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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 ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME501	DCS	OPERATION RESEARCH AND SUPPLY CHAIN	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 20 marks.

Course Educational Objectives (CEOs):

Describe various theories of organizations, their characteristics, strengths, and Weaknesses. (A) Identify what differentiates various types of organizations. (B) Analyze how organizations come to be the way they are, including the factors, pressures, and historical influences that shape them. (C) Describe the basic language and concepts of the modern organization.

Course Outcomes (COs):

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

1. Collaborative project experiences involving both written and oral presentations.
2. Courses with significant experiential learning components.
3. Experiences with identifying, accessing, evaluating, and interpreting information and data in support of assignments, projects, or research.
4. Course experiences with large-scale datasets.

Syllabus

Unit-I

Introduction: History and development of Operations Research, Scientific Methods, Characteristics, Scope, Models in Operations Research,
Linear Programming: Formulation, graphical methods, simplex method, Big- M- method.

Unit-II

Linear programming models:
Assignment Models: Definition, Mathematical Representation, Formulation and Solution, Alternate optimal solution.

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Transportation Models: Definition, Formulation and solution, Alternate optimal solution, Stepping stone method, Modified distribution (MODI) or u-v method.
Sequencing Models: Processing n jobs through two machines, m machines and processing two jobs through m machines, minimal path problem

Unit-III
Network Analysis: Network diagram, Time estimation, Basic steps in PERT and CPM, PERT computation, CPM computation, critical path, Float, Cost analysis, crashing the network.

Unit-IV
Waiting Line Model: Introduction, classification, state in queue, probability distribution of arrival and service times, Single server model (M/M/I), Multiple server model (MMS), Birth and death process.

Unit-V
Supply Chain and it Importance: Introduction and advantages of SC, Key National and International issues.
SC Integration: Push, pull and push-pull systems, SC strategies, direct shipment, cross-docking transshipment, centralized versus decentralized control, central versus local facilities.
SC Inventory Management and Risk Pooling: Single warehouse inventory, the economic lot size model, the effect of demand uncertainty, supply contracts, multiple order opportunities, continuous review policy, variable lead times, periodic review policy, risk pooling, centralized versus decentralized systems, forecasting techniques.

Reference Books:

1. *"Operations Research", by Tasha Hamady 7th edition, (USA: Macmillan Publishing Company), 2003*
2. *"Operations Research", byPerm Kumar Gupta,Dr. D.S Hira, S.Chand publication.*
3. *"Operations Research", by Tasha, Tata McGraw Hill.2002*
4. *"Operations Research", by Wagner, PHI. New Delhi, 2003*
5. *"Operations Research", by Ravi dram & Philips, Tata McGraw Hill.2005*
6. *"Operations Research", by Gupta & Hira, S. Chand. 1e, 2008*
7. *Textbook of Logistics and Supply Chain Management, By D K Agrawal*
8. *Fundamentals of Supply Chain Management: Twelve Drivers of Competitive Advantage, By John T. Mentzer*

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	MID TERM EXAM	QUIZ/ ASSIGNMENT	END SEM	QUIZ/ ASSIGNMENT				
BTME 502	DCS	METROLOGY AND MECHANICAL MEASUREMENT	60	20	20	30	20	2	1	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 introduce basic principles and applications of (A) Metrology and Inspection (B) Linear and angular, force, torque and temperature measurements, (C) Displacement, Velocity/Speed, and Acceleration, Measurement, (D) metrology of screw threads and gears.

Course Outcomes (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

1. Students will describe basic concepts of Metrology
2. Students will select linear measuring instrument for measurement of various components
3. Students will select angular and taper measurement devices for measurement of various components
4. Students will select appropriate temperature measuring device for various applications
5. Students will describe methods of measurement for various quantities like force, torque, power, displacement, velocity/seed and acceleration
6. Students will be able to describe the metrology of screw threads and gears.

Syllabus

Unit - I

General concepts of measurement: Definition-standards of measurement, errors in measurement, limit-gauging, various systems of limits, fits and tolerance, interchangeability, ISI and ISO system. basic principles and design of standards of measuring gauges, types of gauges and their design, accuracy and precision, calibration of instruments, principles of light interference, interferometer, measurement and calibration.

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Unit – II

Linear and angular measurements: Slip gauges, micrometers, Vernier's, dial gauges, surface plates, comparators- mechanical, electrical, pneumatic and optical comparator, angular measuring instruments- sine bar, angle gauges, spirit level, autocollimators, clinometers; measurement of straightness, flatness and squareness.

Measurement of surface finish: Surface finish- definitions, types of surface texture, surface roughness measurement methods, comparison, profile-meters, pneumatic and replica, measurement of run out and concentricity,

Unit – III

Metrology of screw threads and gears: internal/external screw thread, terminology, measurement of various elements of threads, thread micrometer method, two wire and three wire methods; gear terminology, measurement of various elements, constant chord method, base tangent method, plug method; gear tester, gear tooth measurement; rolling gear tester.

Unit – IV

Temperature Measurement: Temperature standards, Temperature scales; Thermometry based on thermal expansion: Liquid in glass thermometers, Bimetallic Thermometers; Electrical resistance thermometry: Resistance Temperature Detectors, Thermistors; Thermoelectric Temperature Measurement: Temperature measurement with thermocouples, thermocouple standards.

Pressure and Velocity Measurement: Relative pressure scales, pressure reference instruments, barometer, manometer, deadweight tester, pressure gauges and transducers, total and static pressure measurement in moving fluids.

Unit-V

Strain Measurement: Stress and strain, resistance strain gauges, gauge factor, strain gauge electrical circuits, multiple Gauge Bridge, bridge constant, apparent strain and temperature compensation, bending compensation. Motion.

Force measurement: Load cells, piezoelectric load cells

Torque measurement: Measurement of torque on rotating shafts, Power estimation from rotational speed and torque.

Reference books:

1. *"Elements of Workshop Technology", by Hajra Choudhury, Vol.II. Media Promoters*
2. *"Manufacturing Technology - Metal Cutting and Machine Tools", by Rao. P.N, Tata McGraw-Hill, New Delhi, 2003.*
3. *"Machine Tool Practices", by Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White, Prentice Hall of India, 1998.*
4. *"Fundamentals of Metal Machining and Machine Tools",by Geofrey Boothroyd, Mc Graw Hill, 1984.*

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5. *"Process and Materials of Manufacture," by Roy. A.Lindberg, Fourth Edition, PHI/Pearson Education 2006.*
6. *"Engineering metrology and instrumentation," by Rajput R.K, Kataria &sons publishers.*
7. *"A text book of engineering metrology," by Gupta. I.C., Dhanpat rai and sons.*

List of Experiments

1. To Measure the angle using Sine bar.
2. To study and use of Vernier's, micrometer and dial gauges
3. To study Performance on surface measurements
4. To study Measurement of straightness, flatness and squareness
5. To study Measurements of Surface roughness using Mechanical Comparator.
6. To study Performance on linear and angular measurements and check different characteristics of measurements.
7. To study Performance on Temperature measurements and check different characteristics of measurements and also do calibration.
8. To study Performance on Stress, strain and force measurements and check different characteristics of measurements and also do calibration.
9. To study Performance on Speed/Velocity, acceleration measurements.
10. To study Measurement of screw threads by one wire and two wire

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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*				
BTME 503	DCS	DYNAMICS OF MACHINE	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):

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. Student would be able to understand the need of Mechanisms in engine parts.
2. Students would be able to understand basics of Displacement, velocity and acceleration of piston.
3. Students would be able to understand Governor Mechanisms.
4. Students would be able to understand the basics of Balancing of masses.
5. Students would be able to understand utility of Friction in Machine parts.
6. Students would be able to analyze Cam movement.

Syllabus

Unit - I

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

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

Unit - III

Balancing of Inertia Forces: Balancing of rotating masses, Two plane balancing, Determination of balancing masses (graphical and analytical methods), Balancing of rotors, Balancing of

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internal combustion engines, Single cylinder engines, In-line engines, V-twin engines, Radial engines, Lanchester technique of engine balancing.

Unit - IV

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.

Unit-V

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.

Reference Books:

1. *"Theory of machines", by Rattan; Publisher: TMH, 2009.*
2. *"Mechanism and Machine Theory", by Ambekar; Publisher: PHI, 2007.*
3. *"Theory of Machines", by Thomas Bevan; Publisher: Pearson, 2010.*
4. *"Theory of Mechanisms and Machines", by Ghosh and Malik; Publisher: East-West Press, 2015.*
5. *"Kinematics and dynamics of machinery", by Norton RL; Publisher: TMH, 2009.*
6. *"Theory of Machines", by P.L. Balaney; Publisher: Khanna, 2003.*

List of Experiments

1. To Perform Experiment on Watt and Porter Governors & also Prepare Performance Characteristic Curves in order to find Stability & Sensitivity.
2. To Perform Experiment on Proell Governor & also Prepare Performance Characteristic Curves in order to find Stability & Sensitivity.
3. To Perform Experiment on Hartnell Governor & also Prepare Performance Characteristic Curves in order to find Stability & Sensitivity.
4. To determine gyroscopic couple on Motorized Gyroscope.
5. To study gyroscopic effects through models.
6. To study Dynamically Equivalent System.
7. To study different types of dynamometers.
8. To study different types of clutch.
9. To study different types of Brakes.

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10. To Study dynamic behavior of cam & follower under various operating conditions using CAM ANALYSIS APPARATUS.

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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*				
BTME 504	DCS	INTERNAL COMBUSTION ENGINES	60	20	20	30	20	3	01	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 a fundamental understanding (A) To impart the knowledge of working of I.C. engines (B) To impart the knowledge of fuel injection and ignition system (C) To impart the detail knowledge of fuel combustion (D) To develop the knowledge of cooling and lubrication system of IC engines (E) To impart the ability of determination of engine performances through Testing.

Course Outcomes (COs)

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

1. Demonstrate the working of IC engines.
2. Describe the fuel injection and ignition system.
3. Explain the fuel combustion within IC engine.
4. Understand the cooling and lubrication system.
5. Evaluate Engine performance.

Syllabus

Unit - I

Air Standard Cycles: Internal and external combustion engines, classification and applications of I.C. Engines, IC engine components and terminology, four stroke cycle engines and two stroke cycle engines, Assumptions made in air standard cycle, Otto cycle, diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles, Stirling and Ericsson cycles, air standard efficiency, specific work output, specific weight, work ratio, mean effective pressure, deviation of actual engine cycle from ideal cycle, valve and port timing diagrams.

Unit - II

Carburetion: factors influencing carburetion, mixture requirements for various operating conditions, types of carburettors.

Fuel Injection System: Functional requirements of an injection system, types of inject systems, components of injection system.

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Ignition System: Requirements of ignition system, battery ignition system, magneto ignition system, electronic ignition system, firing order, ignition timing.

Unit - III

Combustion in S.I. engines: Stages of combustion in S.I. engines, effect of engine variables on ignition lag, combustion phenomenon, knock in S.I. engines, effects of engine variables on knock, combustion chamber for S.I. engines.

Combustion in C.I. engines: Stages of combustion in C.I. engines, variables affecting delay period, knock in C.I. engines, C.I. engine combustion chambers.

Unit - IV

Lubrication and Cooling Systems: Functions of a lubricating system, types of lubrication system; mist, wet sump and dry sump systems, crankcase ventilation, properties of lubricant, SAE rating of lubricants, engine performance and lubrication, necessity of engine cooling, effect of engine variables on engine heat transfer, different types of cooling systems.

Unit - V

Performance parameters of IC engines: Engine power, engine efficiencies, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, specific fuel consumption (BSFC, ISFC), variable affects engine performance, heat balance, engine performance curves.

Engine measurements and Testing: Friction power, indicated power, brake power, fuel and air consumption, speed, temperature of coolant and exhaust, noise and emission measurement.

Pollution and Its Control: Pollutants from S.I. and C.I. engines, Methods of emission control, alternative fuels for I.C. Engines, catalytic convertor.

Reference Books:

1. *"Internal Combustion Engine Fundamentals", by J.B. Heywood, McGraw-Hill, 5th edition.*
2. *"Fundamentals of Internal Combustion Engines", by Paul W. Gill & James H. Smith, Oxford & IBH Pub. Ltd., 4th edition.*
3. *"A Course in Internal Combustion Engines", by* V. *M. Domkundwar, Dhanpat Rai Publication, 3rd edition.*
4. *"Internal Combustion Engines", by V. Ganesan, Tata McGraw-Hill, 2nd edition.*
5. *"Internal Combustion Engines", by M.L. Mathur & R.P. Sharma, Dhanpat Rai Publications, 4th edition.*

List of Experiments

1. To study the working of 2 stroke and 4 stroke petrol (S.I.) engine
2. To study the working of 2 stroke and 4 stroke diesel (C.I.) engine
3. To study valve/port timing diagram of I.C. Engines.
4. To study fuel injection and ignition system of both S.I. & C.I. engines.
5. To study the different lubrication systems of I.C. engine.
6. Evaluate performance of 4-stroke C.I. engine and prepare heat balance sheet.
7. Evaluate performance of 2-stroke C.I. engine and prepare heat balance sheet.

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8. Performance evaluation of four stroke S.I. engine.
9. Performance evaluation of two stroke S.I. engine
10. Performance evaluation of multi-cylinder Diesel/Petrol Engine.

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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 ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME 505	DCS	CAD/CAM/CIM	60	20	20	30	20	2	1	4	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 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. Student will be able to understand the various Design concepts with the help of computer application.
2. Students would be able to get familiarized with the computer graphics application in design and understand the basic 2D & 3D commands of CAD and distinguish the CAD from manual paper drafting, in current industrial & product development scenarios.
3. Students would be able to understand the Solid and Assembly modeling tools to develop virtual product and part programming for manufacturing in various experiments & real life.
4. Students will be able to acquire knowledge of the applications of computers in design and manufacturing of real world product.

Syllabus

Unit – I

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, Digital Prototyping, Information requirements of mfg organizations; business forecasting and aggregate production plan; MPS, MRP and Production Activity Control (PAC), introduction of CAD, CAE, CAM, CAP, CAPP, CATD and CAQ.

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Unit – II

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

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 , Save and Publish Section Objects Wire frame Models, Wire frame Entities, Curve Representation. 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, Location tolerances, drafting practices in dimensioning and Tolerancing, Tolerance Analysis.

Unit – IV

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, Programmed Automations, Machine control unit, Part program, NC tooling. NC machine tools: Nomenclature of NC machine axes, Types of NC machine tools, Machining centers, Automatic tool changes (ATC), Turning centers. ISO codes for turning tools and holders; ATC, modular work holding and pallets; time and power estimation in milling, drilling and turning; adaptive control, sequence control and PLC; simple part programming examples.

Unit-V

Computer Integrated Manufacturing & 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).

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Reference Books:

1. *"CAD/CAM/CIM; Radhakrishnan", by P, Subramanian S and Raju V; New Age Pub.*
2. *"Principles of CIM", by S.Kant Vajpay; PHI*
3. *"CAD/CAM", by Rao PN;;TMH*
4. *"CAD/CAM Computer Aided Design and Manufacturing", by Mikell P. Groover and Emory W. Zimmer, Jr.*
5. *"Computer Integrated Design and Manufacturing", by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.*
6. *"Mastering CAD", by George Omura with Brian Benton Autodesk.*
7. *"PTC Creo Parametric 3.0 for Designers" by Tickoo S, Textbooks Published by BPB*
8. *"SOLIDWORKS 2017 for Designers", by Tickoo S, Textbooks Published by BPB*
9. *"CATIA V5-6R2016 for Designers", by Tickoo S, Textbooks Published by BPB*
10. *"Autodesk Inventor Professional 2017 for Designers", by Tickoo S, Textbooks Published by BPB*

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. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
2. Layout drawing of a building using different layer and line colours indicating all Building details. Name the details using text commands, Make a title Block.
3. To Draw Orthographic projection Drawings (Front, Top and side) of safety valve, knuckle joint, cotter joint & Plummer block etc.
4. Make an Isometric dimensioned drawing from orthographic drawings.
5. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.
6. Draw 3D models by extruding, revolve, sweep, loft & other 3D Modelling commands in AutoCAD.
7. Prepare Assembled 3d cad models of knuckle joint, cotter joint & Plummer block through Creo cad modelling software.
8. Apply Constraints & Mechanism on 4 bar & piston cylinder mechanism through Creo Mechanism tools.
9. Generate G codes & M codes of any models through CAM tools of Creo Software.
10. Write the program prepare any work piece through CNC Machine.

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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*				
BTME 506	DS	PROTOTYPING LAB	0	0	0	0	50	0	0	4	2

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Objectives:-

The primary objective of the course is to Explain & Demonstrate the (A) Prototyping Process with help of (B) Surfacing & Meshing, (C) Sheet Metals & Plastic Modeling & (D) 3D Printing Technology.

Course Outcomes:-

1. Students would be able to understand how to create high quality 3D models for rapid prototyping.
2. Students would be able to understand the Surface, mesh, sheet metals & Plastic modeling to develop product to use in various experiments & real life.
3. Students would be able to Evaluate real-life scenarios and recommend the appropriate use of 3D printing technology.
4. Students would be able to understand economic implications of 3D printing including its impact on startup businesses and supply chains.

Course Contents:-

Unit-I Rapid Prototyping:

History, Development of RP systems, Rapid prototyping Process chain, Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing Principle, Fundamental, Rapid Prototyping Data format, Other translators, medical applications of RP On demand manufacturing, Direct material deposition, Shape Deposition Manufacturing.

Unit-II Liquid Based and Solid Based Rapid Prototyping Systems:

Liquid based system, Classification, Stereolithographic Apparatus (SLA), D-MEC's Solid Creation System, Rapid Freeze Prototyping (RFP), Micro fabrication.
Solid based system: Stratasys' Fused Deposition Modeling, Solidscape's Benchtop System, Cubic Technologies' Laminated object Manufacturing, Multi- Jet Modeling System, Solidimension's Plastic Sheet Lamination, LD Sheet Lamination , Paper Lamination Technology.

Unit-III Surface & Mesh:

Introduction Surface Models, Surface Entities, Surface Representation, Parametric Representation of Analytic Surfaces - Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Coons Surface, Blending

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Surface , Offset Surface, Triangular Patches, Sculptured Surface, Rational Parametric Surface, Trim and Untrim Surfaces, Create & Edit NURBS & Control Vertices.
Create 3D Mesh Primitives , Modify Mesh Objects, Change Mesh Smoothness Levels. Modify Mesh Faces.

Unit-IV Sheet Metals & Plastic Modeling:
Introduction about sheet metals &Plastic modeling, flat, flange, planar, boundary bland, hole, punch, notch, thread, rip, corner relief, bend, unbend, split, editing & conversion. Solid shell & surface thicken.

Unit-V 3D Printing Technology:
3D printing technologies , principles, Applications, possibilities of 3D printing, 3D Scanning & 3D Printing, Economics , Law , Ethics & intellectual property issues in 3D printing . create high quality 3D models for rapid prototyping step by step create models in Sketch Up, AutoCAD, Rhino, Creo or any 3D modeling program , using the 3D printer capability to obtain hands-on experience in producing industrial design from concept to prototype, Creating & Printing of 3D models design.

References

1) *Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, by Ian Gibson, David Rosen, Brent Stucker*
2) *Rapid Prototyping: Principles and Applications , by Chee Kai Chua, Kah Fai Leong, Chu Sing Lim*
3) *3D Printing: Build Your Own 3D Printer and Print Your Own 3D Objects, by James Floyd Kelly*
4) *3D Printing: A Practical Guide for Librarians, by Sara Russell Gonzalez, Denise Beaubien Bennett*
5) *3D Printing For Dummies, by Kalani Kirk Hausman, Richard Horne*
6) *AutoCAD 2D & 3D tutorials and guide by Autodesk Inc.*
7) *Creo parametric Guide, by Parametric Technology Corporation (PTC).*

List of Experiments:

1. To study the concepts of rapid prototyping and its various application.
2. To study of Stereolithographic Apparatus (SLA).
3. To study of D-MEC's Solid Creation System.
4. To study of Rapid Freeze Prototyping (RFP).
5. To study of Stratasys' Fused Deposition Modeling.
6. To study of Laminated object Manufacturing.
7. To study of Solidimension's Plastic Sheet Lamination.
8. To create a surface for product using CAD tool.
9. To create a meshing of any mechanical component using CAD tool.
10. Sheet metal creation using CAD tools.
11. Prepare a CAD model with complex geometry & Generating STL files from the CAD Models & Working on STL files.
12. 3D Printing of mechanical Components.

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUTION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME507	DS	INDUSTRIAL TRAINING	0	0	0	0	30	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 20 marks.

Course Educational Objective of Industrial Training:-
The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an Engineering problem and possibly an industry guide for their Major Project in final semester

Scheme of Studies:-
Duration: Minimum 2 weeks in summer break after IV semester, assessment to be done in V semester.

Scheme of Examination:-
For the assessment of industrial training undertaken by the students, following components are considered with their weightage.

(a) Term Work in Industry **Marks Allotted**
Attendance and General Discipline:-
Daily diary Maintenance:-
Initiative and participative attitude during training:-
Assessment of training by Industrial Supervisor:-

Total:

(b) Practical/Oral Examination (Viva-Voce) in Institution **Marks Allotted**
1. Training Report:-
2. Seminar and cross questioning:-

Total
*During training students will prepare a first draft of training report in consultation with section

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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.

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. Product development procedure and phases.
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
5. Undertaking/assisting project work.
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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Daily Diary: - Industrial Training

Name of the Trainee---------- College ----------

Industry / work place ---------- Week No----------

Department /Section ---------- Date ----------

Dates---------- Brief of observations made, work done, problem/project undertaken, Discussion held, literature consulted etc

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Signature of Supervisor (TPO/Faculty) | Signature of Trainee | Signature of Official in-charge for Training (In Industry)

Supervision of Industrial Training

Faculty and TPO are supposed to plan industrial training in such a manner that students get exposure on most of the above area in the field.

One faculty member or TPO will plan industrial training of students in consultation with training manager of the industry (work place) as per the predefined objectives of training.

Monitoring visits will be made by training and placement officer/faculty in-charge for the group of Students, of the college during training.

Guidance to the faculty / TPO for Planning and implementing the Industrial Training:-

Keeping in view the need of the contents, the industrial training program, this is spread to Minimum 2 weeks duration, has to be designed in consultation with the authorities of the work place; Following are some of the salient points:

Spelling out the objectives of the industrial training in behavioral terms and same is informed in advance to the 1) students, 2) Authorities of the work place and 3) Supervising faculty members.

1. Discussing and preparing students for the training for which meetings with the students has to be planned.
2. Meeting with industrial personnel and orienting them regarding the objective of the training and the expectations of the program.
3. Correspondence with the authorities of the work place.
4. Orientation classes for students on how to make the training most beneficial- monitoring daily diary, writing weekly reports, how to interact with various categories of industrial

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personnel, how to behave and undertake responsibilities, how to gather information from the workplace, ethics etc.

5. Guiding students to make individual plans (week wise/ day wise) to undertake industrial training.
6. Developing a system of maintaining training records, by teachers for every batch of students for convenient retrieval.
7. Inviting industrial personnel to deliver lectures on some aspects of training

Action plan for planning stages at the Institutional Level:-

S. No.	Activity	Commencing Week	Finishing Week	Remark
1.	Meeting with Principal			
2.	Meeting with colleagues			
3.	Correspondence with work place(Industry concerned)			
4.	Meeting with authorities of work place			
5.	Orientation of students for industry training			
6.	Scrutinizing individual training plan of students			
7.	Commencement of individual training			
8.	First monitoring of industrial training			
9.	Second monitoring of industrial training			
10.	Finalization of Training report			
11.	Evaluation of performance at industry level			
12.	Evaluation of Industry Program in the Institutions.			

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
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			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
BTME508	DS	CNC MACHINING LAB	0	0	0	0	20	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 20 marks.

Course Educational Objectives (CEOs):

The main objectives of the course are (A) To study the basic principles and applications of the CNC machine tools (B) To provide the student with an understanding of the modern CNC machine tools and their programming methods.

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

Syllabus

Unit - I

Introduction to CNC Machine Tools: Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines-turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection.

Unit - II

Structure of CNC Machine Tool: CNC Machine building, structural details, configuration and design, guide ways-Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion-Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements- gears, timing belts, flexible couplings, Bearings.

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Unit - III

Drives and Controls: Spindle drives-DC shunt motor, 3 phase AC induction motor, feed drives-stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system-synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer.

Unit - IV

CNC Programming: Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well-known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

Unit-V

Tooling and Work Holding Devices: Introduction to cutting tool materials-Carbides, Ceramics, CBN, PCD–inserts classification- PMK, NSH, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.

Reference Books:

1. *"Computer Numerical Control Machines", by Radha krishnan 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

1. Preparatory activity: a. Collect mechanical components manufactured on CNC machines and show difference compared to conventional machining b. Identify operations on those components. c. Prepare conventional process plan for at least two components.
2. Demonstrate constructional features and modes of operations of CNC
3. Demonstrate inserts, holders and tool management systems.

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4. Develop and simulate CNC Turning part program (at least five) ,identify errors and manufacture on CNC turning machine.
5. Develop and simulate CNC Milling part program (at least five) and identify errors and manufacture on CNC milling machine.
6. Prepare part program with CAD/ CAM software (like master cam, NX) and interface with CNC machine.

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