



Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Technology and Science
Choice Based Credit System (CBCS) Scheme in light of NEP-2020
B. Tech in Mechanical Engineering
(2024 - 2028)

COURSE CODE	CATEG ORY	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*				
BTME501A	DSE	CAD CAM CIM	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) The Design concepts with the help of computer Application (B) Comprehensive Knowledge of computer applications including geometric, Modeling, Assemblies and Manufacturing.

Course Outcomes (COs):

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

1. Understand computer-aided design concepts and their engineering applications.
2. Apply 2D and 3D CAD tools for engineering drawing and distinguish CAD from conventional drafting.
3. Develop 3D solid models, assemblies, and CNC part programs using CAD/CAM tools.

Develop 3D solid models, assemblies, and CNC part programs using CAD/CAM tools.

Syllabus

Unit – I

(9 Hrs)

Introduction: Introduction to CAD, Why CAD Software, Scope, objective, benefit, limitation & evaluation; Engineering Design process, Considerations, Formulation Importance, Regulatory and social issues in Indian context; Conceptual Design, Product Design Cycle, Total life cycle and Digital Prototyping.

Unit – II

(9 Hrs)

Graphics Fundamentals & Standards: Definition, Software configuration of a Graphic system, Functions of a Graphics package, CAD Interface, coordinate system, Creating Basic Drawings, Creating Additional Drawing Objects, Altering Objects, Drawing Organization and Inquiry Commands, Modify and Manipulating Objects, Construction and Reference Geometry, Hatching Objects, Utility Commands, Layers & Blocks, Text, Table & Dimensions, Introducing Printing, Plotting, and Layouts. Database for graphic modeling; PDM, PIM, EDM; define EDM, features of EDM need for CAD data standardization, data exchange formats; GKS, PHIGS, CORE, IGES, DXF STEP DMIS AND VDI; ISO standard for data exchange.

Unit – III

(9 Hrs)

Geometric Modeling & Assembly: Introduction to Geometric Modeling, Types of models, Construction of 3D Solid Primitives, create 3D Solids from Objects, Extrude, Revolve, Sweep, Loft, Combine or Slice 3D Objects, Move Rotate & Scale 3D Objects, Object Sectioning. Wire frame Models, Curve Representation.

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Assembly Modeling, Mating conditions, Generation of assembling sequences, basics of boundary presentation- Spline, Bezier, B-Spline, and NURBS; Sculpture and Ruled surfaces, Precedence diagram, Liaison-sequence analysis; Mechanical tolerance: Tolerance concepts, Geometric tolerance, Types of geometric tolerances.

Unit – IV

(9 Hrs)

Computer-Aided Manufacturing & Part Programming: Computer-Aided Manufacturing, Computer Applications in a Manufacturing Plant, Key Aspects of CAM in a Manufacturing System and Manufacturing Control, G Code & M Code generation through CAD CAM software, Feature Technology, NC, DNC, CNC, NC machine tools: Types of NC machine tools, Automatic tool changes (ATC), Turning centers. ISO codes for turning tools and holders; time and power estimation in milling, drilling and turning.

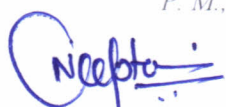
Unit-V

(9 Hrs)

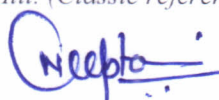
Computer Integrated Manufacturing and Group Technology: Introduction to CIM, Scope of Computer integrated Manufacturing; CIM Wheel; Types of Manufacturing systems; Machine tools and related equipment. Material handling systems; Computer control systems, FMS. Importance of batch and job shop production; merits of converting zigzag process layout flow to smooth flow in cellular layout, Production Flow Analysis (PFA) and clustering methods; concept of part families and coding; hierarchical, attribute and hybrid coding; OPITZ, MICLASS and DCLASS coding; FMS; material handling robots, Computer Aided Process Planning (CAPP).

Text and Reference Books:

1. "Automation, Production Systems, and Computer-Integrated Manufacturing" by Groover, M. P., 5th Edition, Pearson, 2023.
2. "Subramanian, S., and Raju, V., CAD/CAM/CIM" by Radhakrishnan, P., 4th Edition, New Age International Publishers, 2020.
3. "Computer Integrated Manufacturing: From Fundamentals to Implementation" Weatherall, A" Butterworth-Heinemann (Elsevier), 2013.
4. "CAD/CAM: Computer-Aided Design and Manufacturing by Groover" by M. P., and Zimmers, E. W. Jr., Pearson/Prentice Hall. (Classic reference; latest widely available edition/reprint.)
5. "Computer-Integrated Design and Manufacturing" by Bedworth, D. D., Henderson, M. R., and Wolfe, P. M., McGraw-Hill. (Classic reference; latest available reprint.)



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6. "Automation, Production Systems, and Computer-Integrated Manufacturing" by Groover, M. P., 5th Edition, Pearson, 2023.
7. "CAD/CAM: Principles and Applications" by Rao, P. N., 4th Edition, McGraw-Hill Education, 2020
8. "Mastering AutoCAD 2021 and AutoCAD LT 2021" by George Omura and Brian C. Benton, John Wiley & Sons, 2021.
9. "Creo Parametric 11.0 for Engineers and Designers" by Tickoo S, BPB Publications, First Edition, 2025.
10. "SOLIDWORKS 2025 for Engineers and Designers" by Sham Tickoo, BPB Publications, First Edition, 2026

List of Experiments

The students will be required to carry out the following exercises using educational software (Auto CAD, Creo, Solid works, Master CAM etc).

1. Configure the AutoCAD drawing environment and save drawings in .dwg format.
2. Prepare a 2D building layout using layers, annotations, and title blocks.
3. Draw orthographic projections of mechanical components.
4. Generate isometric drawings from orthographic views.
5. Draw standard bolts and nuts with threads and save them as reusable blocks.
6. Create 3D CAD models using basic modeling commands.
7. Develop 3D assembly models of mechanical components using CAD software.
8. Apply motion constraints and simulate engineering mechanisms.
9. Generate G-codes and M-codes using the CAM module of CAD software.
10. Write CNC part programs using standard G and M codes.



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BTME501B	DSE	FINITE ELEMENT ANALYSIS	60	20	20	30	20	3	0	2	4

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Course Educational Objectives (CEOs)

The course provides the knowledge of (A) finite element methods. (B) finite element modeling and simulation techniques (C) FEA in structural vibration and thermal Analysis.

Course Outcomes (COs)

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

1. To model and analyze basic structural elements using FEA tools.
2. To perform thermal and axisymmetric analysis using FEA.
3. To analyze fluid flow and vibrations in mechanical systems.
4. To evaluate dynamic response of structures using FEA.

Syllabus

Unit – I

(9 Hrs)

Basics of FEM: Basic concept of Finite Element Method, Historical background, FEM Applications, General Description of FEM, Commercial FEM software packages, Spring element-stiffness matrix, boundary conditions, solving equations, Variation formulation approach- Rayleigh-Ritz method, Principle of minimum Potential Energy, Weighted residual methods. Initial value and boundary value problems, weighted residual Galerkin and Raleigh Ritz methods-review of Variation calculus, Integration by parts, Basics of variation formulation.

Unit – II

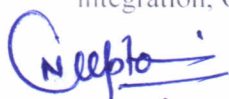
(9 Hrs)

Element Types and Characteristics: Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, Generalized co-ordinates and nodal shape functions; ID bar and beam elements, 2D rectangular and triangular elements; axis-symmetric elements.

Unit – III

(9 Hrs)

Assembly of Elements and Matrices: Concept of element assembly, Global and local coordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Chole's decomposition methods, Numerical integration, One and 2D applications.



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Unit – IV

(9 Hrs)

Higher Order and Iso-parametric Elements: One dimensional quadratic and cubic elements, Use of natural co-ordinate system, Area co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement.

Unit-V

(9 Hrs)

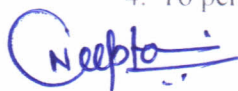
Structural Vibration and Dynamic Analysis: Review of basic dynamic equations, Hamilton's principle, element mass matrices, free vibration (normal mode) analysis, Eigen values and Eigen vectors, Introduction to transient response analysis.

Text and Reference Books:

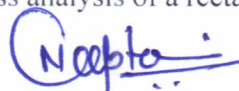
1. "An Introduction to the Finite Element Method" by J. N. Reddy, 4th Edition, McGraw Hill Education, 2019.
2. "Introduction to Finite Elements in Engineering" by T. R. Chandrupatla and A. D. Belegundu, 5th Edition, Pearson Education, 2018.
3. "The Finite Element Method in Engineering" by S. S. Rao, 6th Edition, Butterworth-Heinemann (Elsevier), 2018.
4. "Finite Element Analysis: Theory and Programming" by C. S. Krishnamoorthy, 3rd Edition, McGraw Hill Education, 2018.
5. "The Finite Element Method: Its Basis and Fundamentals" by O. C. Zienkiewicz, R. L. Taylor, and J. Z. Zhu, 7th Edition, Butterworth-Heinemann (Elsevier), 2013.
6. "Concepts and Applications of Finite Element Analysis" by R. D. Cook, D. S. Malkus, M. E. Plesha, and R. J. Witt, 4th Edition, John Wiley & Sons, 2002.
7. "The Finite Element Method for Engineers" by K. H. Huebner, D. L. Dewhirst, D. E. Smith, and T. G. Byrom, 4th Edition, John Wiley & Sons, 2001.

List of Experiments

1. To study the FEA package and perform modeling and stress analysis of trusses.
2. To analyze bars with constant, tapered, and stepped cross-sectional areas.
3. To analyze different types of beams under various loading conditions.
4. To perform stress analysis of a rectangular plate with a circular hole.



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5. To analyze axisymmetric problems like pressurized and rotating cylinders (solid and hollow).
6. To perform thermal analysis for 1D and 2D problems with conduction and convection.
7. To analyze fluid flow problems using FEA tools.
8. To perform vibration analysis of structural elements.
9. To conduct dynamic analysis of beam under variable condition.

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BTME501C	DSE	PLANT MAINTENANCE AND SAFETY	60	20	20	30	20	3	0	2	4

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Course Objectives:

The primary objective of the course is to impart the knowledge of (A) maintenance concepts and strategies, (B) wear, corrosion and fault diagnosis, (C) preventive maintenance, reconditioning, repairing and installation (D) industrial safety.

Course Outcomes:

After completion of this course the students will be able to describe the followings:

1. Students will be able to describe concepts and types of maintenance.
2. Students will be able to describe and understand failure due to wear/corrosion and fault diagnosis.
3. Students will be able to describe and understand PM concept and its importance.
4. Students will be able to understand repair, reconditioning, retrofitting and installation.
5. Students will be able to understand the concepts and need of industrial safety.

Syllabus

Unit-I

(9 Hrs)

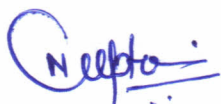
Fundamentals of maintenance engineering: Importance of maintenance, objectives of maintenance, functions of maintenance department, maintenance planning and scheduling, maintenance organization, types of maintenance, maintenance systems: planned and unplanned maintenance, breakdown maintenance, corrective maintenance, opportunistic maintenance, routine maintenance, preventive maintenance, and predictive maintenance, condition based maintenance systems, design-out maintenance, selection of maintenance systems.

Unit-II

(10 Hrs)

Wear and Corrosion: wear; types, causes, effects, wear reduction methods, Lubricants; types and applications, lubrication methods, Corrosion; definition, principle and factors affecting the corrosion, types of corrosion, corrosion prevention methods.

Fault Diagnosis: concept and importance, decision tree-concept, need and applications, Sequence of fault-finding activities, types of faults in machine tools and their general causes and remedies, Failure Modes and Effects Analysis (FMEA), Effects and Criticality Analysis (FMECA),



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documenting maintenance operations and record keeping, data collection and analysis, Failure statistics.

Unit-III

(9 Hrs)

Periodic and Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, Overhaul of electrical and mechanical systems; common troubles and remedies, Preventive Maintenance: definition, need, steps and advantages, planning and scheduling plant shutdowns, Steps/procedure for periodic and preventive maintenance, repair cycle-concept and importance.

Condition Monitoring: Concept of condition monitoring, advanced tools and techniques of condition monitoring for power plants equipment, condition based maintenance.

Unit-IV:

(9 Hrs)

Reconditioning, Retrofitting and Installation: Reconditioning; process, features and advantages, Retrofitting; concept, need and applications, Installation; design and planning of foundation, erection and commissioning of equipment, alignment and testing of equipment, types and applications of tools used for maintenance, maintenance cost & its relation with replacement economy calculation of equipment service life, replacement policies, spares and types of spares, spares planning.

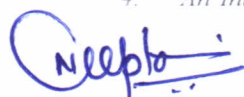
Unit-V

(8 Hrs)

Industrial Safety: Various types of accidents and hazards, fire prevention, mechanical hazards, chemical hazards, noise & vibration control and their prevention and control, safety regulations, safety education and training, cautions and alarming, case studies.

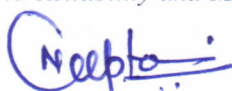
Text and Reference Books:

1. "Plant Equipment & Maintenance Engineering Handbook" by Duncan C. Richardson, 2nd Edition, McGraw-Hill Education, 2014.
2. "Industrial Maintenance Management" by S.K. Srivastava, S. Chand and Co., 2010.
3. "Maintenance Engineering and Management" by K. Venkataraman, PHI Learning Pvt. Ltd., 2nd Edition, 2012.
4. "An Introduction to Reliability and Maintainability Engineering" by Charles E. Ebeling, 2nd Edition,



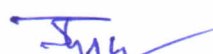
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Waveland Press, 2019.

5. "Installation, Servicing and Maintenance" by S. N. Bhattacharya, S. Chand Publishing, 2013.
6. "Maintenance Engineering Handbook" by Keith Mobley (Editor), 8th Edition, McGraw-Hill Education, 2025.
7. "Handbook of Condition Monitoring" by B. K. N. Rao, Elsevier, 1996
8. "Reliability and Maintenance Engineering" by R. C. Mishra and K. Pathak, New Age International Publishers, First Edition, 2006.

List of Experiments

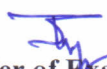
1. Study of various maintenance systems (Breakdown, Preventive, Predictive, Corrective, Condition-Based) through industrial case studies.
2. Preparation of a preventive maintenance schedule for a machine tool or workshop equipment.
3. Preparation of maintenance planning and scheduling using Gantt Chart/PERT/CPM.
4. Identification and study of different types of wear in machine components and methods of wear reduction.
5. Study of different lubricants, lubrication methods, and selection of suitable lubricants for industrial applications.
6. Study of corrosion types, corrosion testing, and corrosion prevention techniques.
7. Preparation of fault diagnosis chart (Decision Tree) for common machine tool failures.
8. Inspection and preventive maintenance of a lathe, milling, drilling, or grinding machine.
9. Study and demonstration of condition monitoring techniques using vibration, temperature, and noise measurements.
10. Preparation of periodic maintenance checklist for workshop equipment.
11. Estimation of maintenance cost, equipment replacement analysis, and calculation of economic service life
12. Preparation of spare parts inventory and ABC analysis for maintenance planning.
13. Case study on an industrial accident and preparation of accident investigation report with preventive measures.



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BTME502A	DSE	ADVANCED MATERIALS	60	20	20	0	0	3	0	0	3

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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.

Course Educational Objectives (CEOs):

To introduction and familiar with (A) special steels and their alloys, (B) automation using hydraulic and Pneumatic system (C) automated work handing system (D) applications of automation in manufacturing.

Course Outcomes (COs):

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

1. Understand the concept of automation.
2. Design a Pneumatic and Hydraulic system for a given application.
3. Understand the transfer mechanisms in automation and handling system
4. Demonstrate the use of different sensors for automation.
5. Design an AGV system or automated mechanical system.

Syllabus

Unit – I

(9 Hrs)

Special Steel and Their Alloys

Metallurgical aspects, properties and applications of different types of stainless steels such as: dual phase steels, trip steels, maraging steels, high speed steels, free cutting steels, ausformed steels, tool steels, manganese steels, chrome steels, electrical steels, bearing steels, spring steels, heat resistant steels, creep steels, HSLA steels etc.,.

Unit – II

(9 Hrs)

Light Metals and Their Alloys

Need of alloying, Aluminum, magnesium and titanium alloys: Metallurgical aspects, Properties and applications.

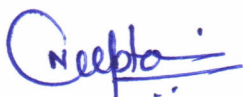
Super alloys: Iron base, nickel base and cobalt base super alloys, Composition, Properties and their application

Unit – III

(9 Hrs)

Nano and Smart Materials

Definition, types, properties and applications, carbon nano tubes, methods of production, shape memory alloys, piezoelectric materials, electro-active polymers, electro-rheological fluid, functionally gradient material (FGM), biomaterials, micro-electro mechanical systems (MEMS).



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COURSE CODE	CATEG ORY	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*				
BTME502A	DSE	ADVANCED MATERIALS	60	20	20	0	0	3	0	0	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.

Unit – IV

(9 Hrs)

Composite Materials:

Definition, Classification, Composite Materials and Structures, Processing of metal matrix composites, polymer matrix composites, ceramic matrix composites, behavior of composites, orthotropic and laminated composite, failure of composites.

Unit – V

(9 Hrs)

Miscellaneous Advanced Materials

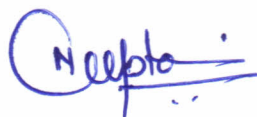
Magnetic materials, ceramics, biomaterials, polymers, aerospace materials and cryogenic materials, semi conducting and superconducting materials and their applications. Properties and applications: strength, stiffness, creep, fatigue and fracture; thermal, damping and tribological properties.

Text Books:

1. "The Science and Engineering of Materials" by Donald R. Askeland and Wendelin J. Wright, 8th Edition, Cengage Learning, 2024.
2. "Materials Science and Engineering: An Introduction" by William D. Callister Jr. and David G. Rethwisch, 11th Edition, Wiley, 2024.
3. "Advances in Material Science" by R K Dogra and A K Sharma, S.K. Kataria & Sons, 2013.
4. "Engineering Materials: Polymers, Ceramics and Composites" by AK Bhargava, PHI, 2012.
5. "Engineering Materials and their Applications" by R. A. Flinn and P. K. Trojan, JPH, 1999.
6. "Nano Technology" by A.K. Bandyopadhyay, New Age Int. Pub. 2008.

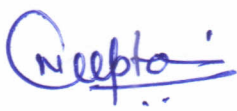
Reference Books:

1. "Smart Materials and Structures" M.V. Gandhi and B.S. Thompson, Chapman and Hall. 1992.
2. "Composite Materials, Science and Engineering" by K.K. Chawla, Springer, 2012.
3. "Advances in Materials and Their Applications" by P. Rama Rao, New Age International (P) Ltd., Publishers, 2012.
4. "Elements of Materials science" by Van Vlack, Pearson, 2002.
5. "Materials Selection in Mechanical Design" by M. F. Ashby, 6th Edition, Butterworth-Heinemann (Elsevier), 2024.



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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME502B	DSE	ROBOTICS AND MACHINE VISION SYSTEM	60	20	20	0	0	3	0	0	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):

This course provides a fundamental understanding of (A) mechanical design of robots, various sensors and its application in the area of industrial robotics. (B) Sensors and programming of industrial robots. (C) Applications of vision and challenges involved (D) Impart knowledge on imaging, machine vision and its applications.

Course Outcomes (COs):

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

1. Explain the various image processing and image analysis algorithms and the issues involved in applying them to various machine vision applications
2. Apply the basic concepts of optics in imaging.
3. Explain the various hardware components of an imaging system for machine vision applications.

Syllabus

Unit-I

Introduction to Industrial Robots: Definition, types, work envelope-based classifications, generations, configurations, control loops, coordinate systems, parts, functions, and specifications.

Robot Motion & Kinematics: Types of motion, direct and inverse kinematics, homogeneous transformations, linkages, joints, and object location/orientation methods.

Unit-II

Drive Systems & End Effectors: Types of drives, grippers – types, selection, classification, design, and force analysis.

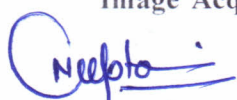
Sensors & Vision Systems: Position, proximity, tactile, and joint force sensors; vision systems, object recognition, image processing, and safety monitoring.

Unit-III

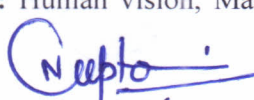
Robot Programming & AI Techniques: Types of Programming; Teach pendant programming; Basic concepts in AI techniques, Concept of knowledge representations, Expert system and its components; Robotic cell layouts, Inter locks, Humanoid robots, Micro-robots; Application of robots in surgery, Manufacturing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

Unit-IV

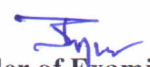
Image Acquisition: Human vision, Machine and Computer vision, Benefits, Block diagram and

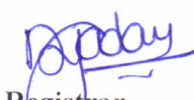

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME502B	DSE	ROBOTICS AND MACHINE VISION SYSTEM	60	20	20	0	0	3	0	0	3

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.

function; Basic components of industrial machine vision; Light behavior, lens basics, lighting techniques, and camera selection; Overview of CCD/CMOS sensors and image formation; Analog and Digital Cameras, Camera Computer Interfaces, Camera calibration.

Image Processing: Introduction to digital images and image processing; Image acquisition modes; Operations like thresholding, smoothing, sharpening, edge detection; Basic color image processing and use of machine vision software.

Unit-V

Machine Vision Analysis & Applications: Feature extraction using region, shape, size, and texture features; basic template matching and classification; 3D machine vision Techniques, decision-making, machine vision applications in manufacturing, electronics, textile, printing, and pharmaceutical industries; applications in non-visible spectrum, OCR/OCV, and vision guided robotics - Field and Service Applications, Agricultural, and Bio medical field, augmented reality, surveillance, bio-metrics.

Text Books:

1. Mikell P. Groover, *Automation, Production Systems, and Computer-Integrated Manufacturing*, 4th ed., Pearson, 2021.
2. J. J. Craig, *Introduction to Robotics: Mechanics and Control*, 4th ed., Pearson, 2018.
3. Sabrie Soloman, *Sensors Handbook*, 2nd ed., McGraw Hill, 2020.
4. Milan Sonka, Vaclav Hlavac, and Roger Boyle, *Image Processing, Analysis, and Machine Vision*, 4th ed., Cengage Learning, 2014.
5. C. Keyness, *Robotics in Manufacturing*, 1st ed. New York, NY, USA: Tailored Read, 2023.

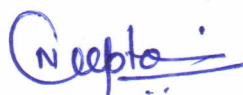
Reference Books:

1. "Industrial Robotics, technology, programming and application", by Groover. M. P. Mc-Graw Hill book and co. 2012
2. R. J. Schilling, *Fundamentals of Robotics: Analysis and Control*, 2nd ed. New York, NY, USA: Wiley, 2023
3. R. K. Mittal and I. J. Nagrath, *Robotics and Control*, 2nd ed. New Delhi, India: McGraw Hill India, 2022.
4. M. P. Groover, *Automation, Production Systems, and Computer-Integrated Manufacturing*, 5th ed. Upper Saddle River, NJ, USA: Pearson, 2024.



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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME502C	DSE	NON-CONVENTIONAL ENERGY SOURCES	60	20	20	0	0	3	0	0	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):

This course provides concepts and knowledge of (a) Solar Energy (b) Wind Energy (c) Bio Energy (d) Ocean Energy & Geothermal Energy.

Course Outcomes (COs):

After learning the course, the students should be able to:

1. Understand the basic concept of renewable energy engineering.
2. Acknowledge, access and analysis various renewable energy system & technology.
3. Evaluate renewable energy related system for a particular application.
4. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Syllabus

Unit – I

(9 Hrs)

Introduction: Needs of Renewable Energy, Advantages and Limitations of Renewable Energy, Present energy scenario of conventional and renewable energy sources, Review of energy sources, Present energy consumption/utilisation pattern sector wise in India, Environmental impact of fossil fuels, growth of energy sector and its planning in India.

Unit – II

(9 Hrs)

Solar Energy: Solar radiation at the earth's surface, solar radiation measurements, estimation of average solar radiation, solar thermal flat plate collectors, concentrating collectors, solar thermal applications: heating, cooling, desalination, drying, cooking, etc, principle of photovoltaic conversion of solar energy, photovoltaic applications. Photovoltaic system for power generation, solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages

Unit – III

(9 Hrs)

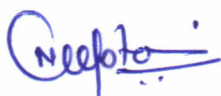
Wind Energy: Power in the wind, Betz limit, site selection, wind energy conversion devices, characteristics, applications, offshore wind energy, Hybrid systems, safety and environmental aspects, wind energy potential and installation in India. basics of wind energy conversion system, effect of density, angle of attack and wind speed, windmill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind.



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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTME502C	DSE ^{sem}	NON-CONVENTIONAL ENERGY SOURCES	60	20	20	0	0	3	0	0	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.

Unit - IV

(8 Hrs)

Bio-Energy: Biomass resources and their classification, biomass conversion processes, thermo chemical conversion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, alcohol production from biomass, bio diesel production, urban waste to energy conversion, biomass energy programs in India.

Unit-V

(10 Hrs)

Ocean Energy: OTEC principle, open, closed and hybrid cycle OTEC system, Energy from tides, estimation of tidal power, tidal power plants, single and double basin plants, site requirements, advantages and limitations wave energy, wave energy conversion devices, advantages and disadvantages, ocean thermal energy.

Geothermal energy: Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications

MHD Power generation: concept and working principle

Text and Reference Books:

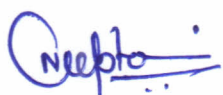
1. "Renewable Energy Resources" by John Twidell and Tony Weir, 4th Edition, Routledge (Taylor & Francis), 2021.
2. "Solar Energy: Principles of Thermal Collection and Storage" by S. P. Sukhatme and J. K. Nayak, 5th Edition, McGraw-Hill Education, 2024.
3. "Solar Engineering of Thermal Processes" by John A. Duffie and William A. Beckman, 5th Edition, John Wiley & Sons, 2020.
4. "Non-conventional energy resources", by Shobh Nath Singh, Pearson India (2015).
5. "Principles of Solar Energy", by Frank Kreith & John F Kreider, John Wiley, New York (2015).
6. "Renewable Energy Engineering and Technology", by Kishore VVN, Teri Press, New Delhi (2010).
7. "Solar Engineering of Thermal Processes" by John A. Duffie and William A. Beckman, 5th Edition, John Wiley & Sons, 2020.
8. "Energy Management and Conservation Handbook" edited by Frank Kreith and D. Yogi Goswami, 2nd Edition, CRC Press
9. "Renewable Energy Engineering and Technology: Principles and Practice" edited by V. V. N. Kishore, TERI Press.



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BTME503	DCC	DYNAMICS OF MACHINE	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):

To introduce basic principles and applications of (A) Engine Mechanisms, (B) Governor Mechanisms, (C) Balancing of Inertia Forces, Friction and Brakes

Course Outcomes (COs):

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

1. Understand the need of engine mechanisms and displacement, velocity and acceleration of piston.
2. Understand Governor Mechanisms.
3. Understand and analyse Balancing of masses.
4. Understand utility of Friction in Machine parts and lubrication concepts.
5. Students would be able to analyze Cam movement, belt drives and braking.

Syllabus

Unit – I

(9 Hrs)

Dynamics of Engine Mechanisms: Displacement, velocity and acceleration of piston; turning moment on crankshaft; turning moment diagram; Fluctuation of crankshaft speed; Analysis of flywheel.

Unit – II

(9 Hrs)

Governor Mechanisms: Types of governors, characteristics of centrifugal governors, gravity and spring controlled centrifugal governors; hunting of centrifugal governors; inertia governors.

Unit – III

(9 Hrs)

Balancing of Inertia Forces: Balancing of rotating masses; Two plane balancing; Determination of balancing masses (graphical and analytical methods); Balancing of rotors; Balancing of internal combustion engines, Single cylinder engines, In-line engines, V-twin engines, Radial engines, Lanchester technique of engine balancing.

Unit – IV

(9 Hrs)

Friction: Frictional torque in pivots and collars by uniform pressure and uniform wear rate criteria. Boundary and fluid film lubrication, friction in journal and thrust bearings, concept of friction circle and axis, rolling friction.


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BTME503	DCC	DYNAMICS OF MACHINE	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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Unit-V

(9 Hrs)

Belt drives: Velocity ratio, limiting ratio of tension; power transmitted; centrifugal effect on belts; maximum power transmitted by belt; initial tension; creep; chain and rope drives.

Brakes: Band brake; Band and block brakes, Internal and external shoe brakes.

Dynamometer: Different types and their applications.

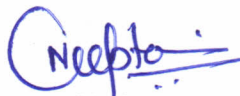
Dynamic Analysis of Cams: Response of un-damped cam mechanism (analytical method), follower response analysis by phase-plane method, jump and cross-over shock.

Text and Reference Books:

1. "Theory of Machines" by S. S. Rattan, 5th Edition, McGraw-Hill Education, 2022.
2. "Theory of Machines", by Thomas Bevan; Publisher: Pearson, 2010.
3. "Theory of Mechanisms and Machines", by Ghosh and Malik; East-West Press, 2015.
4. "Kinematics and dynamics of machinery", by Norton RL; Publisher: TMH, 2009.
5. "Mechanism and Machine Theory" by J. S. Rao and R. V. Dukkipati, 3rd Edition, New Age International Publishers, 2019.
6. "Mechanisms and Dynamics of Machinery" by Hamilton H. Mabie and Charles F. Reinholtz, 4th Edition, Wiley India.
7. "Theory of Machines" by Sadhu Singh, 2nd Edition, Pearson Education India, Latest Available Edition.
8. "Kinematics and Dynamics of Machinery" by Charles E. Wilson and J. Peter Sadler, 3rd Edition, Pearson Education.

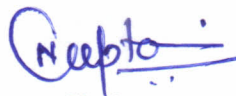
List of Experiments

1. To perform an experiment on Watt and Porter Governors and prepare performance characteristic curves to determine stability and sensitivity.
2. To perform an experiment on Proell Governor and prepare performance characteristic curves to determine stability and sensitivity.
3. To perform an experiment on Hartnell Governor and prepare performance characteristic curves to determine stability and sensitivity.
4. To determine the gyroscopic couple using a motorized gyroscope.
5. To study gyroscopic effects through demonstration models.
6. To study the concept of a dynamically equivalent system.



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BTME503	DCC	DYNAMICS OF MACHINE	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.

7. To study different types of dynamometers.
8. To study different types of clutches.
9. To study different types of brakes.
10. To study the dynamic behavior of a cam and follower under various operating conditions using CAM analysis apparatus.

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BTME509	DCC	SQC AND TOTAL QUALITY MANAGEMENT	60	20	20	0	0	3	0	0	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):

To introduction with (A) Modern quality control techniques to include the design of statistical process control systems, (B) Acceptance sampling and process improvement, (C) Quality Principles, Tools and Techniques.

Course Outcomes (COs):

After completion of this course

1. Student would be able to understand the need of quality, and its concepts.
2. Student would be able to understand various available statistical tools of quality control.
3. Student would be able to analyses basics of quality management and able to understand various management tools and techniques.
4. Students would be able to understand the statistical and economical design issues associated with the monitoring tools.
5. Students will be able to understand the basics of quality function deployment and its tools and techniques.

Syllabus

Unit I

(9 Hrs)

Introduction of Statistical quality Control & TQM

Quality: Definition, need, evolution, The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management: quality philosophies (Contributions of Deming, Juran and Crosby, links between quality and productivity, quality costs legal aspects of quality implementing quality improvement).

Unit II

(10 Hrs)

Methods and Philosophy of Statistical Process Control

Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, ARL, sensitizing rules for control charts); Deming's Magnificent Seven Implementing SPC; An Application of SPC; Nonmanufacturing application of SPC.

Unit III

(9 Hrs)

Control Charts for Variables

Control Charts for $\bar{X}$ and R (statistical basis, development and use, estimating process capability; interpretation, the effect of non-normality on the chart, the OC function, and average run length);

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BTME509	DCC	SQC AND TOTAL QUALITY MANAGEMENT	60	20	20	0	0	3	0	0	3

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Control Charts for $\bar{X}$ and S; Control Chart for Individual Measurements; Applications of Variables Control Charts.

Unit IV

(9 Hrs)

Inferences about Process Quality

Sampling distributions, estimation and confidence interval for process parameter(s), hypothesis testing on process parameter(s) and power analysis, Process Capability Ratios, Process Capability Analysis, Exponentially Weighted Moving Average Control Chart, Moving Average Control Chart

Unit V

(8 Hrs)

TQM Tools & Techniques

Seven traditional tools of quality, new management tools, Six-sigma: Concepts, methodology, application to manufacturing, service sector including IT, Bench marking: reason, process. FMEA, Just-In-Time, Kanban system MRP vs JIT system, Waste elimination, workers involvement through JIT. QFD, Taguchi quality loss function, Inspection: acceptance sampling, OC curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.

Change Management: Introduction, Types, need, scope, diagnosing organizational change, implementing changes, evaluating change.

Text and Reference Books:

1. "Introduction to Statistical Quality Control" by Douglas C. Montgomery, 9th Edition, John Wiley & Sons, 2020.
2. "Statistical Quality Control" by E.L. Grant and R.S. Leavenworth, McGraw-Hill publisher, 2000.
3. "Principles of Quality Control", by Jerry Banks, Wiley publisher, 1999.
4. "Total Quality Management" by Dale H. Besterfield, Carol Besterfield-Michna, Glen Besterfield and Mary Besterfield-Sacre, 4th Edition, Pearson Education, 2013
5. "Total Quality Management" by Naidu, Babu and Rajendran; New age international pub; First Edition Reprint, 2013.
6. "Juran's Quality Handbook" edited by Joseph A. DeFeo, 7th Edition, McGraw-Hill Education, 2017.
7. "The Certified Quality Engineer Handbook" by Connie M. Borror (Ed.), 4th Edition, ASQ Quality Press, 2022.
8. "The Six Sigma Handbook" by Thomas Pyzdek and Paul A. Keller, 5th Edition, McGraw-Hill Education, 2023.



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BTME510	AESE	DESIGN THINKING AND INNOVATION	60	20	20	0	0	2	0	0	2

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 this course is to provide (A) the new ways of creative thinking and learn the innovation cycle of design thinking process, (B) understand product design and prototyping and (C) develop innovative product.

Course Outcomes (COs):

After completion of this course student will able to

1. To apply learning styles and memory techniques in engineering education.
2. To analyze emotions for designing user-centered products.
3. To use creative thinking and design thinking for innovation.
4. To propose and develop real-time innovative product prototypes.
5. To understand individual differences and enhance customer experience.

Syllabus

Unit I

(6 Hrs)

Learning: understanding the learning process, Kolb's learning styles, assessing and interpreting.

Memory: understanding the memory process, problems in retention, memory enhancement techniques.

Emotions: understanding emotions, experience & expression, assessing empathy, application with peers.

Unit II

(6 Hrs)

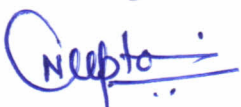
Design Thinking: definition, need, objective, concepts & brainstorming, stages of design thinking process (explain with examples) – empathize, define, ideate, prototype, test.

Creative Thinking: understanding creative thinking process, understanding problem solving, creative problem-solving test.

Unit III

(6 Hrs)

Product Design: process of engineering product design, design thinking approach, stages of product design, examples of best product designs and functions, assignment – engineering product design.



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Prototyping: What is prototype? Why prototype? Rapid prototype development process, testing, sample example, test group marketing

Unit IV

(6 Hrs)

Celebrating the Difference: understanding individual differences & uniqueness, group discussion and activities to encourage the understanding, acceptance and appreciation of individual differences
Customer Centricity: practical examples of customer challenges, use of design thinking to enhance customer experience, parameters of product experience, alignment of customer expectations with product design.

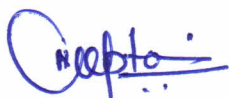
Unit V

(6 Hrs)

Feedback, Re-design & Re-create: feedback loop, focus on user experience, address “ergonomic challenges, user focused design, rapid prototyping & testing, final product, final presentation – “solving practical engineering problem through innovative product design & creative solution”.

Text and Reference Books:

1. "Design Thinking: A Guide to Creative Problem Solving for Everyone" by Andrew Pressman, 2nd Edition, Routledge, 2024.
2. "Product Design and Development" by Karl T. Ulrich and Steven D. Eppinger, 8th Edition, McGraw-Hill Education, 2024.
3. "Design Thinking for Strategic Innovation" by Idris Mootee, 2nd Edition, John Wiley & Sons, 2023.
4. E. Balaguruswamy "Developing Thinking Skills (The way to Success)" Khanna Book Publishing Company, 2022.
5. Gavin Ambrose and Paul Harris "Basics Design 08: Design Thinking" Bloomsbury Publishing India Pvt. Ltd. 2009.
6. Vijay Kumar "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization" Wiley Pub. 2013.
7. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.
8. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.



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BTME507	DCC	METAL CUTTING AND CNC LAB	0	0	0	0	50	0	0	4	2

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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.

Course Educational Objectives (CEOs):

The objective of this course is to provide (A) familiarity with metal cutting machines and their operations, (B) hands-on skills in conventional machining processes, and (C) a foundational understanding of CNC machines, their applications, and programming techniques.

Course Outcomes (COs)

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

1. Understand and perform various operations on lathe machines
2. Understand and perform various operations on milling and drilling machines
3. Understand and perform various operations on shaping and grinding machines
4. Understand the basic principle, structure and sensors and systems of NC, DNC and CNC
5. Familiar with part programming codes and making of programs

Syllabus

Unit-I:

Safety in Machine Shop- Introduction, personal responsibility, causes of accidents, common sources of accidents, preventive measures, and common safety methods.

Lathe: Classification of machine tools and their basic components; lathe- specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature.

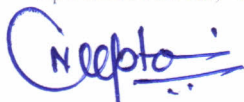
Unit-II:

Milling: Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, milling cutters etc.

Drilling: Drilling operations, types of drilling machines; fixed spindle, radial and universal drilling machines, drilling time.

Unit-III:

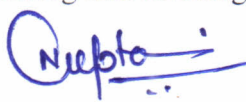
Grinding: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.



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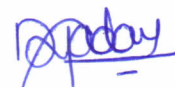
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Unit-IV:

Introduction of NC & CNC: Historical background, principle & basic components of NC, DNC and CNC, differences between NC, DNC and CNC, Classification, Evolution of CNC Technology, advantages, disadvantages and applications of NC, DNC and CNC.

Basic details of CNC structure, different drive and control devices and systems of CNC machines. Various cutting tools and its parameters

Unit-V:

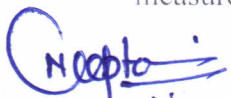
Programming: Basics of CNC machine programming, structure of part programming, preparatory functions (G)-motion, dwell, unit, preset, cutter compensation, coordinate and plane selection groups; miscellaneous (M) codes and other codes, part programming for turning, milling etc. Operations on CNC lathe and CNC Milling.

Text and Reference Books:

1. "Workshop Technology" by W. A. J. Chapman part I, II & III, 5th ed., 2001.
2. "Manufacturing Technology" by P. N. Rao, Vol. 1 and 2, 2018.
3. "Computer Numerical Control Machines", by Radhakrishnan P, New Age Publication, 2012.
4. "CAD/CAM", by Rao P.N., TMH, New Delhi, 2005.
5. "Mechatronics", by HMT Ltd., Tata McGraw-Hill Publishing Company Limited, New Delhi.
6. "Computer Numeric Control", by Warren S. Seamers, Fourth Edition, Thomson Delmar, 2008
7. "CNC Machining Hand Book", by James Madison, Industrial Press Inc., 2006.
8. "Programming of CNC Machines", by Ken Evans, John Polywka & Stanley Gabrel, Second Edition, Industrial Press Inc, New York, 2007
9. "CNC Programming Hand book", by Peter Smid, Industrial Press Inc., 2010

List of Experiments:

1. To study machine shop safety rules and identify common accident causes and preventive measures.



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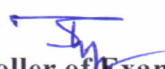
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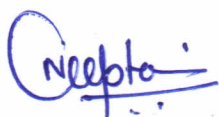
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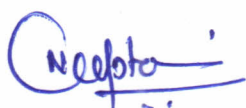
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- To study lathe machine components, tools, and operations (facing, turning, threading, taper turning, etc.).
- To perform multiple operations on a lathe machine such as turning, step turning, drilling, taper turning, thread cutting, and knurling on a single job.
- To study horizontal/universal milling machines along with dividing head and indexing mechanism and demonstrate indexing operation.
- To study and operate a radial drilling machine and prepare a job with precise hole dimensions.
- To study centreless and tool & cutter grinding machines, and understand their working principles and applications.
- To study the basics and components of NC, DNC, and CNC machines, including their drive systems, control units, and feedback mechanisms.
- To understand CNC programming structure, G-codes, M-codes, and simulate basic CNC turning and milling operations.
- To develop and simulate at least five CNC part programs (turning/milling) and identify/correct syntax or logic errors.
- To write and execute a CNC lathe program for facing, step turning, and taper turning operations and prepare the job.
- To write and execute a CNC milling program for operations like engraving ("SVVV Indore") and pocketing (circular/rectangular) on a given workpiece.



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