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SUBJECT CODE	Category.	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTMA301	ODS	APPLIED MATHEMATICS-III	60	20	20	0	0	3	1	0	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 20 marks.

Course Educational Objectives (CEOs):

To introduce the students with the fundamentals of the calculus of the (A) Complex Variable, (B) Random Variable and (C) Fourier Analysis.

Course Outcomes (COs):

After the successful completion of this course students will be able to

1. Understand and apply the basics of the Calculus of the Complex variables.
2. Know the fundamentals of the Probability Theory and Random Process.
3. Apply the concepts of the Fourier Analysis
4. Know the techniques of the Fourier Transform.
5. Find the solution of the PDE.

Syllabus

Unit-I

Complex Analysis: Complex numbers, geometric representation, powers and roots of complex numbers. Functions of a complex variable: Limit, Continuity, Differentiability, Analytic functions, Cauchy-Riemann equations, Harmonic functions, Harmonic conjugates. Elementary Analytic functions (polynomials, exponential function, trigonometric functions), Complex integration, Cauchy's integral theorem, Cauchy's integral formula. Taylor series and Laurent series. Zeros, Singularities and its classifications, Residues, Residue theorem and its applications.

Unit– II

Probability Theory and Random Process: Axiomatic construction of the theory of probability, independence, conditional probability, and basic formulae, random variables, binomial, poisson and normal random variable, probability distributions, functions of random variables;
mathematical expectations, Definition and classification of random processes, discrete-time Markov chains, Poisson process, Correlation and Regression; Expectation and Variance.

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Unit–III

Fourier series: Fourier Integral, Fourier series of 2p periodic functions, Fourier series of odd and even functions, Half-range series, Convergence of Fourier series, Gibb's phenomenon, Differentiation and Integration of Fourier series, Complex form of Fourier series.

Unit–IV

Fourier Transformation: Fourier Integral Theorem, Fourier Transforms, Properties of Fourier Transform, Convolution and its physical interpretation, Statement of Fubini's theorem, Convolution theorems, Inversion theorem

Unit–V

Partial Differential Equations: Introduction to PDEs, basic concepts, Linear and non-linear first order PDE, Higher order linear homogeneous PDE, Separation of variable and its application to the one dimensional wave and heat equation.

Reference Books:

1. *"Complex Variables and Applications" by R. V. Churchill and J. W. Brown, 5th Edition, McGraw-Hill, 1990.*
2. *"Introduction to Partial Differential Equations", by K. Sankara Rao, 2nd Edition, 2005.*
3. *"Introduction to Probability Theory", by P. G. Hoel, S. C. Port and C. J. Stone, Universal Book Stall, 2000.*
4. *"Probability and Statistics with Reliability, Queuing, and Computer Science Applications", by K. S. Trivedi, Prentice Hall of India, 1998.*
5. *"Probabilities, Random Variables and Stochastic Processes", by A. Papoulis and S. Unnikrishna Pillai4th Edition, Tata McGraw-Hill, 2002.*
6. *"Stochastic Processes", by S.M. Ross, 2nd Edition, Wiley, 1996.*
7. *"Higher Engineering Mathematics", by B. S. Grewal, Khanna Publishers, Delhi.*
8. *"Complex Analysis for Mathematics and Engineering", by 3rd Edition, J. H. Mathews and R. W. Howell, Narosa, 1998.*
9. *"Elements of Partial Differential Equations", by I. N. Sneddon, McGraw-Hill, 1957.*
10. *"Advanced Engineering Mathematics", by E. Kreyszig, 5th / 8th Edition, Wiley Eastern / John Wiley, 1983/1999.*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME401	DCS	FLUID MECHANICS	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 20 marks.

Course Educational Objectives (CEOs):

To introduction with (A) Fluid and its properties, (B) behavior of fluid under various conditions, (C) Applications.

Course Outcomes (COs):

After the successful completion of this course students will be able to

1. Understand the fundamentals of fluid mechanics.
2. Understand basics of compressible flow.
3. Understand fundamentals of flow through pipes.
4. Understand statics, dynamics and various approaches to fluid mechanics.

Syllabus

Unit - I

Flow and Fluid Properties: Viscosity, relationship between stress and strain-rate for Newtonian fluids, incompressible and compressible flows, differences between laminar and turbulent flows. Hydrostatics forces: Buoyancy and floatation, manometer, forces on submerged and floating bodies, stability conditions.

Unit - II

Kinematics: Types of fluid flow, rate of flow or discharge continuity equation, velocity and acceleration, velocity potential function and stream function, types of motion, vortex flow.
Ideal flow: Uniform flow, source flow, sink flow, free vortex flow.

Unit - III

Differential Analysis: Differential equations of mass and momentum for incompressible flows, inviscid - Euler equation and viscous flows - Navier-Stokes equations, Bernoulli's equation from

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Euler's equation and assumptions, concept of fluid rotation, vorticity, stream function, Exact solutions of Navier-Stokes equation for Coquette Flow and Poiseuille flow, Orifices and mouthpieces: classifications of and flow through orifice, hydraulic coefficients, experimental determination of hydraulic coefficients, classification and flow through convergent and divergent mouthpiece.

Unit - IV

Dimensional Analysis: Introduction, secondary or derived quantities, methods of dimensional analysis, model analysis, similitudes-types of similarities, dimensionless numbers, models law and Concept of geometric, kinematic and dynamic similarity, some common non-dimensional parameters and their physical significance: Reynolds number, Froude number and Mach number. **Internal Flows:** Fully developed pipe flow, various losses in pipe flow, empirical relations for laminar and turbulent flows: friction factor and Darcy-Weisbach relation.

Unit-V

Prandtl Boundary Layer Equations: Concept and assumptions, qualitative idea of boundary layer and separation, streamlined and bluff bodies, drag and lift forces. Flow measurements: Basic ideas of flow measurement using venturimeter, Pitot - static tube and orifice plate.

Reference Books:

1. *"Fluid Mechanics and Fluid Power Engineering", by D.S. Kumar, S.K. Kataria & Sons*
2. *"Fluid Mechanics and Hydraulic Machines", by R.K. Bansal, Laxmi Publications*
3. *"Fluid Mechanics and Hydraulic Machines", by R.K. Rajput, S. Chand & Co.*
4. *"Fluid Mechanics", by Frank. M. White, McGraw Hill Publishing Company Ltd.*
5. *"Fundamentals of Fluid Mechanics", by Munson, Wiley India Pvt. Ltd*
6. *"Fluid Mechanics by A. K. Mohanty", PHI Learning Pvt. Ltd.*
7. *" Laboratory Manual Hydraulics and Hydraulic Machines", by R V Raikar*

List of Experiments

1. To understand pressure measurement procedure and related instruments/devices.
2. To study meta-centric height of floating body.
3. Verification of Bernoulli's Theorem.
4. To study the velocity of flow using Pitot tube.
5. To determine the Coefficient of discharge through different flow meters. (Any two out of Orifice meter, Venturimeter and Nozzle meter.)
6. To determine the different types of flow Patterns by Reynolds experiment.
7. To study the Friction factor for the different pipes.
8. To study the loss coefficients for different pipe fittings.

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			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME402	DCS	THEORY OF MACHINES	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 20 marks.

Course Educational Objectives (CEOs):

This course provides comprehensive knowledge of (A) Mechanism and machine (B) Kinematics of plane motion, (C) Cam and Follower, (D) Gears and Gear Train, (E) Gyroscope.

Course Outcomes (COs):

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

1. Students will be able to define systematically design and develop mechanisms to perform a specified task and demonstrate an understanding of the concepts of various mechanisms and pairs.
2. Students will be able to do the velocity and acceleration analysis of simple mechanisms.
3. Students will be able to explain effectively present written, oral, and graphical solutions to design problems & develop ability to come up with innovative ideas and design a layout of cam for specified motion.
4. Students will be able demonstrate an understanding of principle of gears.
5. Students will be able to synthesis simple gyroscopic forces and couple, and gyroscopic effect in airplanes, ship and vehicle.

Syllabus

Unit - I

Mechanisms and Machines: Mechanism, machine, plane and space mechanism, kinematic pairs, kinematic chains their classification, degrees of freedom, Grubler's criterion, kinematics inversions four bar mechanism and slider crank mechanism, equivalent linkages, pantograph, straight line motion mechanism, Devis and Ackermann's steering mechanism, Hooke;s joint.

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Unit - II

Motion: kinematics of Plane motion, Absolute & Relative motion, Displacement, Velocity and Acceleration Analysis by Graphical & Analytical methods, Velocity image, Velocity of rubbing, Kennedy's Theorem, Acceleration image, Acceleration polygon, Coriolis acceleration component, Klein's construction, Velocity and Acceleration Analysis using complex Raven's methods..

Unit - III

Cams: Classification of Cams and Followers, Radial Cam Terminology, Analysis of Follower motion (uniform, modified uniform, simple harmonic, parabolic, cycloidal), Pressure Angle, Radius of Curvature, Cam Profile for radial and offset followers Synthesis of Cam Profile by Graphical Approach.

Unit - IV

Gears: Classification of gears and its type, Gear Terminology, Law of gearing, Tooth profiles, velocity of sliding, Path of contact, Arc of contact, Contact Ratio, Interference and Undercutting, Conjugate action.

Gear Trains: Simple, compound, reverted and epi-cyclic gear trains. Velocity ratio and torque calculation in gear trains

Unit - V

Gyroscope: Gyroscopic Action in Machines, Angular Velocity and Acceleration, Gyroscopic torque/ couple, Gyroscopic effect on Naval Ships, Stability of Two and Four Wheel Vehicles, Rigid disc at an angle fixed to a rotating shaft.

Reference Books:

1. *"Mechanism and Machine Theory", by Ambekar AG; PHI. Eastern Economy Edition 2015*
2. *" Theory of machines & Mechanism " by Uicker & Shigley, Second Edition Oxford University Press*
3. *"Theory of Machines", by Dr. Jagdish Lal; Metropolitan Book Co; Delhi*
4. *"Mechanism and Machine Theory", by Rao J S and Dukkipati; New Age Delhi.*
5. *"Theory of Machines", by S.S. Rattan, (2009), Third Edition, Tata McGraw-Hill*

List of Experiments

1. To synthesize and demonstrate the inversion of four bar mechanism through animation and model.
2. To synthesize and demonstrate the inversion of single slider and double slider crank mechanism through animation and model.
3. To construct and demonstrate the steering mechanism based on Davis & Ackermann's Steering mechanisms principles.
4. To find out velocity & acceleration of slider crank mechanism by Klein's Construction.

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6. To draw Involutes profile of a gear by generating method.
7. To find out velocity ratio of various gear trains.
8. To study working of sun and planet epicycle gear train mechanism using models
9. To study various types of belt drives & find out the velocity ratio of the drive.
10. To finds out gyroscopic couple.

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME403	DCS	APPLIED THERMODYNAMICS	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 20 marks.

Course Educational Objectives (CEOs):

(A) To gain knowledge of Economics of Steam Power Plant, Different types of Boilers & their application with Ash and Coal Handing Systems, and Heat Balance Sheet calculation during Combustion in Boiler. (B) To study of various vapour cycle of Steam Power plant and Effect on efficiency of this vapour cycle of various operating conditions etc. (C) To study of Ideal gas relationship, Mach number and its significance, Effect of Mach number on compressibility etc. (D) To gain knowledge of One Dimensional Isentropic Flow. (E) To study of various types of condenser and their applications in steam power plant.

Course Outcomes (COs):

After completions of this course student will be able to understand the following points.

1. Student will be able to understand steam generators, its application in steam power plant also able to make calculation of steam generator efficiency and steam plant economics.
2. They will understand various vapour cycles and also able to analyze them.
3. Student will be able to understand Fundamentals of Compressible Flow and relationship between stagnation temperature, pressure, density and enthalpy in terms of Mach number.
4. Student will understand One Dimensional Isentropic Flow and flow in nozzle under various conditions.
5. Student will get idea about the various types of Circulating Water System, Feed water, Condenser and their application according to requirements.

Syllabus

Unit -1

Economics of Power Plant: Review of thermodynamics, Steam Power Plant, Layout and Design of Power Plant, Site selection of Steam Power Plant, Power Plant Economics and Consideration, Load duration curves, Indian energy scenario.

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Unit-II

Steam Boiler: Introduction of steam generating equipment's boiler and its various types of Steam Boiler, high and low pressure boiler, boiler mountings and accessories, critical and non-critical boiler, coal and Ash handling system, combustion in boilers, performance and rating of boilers, heat balance sheet, boiler draught, overview of boiler codes, Performance and rating of boilers.

Unit – II

Analysis of Steam Cycles: Carnot Cycle, Rankine Cycle, Mean Temperature of Heat Addition, Effect of Variation of Steam Condition on Thermal Efficiency, Reheating of Steam, Regeneration, Feed water Heater, Optimum Degree of Regeneration, Ideal and actual regenerative cycle with single and multiple heaters, Supercritical Pressure Cycle, Deaerator.
Combined Cycle: Binary Vapour Cycles, Coupled Cycles, Combined Cycle Plants.

Unit - IV

Fundamentals of Compressible Flow: Ideal gas relationship, The adiabatic energy equation, Mach number and its significance, Mach waves, Mach cone and Mach angle, static and stagnation states, relationship between stagnation temperature, pressure, density and enthalpy in terms of Mach number, stagnation velocity of sound, reference speeds, various regions of flow, Effect of Mach number on compressibility, Area velocity relationship

Unit - V

One Dimensional Isentropic Flow: General features of isentropic flow, performance curve, Comparison of adiabatic and isentropic process, One dimensional isentropic flow in ducts of varying cross-section- nozzles and diffusers, operation of nozzles under varying pressure ratio, mass flow rate in nozzles, diffusers, critical properties and choking, area ratio as function of Mach number, Impulse function, non-dimensional mass flow rate in terms of pressure ratio, area ratio and Mach number, Working charts and gas tables, Application of Isentropic flow.

Reference Books:

1. *"Power plant Engineering", by Nag PK, TMH*
2. *"Basic and applied Thermodynamics", by P. K. Nag, TMHR.*
3. *"Thermal Engineering", by R. Yadav.*
4. *"Fundamental of Compressible flow", by S. M. Yahya, New age international Publication, Delhi*
5. *" Fundamentals of compressible fluid dynamics ,"by P. Balachandran, PHI Learning, New Delhi*
6. *" The dynamics and thermodynamics of Compressible fluid low Volume-I , by"Ascher H. Shapiro, the Ronald Press Company, New York.*
7. *"Gas Dynamics", by E. Rathakrishnan, PHI Learning Pvt. Ltd*

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List of Experiments

1. To Study different types of boilers with application.
2. To Study boiler mountings and accessories.
3. To study performance and rating of boiler.
4. To study different types of coal & Ash handling system.
5. Determination of thermal efficiency of steam power plant.
6. To study Regenerative & Reheat cycle of steam power plant.
7. To study Binary Vapour & Combined cycle plant.
8. To determine mass flow for different condition of Nozzle.
9. To determine mass flow for different condition of Diffuser.
10. To study performance curve for one dimensional isentropic flow.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME404	DCS	MACHINE DESIGN - I	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 20 marks.

Course Educational Objectives (CEOs):

(A) To understand the design methodology for machine elements.
(B) To analyse the forces acting on a machine element,
(C) Apply suitable design methodology.
(D) To understand the various standards and methods of standardization.
(E) To apply the concept of parametric design and validation by strength analysis.

Course Outcomes (COs):

Student will be able to

1. Understand the design concepts of various machine elements.
2. Design the various types of springs.
3. Design the shafts and couplings.
4. Design the threaded and welded joints.
5. Understand the concepts of bearing lubrication and design the journal bearings.

Syllabus

Unit -I

Introduction: Introduction to Design process, Design considerations, engineering materials properties and processes of their selection, BIS designation of steels, manufacturing considerations in design, Bending and Torsional stress equations, Impact and Shock loading, Stress concentration factor, Size factor, Surface limits factor, Design stress.

Unit -II

Fatigue strength and design of springs: Variable and cyclic loads, Fatigue Strength, Endurance limit, S- N Curve, Soderberg, Gerber and Goodman equations, fatigue failure, design consideration in fatigue, classification and spring materials, Spring end formation, Design of helical compression springs, helical extension springs, torsion springs, laminated springs, Protective coatings, Equalized stress in spring leaves. Multi - leaf springs. Surge in springs, nipping and shot peening.

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Unit -III

Shafts, keys and couplings: Shafts design on strength basis, torsional rigidity basis, ASME codes for shafts, Keys and cotter design, Flat and square keys, Splines, Rigid and flange couplings, Flexible couplings.

Unit -IV

Threaded and welded joints: Forms of threads, basic types of screw fastenings, ISO metric screw threads, eccentrically loaded bolted joints, Torque requirement for bolt tightening, Fluctuations loads on bolted joints, fasteners, Joints with combined stresses. Power screws, Force analysis. Collar friction, Differential and compound screws design. Types and strength of weld joints subjected to bending and fluctuating loads, cotter and knuckle joints, welded joints, different types welded joints and their design aspects.

Unit - V

Journal Bearing: Types of lubrication, viscosity, hydrodynamic theory, design factors, temperature and viscosity considerations, Reynold's equation, stable and unstable operation, heat dissipation and thermal equilibrium, boundary lubrication, dimensionless numbers, Design of journal bearings, Rolling-element Bearings: Types of rolling contact bearing, bearing friction and power loss, bearing life; Radial, thrust & axial loads; Static & dynamic load capacities; Selection of ball and roller bearings; lubrication and sealing.

Reference Books:

1. *"Design of Machine elements", by Bhandari. V.B. (2010) Tata Mc Graw Hill Book Co, Third Edition.*
2. *"Machine Design", by R.S. Khurmi, J. K. Gupta. (2008) Eurasia Publishing House (Pvt.) Ltd.Revised Edition.*
3. *"Machine Design", by Shingley J.E, TMH.*
4. *"Design of Machine elements", by Sharma and Purohit; PHI.*
5. *"Machine Design", by Wentzell Timothy H, Cengage learning.*
6. *"Machine Design", by Mubeen; Khanna Publisher.*
7. *"Design of Machine Elements", by Ganesh Babu K and Srithar k, TMH.*
8. *"Machine Design", by Sharma & Agrawal; Kataria & sons.*

List of Experiments (Please Expand it):

Solve various design problems as per the syllabus.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME407	DCS	CNC LAB	0	0	0	30	20	0	0	4	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 20 marks.

Course Educational Objectives (CEOs):

The main objectives of the course are

(A) To learn basic principles and applications of the CNC machines

(B) To provide the student with an understanding of the modern CNC machine tools and their programming methods.

(C) Intellect experiment skill of CNC operations

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 basic principle of CNC machine tools
2. Describe tooling and work holding devices for CNC machine tools
3. Explain drives and positional transducers used in CNC machine tools
4. Able to program for CNC machine tools
5. Able to perform different CNC operations

Syllabus

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

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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

Reference Books:

1. *"Computer Numerical Control Machines", by Radhakrishnan P, New Age Publication, 2012.*
2. *"CAD/CAM", by Rao P.N., Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002.*
3. *"Mechatronics", by HMT Ltd., Tata McGraw-Hill Publishing Company Limited, New Delhi.*
4. *"Computer Numeric Control", by Warren S.Seamers, Fourth Edition, Thomson Delmar, 2002*
5. *"CNC Machining Hand Book", by James Madison, Industrial Press Inc., 1996.*
6. *"Programming of CNC Machines", by Ken Evans, John Polywka & Stanley Gabrel, Second Edition, Industrial Press Inc, New York, 2002*
7. *"CNC Programming Hand book", by Peter Smid, Industrial Press Inc., 2000*
8. *"Introduction to Computer Numerical Control", by Berry Leathan – Jones, Pitman, London, 1987.*

List of Experiments (*Perform at least 10*):

1. Study principle and basic elements of NC, DNC and CNC.
2. Study of basic drive, control and feedback system of CNC machine.
3. Study of various functions and codes used in CNC programming.
4. Develop and simulate CNC turning part program (at least five) and identify errors.
5. Write a program to obtain the facing in the CNC lathe and make a job.
6. Write a program to obtain the step turning cycle in the CNC lathe and make a job.
7. Write a program to obtain the taper turning cycle in the CNC lathe and make a job.
8. Write a program to obtain the Drilling Cycle in the CNC lathe and make a job.
9. Write a program to obtain the Threading Cycle in the CNC lathe and make a job.
10. Develop and simulate CNC milling part program (at least five) and identify errors.
11. Write a program to obtain linear and circular interpolation on the given work piece.
12. Write a program to engrave the letters "SVVV Indore" on the given work piece.
13. Write a program to perform the rotation operation on the given work piece.
14. Write a program to perform the circular pocketing operation on the given work piece.
15. Write a program to perform the rectangular pocketing operation on the given work piece.

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