Specifications and Selection – Geometrical Image, formation models – Camera Calibration.

Unit-IV

Machine Vision Analysis & Applications: Feature extraction; Region Features, Shape and Size features, Texture Analysis; Template Matching and Classification, 3D Machine Vision Techniques, Decision Making; Machine vision applications in manufacturing, electronics, printing, pharmaceutical, textile etc. applications in non-visible spectrum, metrology and gauging, OCR and OCV; vision guided robotics; Field and Service Applications, Agricultural, and Bio medical field, augmented reality, surveillance and bio-metrics.

Unit-V

Image Acquisition & Processing: Machine Vision Software, Fundamentals of Digital Image, Image Acquisition Modes, Image Processing in Spatial and Frequency Domain, Point Operation, Thresholding; Grayscale Stretching, Neighborhood Operations, Image Smoothing and Sharpening; Edge Detection, Binary Morphology, Color image processing

Text Books:

1. *"Robotics: Control, Sensing, Vision, and Intelligence" by K.S. Fu, R.C. Gonzalez, and C.S.G. Lee, McGraw-Hill, 1987.*
2. *"Introduction to Robotics: Mechanics and Control" by John J. Craig, Pearson, 2017.*
3. *“Robots and manufacturing Automation” by C. Ray Asfahl, John Wiley and Sons, 1992*
4. *“Introduction to Robotics- mechanics and control” by Craig. J. J., Pearson, 2014.*
5. *"Automation, Production Systems and Computer Integrated Manufacturing" by Mikell P. Groover, Pearson Education Asia, 2001.*
6. *"Robot Modeling and Control" by Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Wiley, 2006.*
7. *"Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, Pearson, 2020.*

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Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Reference Books:

1. *"Industrial Robotics, technology, programming and application" by Groover M. P., Mc-Graw Hill, 2012*
2. *"Robotics Control, sensing, vision and intelligence" by Fu K.S., Gonzalac R.C. and Lee C.S.G, Mc-Graw Hill, 2011.*
3. *"Introductory Techniques for 3D Computer Vision" by Emanuele Trucco and Alessandro Verri, Prentice-Hall, 2009*
4. *"Robotic Engineering: An Integrated Approach" by Richard D. Klafter, Thomas A. Chmielewski, and Michael Negin, Prentice Hall, 1989.*
5. *"Handbook of Industrial Robotics" edited by Shimon Y. Nof, John Wiley & Sons, 1999.*
6. *"Digital Image Processing" by Rafael C. Gonzalez and Richard E. Woods, Pearson, 2018.*
7. *"Introduction to AI Robotics" by Robin R. Murphy, MIT Press, 2000.*

List of Experiments:

1. To understand and identify different types of industrial robots.
2. To study the direct and inverse kinematics of a simple robotic arm.
3. To analyze the forces exerted by different types of robotic grippers.
4. To learn basic robotic programming.
5. To understand basic AI concepts and knowledge representation.
6. To explore the use of robots in surgical applications.
7. To compare human vision with machine/computer vision.
8. To study the effect of different lighting conditions on image acquisition.
9. To explore 3D machine vision techniques.

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BTAU701C	DE	COMBUSTION AND HEAT TRANSFER	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; T - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Educational Objectives (CEOs)

The students (A) Will Be Able to familiarize with combustions in IC engines, (B) understand the heat transfer fundamentals in IC Engines, (C) able to solve problems related to heat transfer.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes, the students will be able to

1. Apply knowledge of combustion and heat transfer on S.I. and C.I. engines.
2. Solve/describe the problems related to heat transfer by conduction.
3. Solve/describe the problems related to heat transfer by convection.
4. Demonstrate Heat transfer from extended surface, steady flow of heat along a rod.

Syllabus

Unit-I

Combustion: Combustion phenomena of S.I. and C.I. engines, Stages of combustion, Photographic studies of combustion process- p-q diagrams in S.I. and CI engines. Abnormal combustion-Effect of engine variables on knock-Factors controlling combustion chamber design. Combustion chambers: Diesel engine combustion chambers open, Divided, Swirl, Turbulent and Ricardo's M Combustion chambers.

Unit-II

Heat Transfer in IC engines: Heat transfer, Temperature distribution and thermal stress in Piston, Cylinder Liner, cylinder head, Fins and valves. Variation of gas temperatures; Heat transfer coefficient and combustion system-Effect of engine load on piston temperature heat rejected to coolant quantity of water required.

Unit-III

Introduction to heat transfer: Temperature, Heat and thermal equilibrium, Modes of basic laws of heat transfer i.e., conduction, Convection and Radiations; Fourier equation and Thermal Conductivity, Derivation of the general form of heat conduction equation in Cartesian, Cylindrical Spherical Coordinates.

Unit-IV

Conduction Heat Transfer: Steady State Conduction, Heat conduction through plane wall, Composite wall, cylindrical wall, multi-layer cylindrical wall, and through spheres; effect of variable conductivity, Critical thickness of Insulation; conduction with heat generation, plane wall with uniform heat generation, Dielectric heating, Cylinder with uniform heat generation, Heat transfer from extended surface, Heat dissipation from and infinitely long fin, Fin performance.

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Unit-V

Convection Heat Transfer: Free and forced convection, Laminar and Turbulent flow, Newton- Rekhman Law: Convection rate equation, Nusselt Number; radiation heat exchanger; salient features and characteristics of radiation, Absorptive, reflectivity and transmittance; spectral and spatial energy distribution, wavelength distribution of black body radiation, Plank's law; total emissive power: Stefan Boltzman law, Wien's displacement law, Kirchoffs Law, gray body and selective emitters.

Text and reference Books:

1. *"Internal Combustion Engine Fundamentals", by J.B. Heywood, McGraw-Hill, 1995.*
2. *"Fundamentals of Internal Combustion Engines", by Paul W. Gill & James H. Smith, Oxford & IBH Pub. Ltd., 1992.*
3. *"A Course in Internal Combustion Engines", by V. M. Domkundwa, Dhanpat Rai Publication, 2013.*
4. *"Internal Combustion Engines", by V. Ganesan, Tata McGraw-Hill, 2nd edition, 2012.*
5. *"Heat and mass transfer" by Sukhatme SP, University Press Hyderabad, 2005.*
6. *"Heat transfer" by Holman JP, TMH, 2011*
7. *"Heat and Mass Transfer" by Nag PK, TMH, 2007.*
8. *"Heat Transfer Principles and App, by Dutta BK, PHI Learning, 2015.*
9. *"Heat transfer" by Mills AF and Ganesan V, Pearson, 2009.*
10. *"Heat and Mass transfer" by Cengel Yunus A, TMH, 2011.*

List of experiments (please expand it);

1. To study the combustion phenomena of S.I. and C.I. engines.
2. To study the conduction through a rod to determine thermal conductivity of material.
3. To study the forced and free convection over circular cylinder.
4. To study the free convection from extended surfaces.
5. To study the parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
6. To study the calibration of thermocouple.
7. To study the experimental determination of Stefan Boltzmann constant.
8. To study the force convection from extended surfaces.

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BTAU703	DCS	VEHICLE DYNAMICS	60	20	20	30	20	3	1	2	5

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)
This course provides a fundamental understanding of (A) Vehicle handling and ride performance through the development (B) Analysis and critical interpretation of vehicle/system models.

Course Outcomes (COs)
After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Student will be able to understand the Performance Characteristics and Aerodynamics of vehicle.
2. Student will be able to identify the various forces and loads and performance under acceleration, ride and braking.
3. Student will be able to solve the fundamental problems in vehicle dynamics.

Syllabus

Unit I
Performance Characteristics of Vehicle: SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, power limited and traction limited acceleration, braking performance, Brake proportioning, Braking efficiency.
Aerodynamics: Mechanics of Air Flow around a Vehicle, Pressure Distribution on a Vehicle, Aerodynamic Forces, Drag Components, Aerodynamics Aids.

Unit II
Tire Mechanics: Tire Construction, Size and Load Rating, Terminology and Axis System, Tractive Properties, Cornering Properties, Camber Thrust, Aligning Moment, Combined Braking and Cornering, Conicity and Ply Steer, Slip, Skid, Rolling Resistance, Elastic Band Model for longitudinal slip, Simple model for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic Tire Formula.

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Unit III

Suspensions: Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Center Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points.

Unit IV

The Steering System: The Steering Linkages, Steering System Forces and Moments, Steering System Models, Steering Geometry, Steady Handling (2 DOF steady state model), Under-steer and Over-steer, Effect of Tire Camber and Vehicle Roll (3 DOF steady-state model), Transient Handling and Directional Stability (2 DOF unsteady model), Effect of Vehicle Roll on Transient Handling (3 DOF unsteady model), Steady-State and Transient Handling of Articulated Vehicles.

Unit V

Motorcycle Dynamics: Kinematic structure of motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting on motorcycle (tyre rolling resistance, aerodynamic resistance forces, resistant force caused by slope), Location & height of motor cycle's centre of gravity (C.G), Moments of inertia on Motorcycle; Introduction to Front & Rear suspensions of Motorcycle.

Text and Reference Books:

1. *"Vehicle dynamics", by R.V. Dukkipati, Narsova Publications, 2012.*
2. *"Fundamentals of Vehicle dynamics", by Thomas D Gillespie, SAE USA, 1992.*
3. *"Vehicle Dynamics & control", by Rajesh Rajamani, Springer, 2011.*
4. *"Theory of Ground Vehicles", by Wong J Y, John Wiley & Sons, New York, 1978*
5. *"Race car Vehicle Dynamics", by Milliken W F and Milliken D L, SAE, 1997.*

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6. *"Motor Vehicle", by Garrett T K, Newton K and Steeds W, Butter Worths& Co., Publishers Ltd., New Delhi, 2001.*
7. *"Vehicle and Engine Technology", by Heinz Heister, SAE Second Edition, 1999*
8. *"Motorcycle Dynamics", by Vittore Cossalter, 2nd Edition, Publisher: lulu.com, 2006.*

List of Experiments

1. Experimental study of mechanism for air flow over different geometry of vehicles.
2. Experimental studies of measurements of drag and lift coefficient for different geometry vehicle using wind tunnel apparatus.
3. To study the effect of tyre pressure and temperature on the performance of the tyre.
4. Finding the stiffness of tyre with variation of air pressure.
5. To simulate and study the effect of different conditions on vehicle loading.
6. Study of latest technologies available nowadays in vehicles helping to maintain stability of the vehicle on the road.
7. Study geometry of motorcycles as well as various types of forces faced by the motorcycle & its rider.
8. Study the location & height of Centre of gravity (C.G) of a motorcycle.

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Choice Based Credit System (CBCS) Scheme in light of NEP-2020

B. Tech/B.Tech+MBA in Mechanical Engineering

(2021-2025)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME603	DCC	MECHANICAL VIBRATION	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)

This course provides a fundamental understanding of (A) Vibration and noise in mechanical system and machines (B) Design modifications to reduce the vibration and noise(C) increase the life of components and control noise.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Understand free and forced vibrations of single degree freedom systems.
2. Analyze balancing problems in rotating and reciprocating machinery.
3. Understanding causes, source and types of vibrations in machineries.
4. Gaining knowledge in sources and measurement standard of noise.
5. Ability to design and develop vibrations and noise control systems.

Syllabus

Unit – I **(10 Hrs)**

Fundamental Aspects of Vibrations: Definition of Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems.

Un-damped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton's second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: compound pendulum.

Unit – II **(9 Hrs)**

Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

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BTME603	DCC	MECHANICAL VIBRATION	60	20	20	30	20	3	0	2	4

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Unit – III **(9 Hrs)**

Harmonically excited Vibration: One degree of freedom, forced harmonic vibration vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments).

Whirling Motion and Critical Speed: Whirling motion and Critical speed: Definitions and significance. Critical – speed of a vertical, light – flexible shaft with single rotor: with and without damping .Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Unit – IV **(9 Hrs)**

Systems With Two Degrees of Freedom : Un-damped free vibration of 2 d.o.f and Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation ; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Unit-V **(8 Hrs)**

Noise Measurement & Control : Noise and its causes, sound pressure / intensity / power level and their inter-relation, Decibel scale, Loudness and equal loudness contours, Effect of machine / process noise on operators, employees and local residents. Standards of noise level and exposure limit, Methods of industrial noise control, Measurement of noise, Sound spectra and octave band analysis. Background noise, weighted networks,

Text Books:

1. "Theory of Vibrations with Applications" by W.T. Thomason, M.D. Dahleh and C. Padmanabhan, Pearson, 2008.
2. "Text book of Mechanical Vibrations", by Dukikipati RV Srinivas J; Publisher PHI, 2012.
3. "Mechanical Vibrations" by S.S. Rao, Pearson, 2018.

Reference Books:

1. "Mechanical Vibrations and Noise Engineering", by Ambekar A.G; Publisher: PHI, 2013.
2. "Element of Vibration Analysis", by Meirovitch Leonard Publisher: TMH, 2010

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***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

3. "Mechanical Vibrations", by Kelly SG and kudari SK; Publisher: Schaum Series; TMH, 2011.
4. "Mechanical Vibrations" by G.K. Grover, Nem Chand & Bros, 2009.
5. "Vibrations and waves in continuous mechanical systems" by P. Hagedorn and A. DasGupta, John Wiley, 2007.

List of Experiments

1. To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account
2. To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system
3. To find out natural frequency and damped free frequency of a torsion pendulum and, hence to find out coefficient of damping of the oil
4. To observe the phenomenon of ' whirl' in a horizontal light shaft and to determine the critical speed of the shaft
5. To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.
6. To demonstrate the principle of tuned Un-damped Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting natural frequencies
7. To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU706	SEC	CFD (COMPUTATIONAL FLUID DYNAMICS) LAB	0	0	0	0	50	0	0	2	1

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)

(A) To gain a solid understanding of the fundamental principles of fluid dynamics and their application in solving engineering problems, (B) Learn to use CFD software tools to model, simulate, and analyze fluid flow problems and (C)Engage in project-based learning to integrate CFD with other engineering disciplines and real-world applications.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes students will be able

1. To demonstrate a comprehensive understanding of the basic principles of fluid dynamics.
2. To successfully set up and conduct CFD simulations using appropriate solver settings.
3. To analyze and interpret simulation results and validate the accuracy and reliability of the CFD models.
4. To conduct comprehensive CFD projects and demonstrate the ability to manage complex engineering tasks.
5. To recognize and address ethical issues related to the use of CFD in engineering design.

Syllabus

Unit I

Introduction: Introduction to computational fluid dynamics: history, uses, application, significance and recent scenario. Governing Equations: Continuity, momentum, and energy equations.

Unit 2

Mathematical Models and Discretization: Modeling Techniques: Simplifications, assumptions, and physical models. Discretization Methods: Finite difference, finite volume, and finite element methods. Grid Generation: Structured and unstructured grids, mesh quality, and refinement.

Unit 3

Numerical Methods: Solution Techniques: Explicit and implicit methods, stability, and convergence. Time Stepping Methods: Steady-state and transient solutions, Pressure-Velocity Coupling: SIMPLE, PISO algorithms.

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BTAU706	SEC	CFD (COMPUTATIONAL FLUID DYNAMICS) LAB	0	0	0	0	50	0	0	2	1

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Unit 4

Heat Transfer and Multiphase Flows: Heat Transfer in CFD: Conduction, convection, and radiation modeling. Multiphase Flow Models: Eulerian and Lagrangian approaches, Volume of Fluid (VOF) method.

Unit 5

Applications, Case Studies and CFD Project: Practical Applications: Aerodynamics, hydrodynamics, HVAC, combustion, etc. Case Studies: Real-world examples and project-based learning. Validation and Verification: Techniques to ensure accuracy and reliability of CFD simulations. Project Work: Define, set up, and solve a CFD problem. Report Writing: Document the methodology, results, and conclusions. Presentation: Present findings and demonstrate the CFD simulation.

Textbooks

1. *"Computational Fluid Dynamics: The Basics with Applications" by John D. Anderson, McGraw-Hill, 1995.*
2. *"An Introduction to Computational Fluid Dynamics: The Finite Volume Method" by H.K. Versteeg and W. Malalasekera, 2nd ed., Pearson, 2007.*
3. *"Fundamentals of Computational Fluid Dynamics" by Patrick J. Roache, Hermosa Publishers, 1998.*
4. *"Numerical Heat Transfer and Fluid Flow" by Suhas V. Patankar, Hemisphere Publishing Corporation, 1980.*
5. *"Introduction to Computational Fluid Dynamics: Development, Application and Analysis" by Atul Sharma, Wiley, 2021.*
6. *"Computational Fluid Mechanics and Heat Tranfer", by Pletcher, R. H., Tannehill, J. C., Anderson, D., 3rd ed., CRC Press, 2011, ISBN 9781591690375.*
7. *"Introduction to Computational Fluid Dynamics" by Atul Sharma, 1st ed., Ane Books, 2019.*

Reference Books

1. *"Computational Methods for Fluid Dynamics" by Joel H. Ferziger and Milovan Perić, 3rd ed., Springer, 2002.*
2. *"Computational Fluid Mechanics and Heat Transfer" by Richard H. Pletcher, John C. Tannehill, and Dale Anderson, 3rd ed., CRC Press, 2012.*

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BTAU706	SEC	CFD (COMPUTATIONAL FLUID DYNAMICS) LAB	0	0	0	0	50	0	0	2	1

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

3. *"Advanced Engineering Fluid Mechanics" by K. Muralidhar and G. Biswas, 2nd ed., Alpha Science International, 2005.*
4. *"Applied Computational Fluid Dynamics Techniques: An Introduction Based on Finite Element Methods" by Rainald Löhner, 2nd ed., Wiley, 2008.*
5. *"The Finite Volume Method in Computational Fluid Dynamics: An Advanced Introduction with OpenFOAM® and Matlab" by F. Moukalled, L. Mangani, and M. Darwish, Springer, 2015.*
6. *"Computational Fluid Flow and Heat Transfer" by K. Muralidhar and T. Sundararajan, 2nd ed., Narosa Publishing House, 2003.*
7. *"Numerical Methods for Fluid Dynamics" by S. V. Patankar, 1st ed., CRC Press, 1991 (another classic by Suhas V. Patankar).*

List of Experiments

Experiment 1: Introduction to CFD Software: Getting familiar with the interface and basic functionalities of CFD software (e.g., ANSYS Fluent, Open FOAM).

Experiment 2: Governing Equations and Boundary Conditions: Setting up a simple 2D flow problem (e.g., flow over a flat plate) and applying boundary conditions.

Experiment 3: Mesh Generation: Creating structured and unstructured meshes for a simple geometry and analysing mesh quality.

Experiment 4: Finite Volume Method (FVM): Implementing the FVM for a 1D heat conduction problem.

Experiment 5: Pressure-Velocity Coupling (SIMPLE Algorithm): Solving a 2D lid-driven cavity flow problem using the SIMPLE algorithm.

Experiment 6: Turbulence Model Application: Simulating turbulent flow in a pipe using different turbulence models (e.g., k-ε, k-ω).

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BTAU706	SEC	CFD (COMPUTATIONAL FLUID DYNAMICS) LAB	0	0	0	0	50	0	0	2	1

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***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Experiment 7: Heat Transfer Simulation: Simulating conjugate heat transfer in a heat exchanger.

Experiment 8: Aerodynamic Analysis: Simulating the flow around an airfoil and analyzing the lift and drag forces.

Experiment 9: HVAC System Simulation: Simulating airflow and temperature distribution in a room with an HVAC system.

Experiment 10: Adaptive Mesh Refinement: Implementing adaptive mesh refinement for a complex geometry.

Experiment 11: Project Work: Defining and solving a real-world CFD problem as a comprehensive project & this may include meshing, simulation, result analysis, and reporting.

Experiment 12: Verification and Validation: Performing verification and validation of a CFD model using experimental or benchmark data.

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BTME705	PW/I	MINOR PROJECT	0	0	0	60	40	0	0	6	**3**

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

Students obtain a hands-on experience by converting a small novel idea/technique into a working model/prototype or analysis etc. applying multi-disciplinary skills and / or knowledge and working in at team/individual.

Course Outcomes (COs):

At the end of the course, student will be able-

1. To conceptualise a novel idea / technique into a product.
2. To think in terms of multi-disciplinary environment and apply it.
3. To apply multi- disciplinary technical knowledge into project.
4. To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design/carried out work.

Syllabus

A multidisciplinary project is to be taken up by a team/individual (as per the university guidelines). Development of prototype product, a 3D model, simulation, analysis of particular technical problem etc. blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. Also, a presentation* is to be made for the reviewers* on the work done by the candidate.

*Review or evaluation/ report preparation/presentation will be as per guidelines of university/institute/head.

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BTME709	PW/I	INDUSTRIAL TRAINING	0	0	0	0	50	0	0	6	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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(b) Practical/Oral Examination (Viva-Voce) in Institution

1. Training Report:-
2. Seminar and Viva-Voce:-

*During training students will prepare a first draft of training report in consultation with section in-charge. After training they will prepare final draft with the help of T.P.O. /Faculty of the Institute. Then they will present a seminar on their training and they will face viva-voce on training in the Institute. *Change in evaluation may be possible and the decision of Head/concerned authority will be final.*

Learning through industrial training:-

During industrial training students must observe following to enrich their learning Industrial environment and work culture.

1. Organizational structure and inter personal communication.
2. Machines/equipment/instrument-their working and specifications.
3. Manufacturing, process, product development procedure and phases etc.
4. Project Planning, monitoring and control.
5. Quality control and assurance.
6. Maintenance system
7. Costing system
8. Stores and purchase systems.
9. Layout of Computer/EDP/MIS centers.
10. Roles and responsibilities of different categories of personnel.
11. Customer services.

Students are supposed to acquire the knowledge on above by-

1. Direct Observations without disturbing personnel at work.
2. Interaction with officials at the workplace in free/ tea time
3. Study of Literature at the workplace (e.g. User Manual, processes, schedules, etc.)
4. "Hand's on" experience

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BTME709	PW/I	INDUSTRIAL TRAINING	0	0	0	0	50	0	0	6	3

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

5. Undertaking/assisting project work, manufacturing process, R&D, quality control etc.
6. Solving problems at the work place.
7. Presenting a seminar
8. Participating in group meeting/discussion.
9. Gathering primary and secondary data/information through various sources, storage, retrieval and analysis of the gathered data.
10. Assisting official and managers in their working
11. Undertaking a short action research work.
12. Consulting current technical journals and periodicals in the library.

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