C. U. SHAH UNIVERSITY

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I **CODE**: - PGME101
NAME – Computer Aided Design and Modeling (CADM)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours) (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			Total
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	
						Marks	Hours	Marks	Hours					
PGME101	Computer Aided Design and Modeling (CADM)	4	0	0	4	30	1.5	70	2.5	100	--	-	-	100

Objectives:-

- To impart students greater depth of technical knowledge in the area of design using modelling & programming softwares
- To learn detailed engineering of 3D models & applications of computer system to a solution of design problem

Prerequisites: - Basics of drawing and mechanical design, C programming, Computer soft skill, Basic understanding of Matrices.

Course outline:-

Sr. No.	Course Contents
1	**Introduction**: Need and Scope of Computer Aided Machine Design
2	**Computer graphics**: Principles of interactive computer graphics and overview of hardware available for use in CAD; Scan conversion; Bresenham's Algorithm for line, circle, Geometric transformations- 2D and 3D translation, scaling, rotation, shear and reflection, homogeneous transformations
3	**Geometric modelling**: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves Hermit cubic splines Bezier curves, B-splines rational curves. Projection: parallel & Perspective Projections **Visual Realism** : Hidden Line and Surface removal, Shading, Coloring.
4	**Surface modeling** :Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.
5	**Geometric modelling-3D**: Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Feature based modelling,`Octree Solid Models, Faceted Solid Model, STL Models.
6	**Solid modeling using software**: Capabilities of various commercially available software in the area of CAD such as Pro E, I-DEAS, CATIA etc. Concept of Computer Animation, Computer aided design of mechanical elements

	with animation. Mechanical Assembly: Introduction, Assembly Modeling, Inference of position from mating conditions, Representation Schemes.
7	**Computer aided design of machine components:** To develop computer programs using 'C'/ 'C++' / Visual basic Programming language for the machine components such as shafts, springs, couplings, clutches, brakes, levers, gears, belts Writing interactive programs to solve design problems and production of drawings – using any languages like Auto LISP/C/ etc., ADS/ARX for AutoCAD Programming.
8	**CAD/CAM Data Exchange**: Evaluation of Data Exchange format, IGES, PDES.

Learning Outcomes:-

- At the end of the course the students appreciate that Computer aided design & modeling technologies provide a valuable resource tool for the futuristic design.
- Students can achieve the current and futuristic trends in mechanical software and its applications based on industrial demands the field of CAD.
- Students can focus on changes brought about in the product cycles with the advent of CAD systems.

Books Recommended:-

1. CAD/CAM Theory and Practice **Ibrahim Zeid & R.Sivasubramanian**, Tata Mc Graw Hill international.
2. "Mathematical Elements for Computer Graphics **David F. Rogers and J. Alan Adams,** McGraw-Hill.
3. Computer Graphics **Zhigang Xiang and Roy A Plastock** , Mc Graw Hill
4. Computer Graphics **Donald Hearn and M. Pauline Baker,** Prentice Hall of India
5. Mastering CAD/CAM **Ibrahim Zeid**, Mc Graw Hill international.
6. Geometric Modelling **Mortenson, M.E., John Wiley & Sons**, NY, 1985.
7. CAD/CAM **P.N. Rao** , TMH.
8. Design of Machine Elements **C.S. Sharma & Kamlesh Purohit**, PHI Publications.
9. AutoCAD By Prof. Sham Tickoo

Research reference:-

1. ASME Journal of Mechanical Design
2. IEEE Computer Graphics and Applications
3. IE Mechanical Engg.

FACULTY OF :- Technology & Engineering
DEPARTMENT OF :- Mechanical Engineering
SEMESTER :- I **CODE** :- PGME102
NAME – Computer Aided Production Management (CAPM)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			Total
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	
						Marks	Hours	Marks	Hours					
PGME102	Computer Aided Production Management (CAPM)	4	0	2	6	30	1.5	70	2.5	100	30	20	50	150

Objectives:-

- The aim of this course is to develop an understanding of the knowledge in Computer Aided Production management
- With the help of this course students study how to maintain information about manufacturing resources, enhance production capabilities, develop new facilities and systems and share information through a common database.

Prerequisites: - Knowledge of Production Planing and Control. Basics of Computers and database management systems.

Course outline:-

Sr. No.	Course Contents
1	**Computer Aided Forecasting** : Nature and use of forecast, sources of data, demand patterns, forecasting models, Forecasting Techniques, selection of forecasting technique, measurement of forecast Accuracy, Adoptive methods.
2	**Computerized relative allocation of facility technique**, automated layout design program and computerized relationship layout planning for facility location and layout
3	**Computer Aided Process Planning:** Generative and variant types, backward and forward approach, feature based and CAD based CAPP, Operation Management. Job Sequencings, scheduling
4	**Inventory Control:**

	Introduction, Parameter, Cost associated, Deterministic inventory Models, Simple EOQ Model, Model for finite production rate, Model for Instantaneous production with finite shortage cost,etc, Stochastic Inventory Model, Buffer stock, Distribution of demand during the lead time, Inventory control systems, ABC analysis.
5	**MRP:** Introduction, Objective, Input, Computational procedure, information provided by the system. Detailed capacity planning, manufacturing resources planning **ERP:** Introduction, main features, generic model of ERP system, selection of ERP, proof of concept approach, analytic hierarchy approach, ERP implementation.
6	**Shop Floor Control:** Data collection, computer generated time standard. Assembly Line Balancing.
7	**Simulation:** Major activities, purpose, simulation process, types methodology, simulation packages, process quality simulator, computer requirements trends, applications simulation of machine shop.

Learning Outcomes:-

1. Knowledge about roll of computers in PPC.
2. Knowledge about integrating production functions through a common database.

Books Recommended:-

1. Computer Aided Manufacture **Chien Chang and Richard A Wysk**, Prentice Hall.
2. CAD / CAM **M.P. Groover & Zimmers**.
3. G.T. in the engineering industr **Bur bridge**.
4. Modern Production Management **Buffa & Sarin**.
5. Computer aided manufacturing **P.N.Rao, N.K.Tewari, T.K. Kundra**
6. Computer Aided Production Management **P.B.Mahapatra**.
7. Production Operation Management **Adam Ebert**.
8. CAD / CAM / CIM **P. Radhakrishnan, S. Subramanyan**, New Age International.
9. Simulation modeling and analysis **Averill M Law & David Kelton** – Tata Mcgraw Hill
10. Quantitative Techniques **L. C. Jhamb**, Everest Publishing House, Pune.

Research Reference:-

1. www.qfinance.com › Home › QFINANCE Dictionary
2. www.springer.com
3. www.sciencedirect.com

C. U. SHAH UNIVERSITY

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I **CODE**: - PGME103
NAME – Robotics and Machine Vision (RMV)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			Total
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	
						Marks	Hours	Marks	Hours					
PGME103	Robotics and Machine Vision (RMV)	3	0	0	3	30	1.5	70	2.5	100	-	-	-	100

Objectives:-

- The course objectives define the details study about the robotics and its applications.
- To learn Kinematic methods for the design and analysis of robot manipulators and similar mechanisms.
- The vision syllabus ranges over the variety of image acquisition systems now available, leading on to methods of image analysis.
- The course objective is to address current research problems in the "machine vision" and "Robotics" areas, with special emphasis on problems that cross the boundaries between them.

Prerequisites: - Basic knowledge about Kinematic, dynamic and images.

Course outline:-

Sr. No.	Course Contents
1	**Introduction-** Basic Structure– Classification of robot and Robotic systems –laws of robotics – robot motions – work space, precision of movement. Robot Drives and control systems
2	**Control system and components**: basic concept and models controllers control system analysis, robot activation and feedback components. Power transmission system..
3	**Motion analysis and control**- Manipulator kinematics, position representation, forward transformation, homogeneous transformation, Manipulator path control, Robot dynamics, Configuration of robot controller.
4	**End effectors**-Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of Grippers – Vacuum cups – Magnetic Grippers – Adhesive Grippers –RCC Grippers, Robot end effector interface.
5	**Sensors**- Position sensors – Potentiometers, encoders – LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC, VOICE recognition and synthesizers.

6	**Machine vision**- Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation. Image processing Techniques: Data reduction – Windowing, digital conversion. Segmentation – Thresholding, Connectivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region Splitting, Binary Morphology and grey morphology operations.
7	**Feature extraction**- Image analysis, Object recognition by features, Depth measurement, specialized lighting techniques. Image Data Compression, Real time Image processing, Application of Vision systems.
8	**Robot programming**: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations, Robot Languages.
9	**Robot application**: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

Learning Outcomes:-

On completion of this course, students should be able to:

1. Understand the various application of Robotics with its effective vision system in the industrial field.
2. Appreciate and analyse kinematics and positional control of articulated manipulators.
3. Design techniques for controlling mechanical systems.
4. Appreciate basics of machine vision concepts applicable to robotics.

Books Recommended :-

1. Introduction to Robotics: Analysis, Systems, Applications **Saeed B. Niku**, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)
2. Industrial Robotics – Technology, Programming and Applications **M.P. Groover**, McGraw-Hill, USA, 1986.
3. Machine Vision **Ramesh Jam, Rangachari Kasturi, Brain G. Schunck**, Tata McGraw-Hill, 1991.
4. Robotics for Engineers **Yoremkoren**, McGraw-Hill, USA, 1987.
5. Robotics and Image Processing **P.A. Janaki Raman**, Tata McGraw-Hill, 1991.
6. Robotics and control **R.K.Mittal and I.J.Nagrath** , Tata Mcgraw hill ,2003
7. A Robot Engg text book **Mohseen Shahinpoor**, Harper and Row Publishers, NY.
8. Fundamentals of Robotics – Analysis and Control **Robert J Schilling**, PHI.
9. Robotic Engineering – An Integrated Approach **Richard D Klaffer, Thomas A Chmielewski, Michael Negin** – PHI.
10. Robot Dynamics and Control Mark **W Spong, M Vidyasagar** – Wiley India.
11. Intro to Robotics, Mechanics and Control **John J Craig**, Pearson Education.
12. Industrial Robots **Ganesh S Hegde** – Laxmi Publications.

Research Reference:-

1. ASME – Journal of Mechanisms and Robotics
2. www.springer.com
3. www.sciencedirect.com

C. U. SHAH UNIVERSITY

DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I **CODE**: - PGME 104
NAME – Advanced Machine Design (AMD)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			Total
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	
						Marks	Hours	Marks	Hours					
PGME104	Advanced Machine Design (AMD)	4	0	0	4	30	1.5	70	2.5	100	-	-	-	100

Objectives:-

- To educate students the concepts of stress analysis, theories of failure and design to analyze, machine components.
- To teach students mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.
- To develop analytical abilities for providing solutions to engineering design problems.
- To recognize those factors constituting a practical, functional, efficient, and safe mechanical design.

Prerequisites:-

- Basic Knowledge of machine design.
- Analytical knowledge.

Course outline:-

Sr. No.	Course Content
1	**Design Basics and Philosophy** General design procedure for design problems, Design concepts, Safe life v/s fail safe design , Stress and strain analysis , Theories of failures & Design based on fatigue.
2	**Design for X (DFX);** X - Strength, Rigidity, Assembly, Limited Life, Failure, Manufacturability, Reliability, Maintenance.
3	**Design of Spindle** Functions of Spindle Unit and Requirements, Materials of Spindles, Effect of Machine Tool Compliance on Machining Accuracy, Design Calculations of Spindle-Design of Spindle for Bending Stiffness : Deflection of Spindle Axis due to a)Bending, b) Compliance of Spindle Supports, c) Compliance of the Tapered Joint
4	Friction theories, wear & types of wear, Lubrication, different modes of lubrication - hydrodynamic, hydrostatic & Elasto-Hydrodynamic, porous bearings, determination of static load capacity of bearing (Stribek's equation), Bearing design & testing.
5	**Advances in gear design** Gear materials, corrective gear design, gear rating calculation as per BIS, etc

6	**Design of gearbox for machine tools** Introduction, Basic consideration of design of drives, determination of variable speed range, Geometric progression - Standard step ratio –Saw Diagram, Ray diagram, kinematics layout – Design of sliding mesh gear box, Design of multi speed gear box.
7	**Optimum design** Objective of optimum design - Johnson 's method of Optimum Design (MOD). Adequate and optimum design. Primary, subsidiary and limit equations. Optimum design with normal specification of simple machine elements like tension bar, transmission shaft, helical spring-Introduction to optimum design with redundant specification.
8	**Axisymmetric Problems** Thick-walled cylinders, rotating discs.
9	Recent trends in materials handling equipment design, basic principles of design, main girder design, structure analysis, loading patterns, service factors & environmental conditions, testing as per BIS, etc.
10	**Robust Design** Steps in Robust Design**,** Fundamental Principle**,** Tools used in robust Design**,** Application and Benefits of Robust Design

Learning Outcomes:-

- The students will develop the ability to make proper assumptions, perform correct analysis while designing specific mechanical components.
- The students will apply Optimization Techniques to Mechanical Design Problems
- Able to select the material handling equipments, its design principles, different loading patterns and structural analysis.
- Analyze the various modes of failure of machine components under different load patterns
- Able to use design data books and different codes of design.

Books Recommended:-

1 Advanced Solid Mechanics **L S Srinath**, Tata McGraw-Hill
2 Theory of Elasticity (Third Edition) **S P Timoshenko, J N Goodier**,McGraw-Hill
3 Mechanical System Design **Farazdak Haidery**.
4 Engineering Design **George E. Dieter**, McGraw Hill.
5 Machine Design – An Integrated Approach **Robert L Norton**, Pearson Education.
6 Design of machine Elements **Bhandari V. B.**
7 Handbook of Gear design **G.M. Maitra, vol. –I & II**.
8 Mechanical Analysis & Design **Arhur H. Burr & John B. Chetham**,Prentice Hall India
9 Machine tool design **N.K.Mehta**
10 Material handling equipment **P.Rudenko**
11 Machine elements : life and design **Boris M. Klebanov, David M. Barlam, Frederic E. Nystrom.**
12 Mechanical Design Synthesis with optimization applications **Johnson R.C.**
13 Taguchi, "Methods Expalined – Practical Steps to Robust Design **TapanBagchi,** Prentice Hall, India
14 Quality Engineering using Robust Design **Madhav S. Phadke**, Prentice Hall, Englewood Cliffs
15 PSG Design Data Book
16 Product Design for Manufacture and Assembly-Third Edition, 2010 by **Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight**; CRS Press

Research Reference:-

1 ASME Journal of Mechanical Design (http://asmedl.aip.org/MechanicalDesign)
2 IEEE (http://ieeexplore.ieee.org)
3 E book- http://scribd.com
4 www.kettering.edu/academics/...use/machine-design

C. U. SHAH UNIVERSITY

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I **CODE**: - PGME105
NAME – Advanced Material Technology (AMT)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	PR/Viva	TW	Total	Total
						Marks	Hours	Marks	Hours					
PGME105	Advanced Material Technology (AMT)	3	0	0	3	30	1.5	70	2.5	100	--	-	-	100

Objectives:-

- Decision having to do with materials is an essential part of mechanical engineering practice.
- Every engineering design must finally be expressed in a material structure or device. Every technological advance must eventually be embodied in a material form.
- The choice of the right materials for given requirements, the proper use of those materials, including the development of new ways of using them for greater effectiveness, even the production of new materials – all are the direct responsibility of the engineer.
- The study of the behavior of materials is therefore incomplete without a certain amount of experimental research, from which a familiarity can be obtained.

Prerequisites:-

- Basic knowledge of materials and its behaviour.
- Basics of plasticity and elasticity.
- Basics of material failure like fatigue, creep etc…

Course outline:-

Sr. No.	Course Contents
1	**Atomic structure and Chemical Bonding:** Atomic concepts, Atomic Models, Quantum numbers, Electronics configuration, periodic table, Atomic bonding in solids (chemical), bonding and crystal properties
2	**Stress and strain relationship for elastic behaviour:** Introduction, description of stress at a point, in two dimension and in three dimension, description of strain at a point, Mohr's circle of stress and strain, elastic stress-strain relations, calculation of stresses from elastic stains, strain energy, anisotropy of elastic behaviour, stress concentration, finite element method
3	**Elements of plastic behaviour:** Introduction, Flow curve, true stress strain, yielding criteria for ductile metals, combined

	stress, anisotropy in yielding, yield surface and Normality, plastic stress strain relations, 2 dimensional flow – slip line field theory
4	**Thermal Properties of Materials:** Specific Heat: Classical, Einstein, Debye theory, Anharmonic crystal imperfections, Electronic specific heat, Thermal Expansion, Hypothetical & Actual Energy Curves.Thermal Conductivity, Wridemann – Franz ratio.
5	**Analysis of failure of metals: Fracture, Fatigue and Creep** Introduction, types of fracture, factors affecting fracture, Griffith crack theory, fracture toughness, Failure case studies, and methods of testing, fatigue failure, fatigue tests, factors affecting fatigue properties, fatigue crack growth, fatigue case studies and methods of testing, creep data, creep with metals, creep with polymers
6	**Advanced Engineering Materials:** Super alloys, Ferro electric and piezoelectric materials, advanced magnetic materials, advanced engineering polymer materials, advanced ceramic and composite materials, photo conducting and photovoltaic materials, electro-optic materials, Lasers, smart materials. Biomaterials, determining mechanical properties and their applications. Recent trends in Bio-Material Characterization
7	**Performance of Materials in service:** Service performance, corrosion, and its control, Delayed fracture, Performance of materials at High & low temperatures, Radiation damage and recovery and evaluation destructive and non destructive techniques
8	**Material selection and Design:** Introduction, selection of materials, service conditions, Primary processes, Secondary processes, strength-to-density and modulus-to-density ratios, safety and liability, Quality control and quality Assurance, Ashby Charts, Use of computers

Learning Outcomes :-

- Student can analyze the application of particular material for specific application.
- Can analyse material behaviour for given type of loading.
- The design of part with particular material for any application can be made.

Books Recommended :-

1. Engineering Material Technology **W. Bolton, Butterwarth – Heinemann**, 3rd Edition,
2. Material Science for engineers **James F Shackelford & Madanapalli K. Muralidharan**, Pearson Education.
3. Elements of Material Science – Sixth edition **Laurence H. Van Vlack**, Pearson Education.
4." Engineering Design- A Material and Processing Approach George **E. Deiter**, McGraw Hill Intl., 2nd Edition, 2000.
5. Theory of Elasticity and Plasticity **Timoshenko**.
6. Engineering Materials & Their Applications. **R. A. Flinn & P. K. Trojan**.
7. Material – Selection & Design. **ASM Handbook Vol.-20.**
8. Materials – Principles & Practice. Charles **Newey & Graham Weaver.**
9. Material Science & Engineering. Callister **W. D.**

Research Reference:-

1. Advanced Materials - Technology Strategy Board
2 www.sp.edu.sg/amtc/
3 ASME - Journal of Engineering Materials and Technology

C. U. SHAH UNIVERSITY

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I **CODE**: - PGME 106
NAME – CAD Software (CADS)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			Total
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	
						Marks	Hours	Marks	Hours					
PGME106	CAD Software (CADS)	0	0	4	4	--	--	--	--	--	80	20	100	100

Objectives:-

- To learn detailed engineering of Industrial Drawing & application of computer system to a solution for modeling complex geometries.
- To provide hands on training sessions on CAD programming and modelling softwares.
- To create standards compliant 2D and 3D drawings & to learn computer representation & manipulation of geometric data.

Prerequisites:- Basics of drawing and mechanical design, C programming, Computer soft skill, Basic understanding of Matrices

Course outline:-

Sr. No.	Course Contents
1	To prepare a computer program for scan converting a line, circle using Bresenham's algorithm.
2	Preparation of computer program for 2D transformations.
3	Preparation of computer program for 3D transformations.
4	Study of DXF, IGES, STL and script file formats and preparing models.
5	Study of Wire frame Modelling and making models using commercial software.
6	Study of Solid Modelling and making models using commercial software.
7	Study of Surface Modelling and making models using commercial software.
8	Assembling of part models using constraints
9	Computer program preparation for the designing of Machine components using File / Database management.
10	Project

Learning Outcomes:-

- At the end of the course the students appreciate that Computer aided design & analysis technologies provide a valuable resource tool for the futuristic design.

- A student will be able to learn computer representation & manipulation of geometric data.
- This course will give the student some insight, to the working behind readily available CAD software.

Books Recommended:-

1. Pro Engineer Wildfire 4.0 **Prof. Sham Tickoo**,
2. Pro/Engineer Wildfire (with CD-ROM containing Pro/E Wildfire Software) (Paperback). **Louis Gary Lamit**

Research Reference:-

1. ASME Journal of CAD
2. www.springer.com
3. www.sciencedirect.com

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	Total
						Marks	Hours	Marks	Hours					
PGME107	Tribology in Design & Surface Engineering (TDSE)	4	0	2	6	30	1.5	70	2.5	100	30	20	50	150

Objectives: - By this course student can gain the knowledge about various aspects of friction & wear and the methods to overcome friction & wear.

Prerequisites:-Basic concept of wear and friction and theories like lubrication, surface treatments etc...

Course outline:-

Sr. No.	Course Contents
1	**Surface Interaction and Friction** Topography of Surfaces – Surface features-Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact
2	**Wear and Surface Treatment** Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models-Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements –Laser methods – instrumentation - International standards in friction and wear measurements
3	**Lubricants and Lubrication Regimes** Lubricants and their physical properties- Viscosity and other properties of oils –Additives and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts-Boundary Lubrication- Hydrodynamic lubrication — Elasto and plasto hydrodynamic – Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.
4	**Theory of hydrodynamic and hydrostatic lubrication** Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load

	capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing- Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings
5	**High pressure contacts and elasto hydrodynamic Lubrication** Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives.
6	**Industrial Components and Systems** Slider bearings – self acting finite bearings, failure modes, materials rolling element bearings – Types, contact mechanics, bearing internal load distribution, lubrication – Bearing geometry and kinematics, load ratings and life prediction, torque calculation, temperature analysis, endurance testing and failure analysis.

Books Recommended:-

1. Basic Lubrication Theory **Cameron, A**. , Ellis Herward Ltd., UK, 1981.
2. Principles of Tribology **Hulling, J. (Editor)** , MacMillan, 1984.
3. Engineering Tribology **Williams, J.A.** Oxford University Press, 1994.
4. Tribology Handbook **Neale, M.J**. , Butterworth Heinemann, 1995.
5. Modern Tribology Handbook Vol. – I & II. **Bharat Bhushan**
6. "Friction and Wear of materials Rabinowicz.E, John Willey &Sons, UK, 1995.
7. Fundamentals of Tribology **S.K.Basu, S.N.Sengupta & B.B.Ahuja**, Prentice – Hall of India Pvt Ltd, New Delhi, 2005.
8. Engineering Tribology **G.W.Stachowiak & A.W .Batchelor** , Butterworth- Heinemann, UK, 2005.
9. Friction wear Lubrication – Tribology . Hand book Vol 1-2-3 , kragelsky & V. V. Elison, MIR Publications

Research Reference:-

1. ASME 'Journal of Tribology'
2. Proceeding of the Institution of Mechanical Engineers, Part J : Journal of Engineering Tribology
3. Indian Journal of Tribology - Tribology Society of India

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I **CODE**: - PGME108
NAME – Vibration Analysis & Condition Monitoring (VACM) (DEPT. ELECT-I)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	Total
						Marks	Hours	Marks	Hours					
PGME108	Vibration Analysis & Condition Monitoring (VACM)	4	0	2	6	30	1.5	70	2.5	100	30	20	50	150

Objectives:-

1. To understand the Fundamentals of Vibration and its practical applications.
2. To understand the working principle and operations of various vibrations Measuring instruments and Special Vibration measuring techniques.
3. To understand the condition monitoring based on Vibration analysis and its practical applications.

Prerequisites: - Basic Introduction about balancing & Vibration. Knowledge of Dynamics of Machineries subject.

Course outline:-

Sr. No.	Course Contents
1	Causes and effects of vibration. Vibrations of Single Degree, Two Degree and Multi Degree of freedom systems. Steady state and transient characteristics of vibration.
2	Introduction to Condition Monitoring, Failure types, investigation and occurrences. Causes of failure, Characteristics of vibration – SHM, Periodic motion, Displacement, Velocity and acceleration. Peak to peak & RMS, linear and logarithmic scales and phase angle.
3	Vibration measuring instruments, vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers.
4	Condition Monitoring through vibration analysis. Frequency analysis, Filters, Vibration signature of active systems, vibration limits and standards. Contaminant analysis, SOAP and other contaminant monitoring techniques.
5	Special vibration measuring techniques - Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring,

	Cepstrum analysis, Modal analysis, critical speed analysis, Shaft –orbit & position analysis.
6	Experimental Methods in Vibration analysis- Vibration Analysis Overview - Experimental Methods in Vibration Analysis, FFT Analysers (Multi Channel), Selection of Sensors- Accelerometer Mountings. –Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes.

Learning Outcomes:-

On completion of this course you will be able to:

1. Understand the concept of machine condition monitoring and develop familiarity with the technology used in this field.
2. Learn how to apply vibration analysis techniques to diagnose faults in rotary machines and take proper actions.
3. Learn how to prepare appropriate reports to communicate the results of analysis.
4. Know the different systems used to measure and analyse vibration.

Books Recommended:-

1. Mechanical Fault Diagnosis and Condition Monitoring **Collacott, R.A**., Chapman & Hall, London, 1982.
2. Introduction to Machinery Analysis and Monitoring **John S. Mitchell**, Penn Well Books, Penn Well Publishing Company, Tulsa, Oklahoma, 1993.
3. Vibration Measurement and Analysis **Nakra, B.C. Yadava, G.S. and Thuested, L.,** National Productivity Council, New Delhi, 1989.
4. Time Series Analysis **Pox and Zenkins.**
5. Vibration and Time Series Analysis **A.H. Search**,
6. Mechanical Vibrations **S.S. Rao**, Addison - Wesley Pub. Co., 1995.
7. Theory of Vibration with Applications **Thomson, W.T.** – CBS Publishers and Distributors, New Delhi, 1990
8. Mechanical Vibration Practice with Basic Theory **Ramamurti. V**, Narosa, New Delhi, 2000.
9. Mechanical Vibrations S**. Graham Kelly & Shashidar K. Kudari ,** Tata McGraw – Hill Publishing Com. Ltd New Delhi, 2007.

Research Reference:-

1. ASME – Journal of Vibration and Acoustics
2. www.springer.com
3. www.sciencedirect.com

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I **CODE**: - PGME109
NAME – Design of Hydraulic & Pneumatic System. (DHPS) (DEPT ELECT-I)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			Total
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	
						Marks	Hours	Marks	Hours					
PGME109	Design of Hydraulic & Pneumatic system. (DHPS)	4	0	2	6	30	1.5	70	2.5	100	30	20	50	150

Objectives:-

- To familiar with the Hydraulics & pneumatics.
- Most of the automation uses Hydraulic or Pneumatic application. So to understand automation in all aspects this type of knowledge if required
- Knowledge of maintaining the hydraulic and pneumatic systems.

Prerequisites:-

- Basics of Hydraulic and Pneumatic system.
- Basic knowledge of electrical circuits.

Course outline:-

Sr. No.	Course Contents
1	**Introduction** Fluid Power Types, Systems and their applications Desirable Properties of hydraulic & pneumatic fluids, Selection of fluids, Components of FPS.
2	**Hydraulic symbols** Circuit elements, Fluid pumps and motors, Hydraulic valves, Types of controls, Re servoirs for fluids, miscellaneous units, Composite symbols
3	**Fluid power pumps** Classification, reciprocating, rotary, centrifugal, working principle, performance characteristics curves,selection. Design considerations.
4	**Pressure accumulators** Types, selection & design considerations
5	**Oil hydraulic systems and hydraulic actuators** Hydraulic Power Generators – Selection and specification of pumps, pump

	characteristics. Linear and Rotary Actuators – selection, specification and characteristics.
6	**Control and regulation elements** Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.
7	**Hydraulic circuits** Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning,copying, - forklift, earth mover circuits- design and selection of components – safety and emergency mandrels.
8	**Pneumatic systems and circuits** Pneumatic fundamentals - control elements, position and pressure sensing – logic circuits - switching circuits - fringe conditions modules and these integration -sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.
9	**Installation, maintenance and special circuits** Pneumatic equipments- selection of components - design calculations – application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, System Programming, Low cost automation - Robotic circuits.

Learning Outcomes :-

- Student can achieve depth knowledge of Hydraulics and Pneumatics.
- Can gain how to solve the installation & maintenance problems.

Books Recommended:-

1. Fluid Power with Applications **Antony Espossito**, Prentice Hall, 1980.
2. "Basic fluid power **Dudleyt, A. Pease and John J. Pippenger, PrenticeHall, 1987**.
3. Hydraulic and Pneumatics **Andrew Parr**, Jaico Publishing House, 1999.
4. Pneumatic and Hydraulic Systems **Bolton. W.**, Butterworth –Heinemann, 1997.
5. Hydraulic and Pneumatic Controls: Understanding made Easy **K.Shanmuga Sundaram,** S.Chand & Co Book publishers, New Delhi, 2006.(Reprint2009)
6. Fluid Power Circuits and Controls: Fundamentals and Aapplications",by **Cundiff John S.,** Lavoisier Publication,2001.
7. Fluid Power Technology **Kokernak Robert P.**, Prentice H all, 1998.
8. Fluid Power Technology **Norvelle Don**, West Publishing Co., 1995
9. Industrial Hydraulic Control Peter **Rohner**, Prentice Hall, 1987.

Research Reference:-

1. *hydraulicspneumatics.com/*
2. *journal.fluid-power.net/*
3. controlmanuals.com › Pneumatics › Pneumatics System

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I **CODE**: - PGME 110
NAME – Reverse Engineering (RE) (DEPT ELECT-I)

Teaching & Evaluation Scheme:-

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Evaluation Scheme								
						Theory					Practical (Marks)			Total
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Total	Pr/Viva	TW	Total	
						Marks	Hours	Marks	Hours					
PGME110	Reverse Engineering (RE)	4	0	2	6	30	1.5	70	2.5	100	30	20	50	150

Objectives:-

- Generating a good understanding of RE history, its development and applications.
- To expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.

Prerequisites:-CAD, CAM, Production Technology

Course outline:-

Sr. No.	Course Contents
1	**Introduction** Scope and tasks of RE - Domain analysis- process of duplicating
2	**Tools for RE** Functionality- dimensional- developing technical data – digitizing techniques - construction of surface model - solid-part material- characteristics evaluation - software and application- prototyping - verification
3	**Concepts** History of Reverse Engineering – Preserving and preparation for the four stage, process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation
4	**Data management** Data reverse engineering – Three data Reverse engineering strategies – Definition – organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse

	Engineering of assembly programs: A model based approach and its logical basics
5	**Integration** Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement – feature capturing – surface and solid members
6	**Powder based rapid prototyping systems** Rapid Prototyping Techniques, Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. SLA, FDM, LOM and LM. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, manufacturing using Laser sintering, customized plastic parts, customized metal parts, -manufacturing - Laser Engineered Net Shaping (LENS).

Learning Outcomes: - awareness about reverse engineering and rapid prototyping processes and its practical applications**.**

Books Recommended:-

1. Design Recovery for Maintenance and Reuse **T J Biggerstaff**, IEEE Corpn. July 1991
2. White paper on RE **S. Rugaban**, Technical Report, Georgia Instt. of Technology,1994
3. Reverse Engineering **Katheryn, A. Ingle**, McGraw-Hill, 1994
4. Data Reverse Engineering **Aiken, Peter**, McGraw-Hill, 1996
5. Reverse Engineering **Linda Wills, Kluiver** Academic Publishers, 1996
6. Co-ordinate Measurment and reverse engineering **Donald R. Honsa**, ISBN 1555897, American Gear Manufacturers Association.

Research Reference:-

1. ASME journal of RE
2. www.springer.com
3. www.sciencedirect.com