FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGRM 201
NAME – Research Methodology (RM)

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					
PGME201	Research Methodology (RM)	2	0	0	2	30	1.5	70	2.5	100	-	-	-	100

Objectives:-
The objective of the course is to introduce the basic methods of conducting research, explore ideas in formulating research objectives and hypotheses and sample framework for taking up research studies in a structured manner. Also it is intended to facilitate for the development of an insight into different statistical tools for data analysis, interpretation and presentation of reports in different areas of research.

Prerequisites:-Knowledge of Basic research methods studied in B.E.

Course outline:-

Sr. No.	Course Contents
	The course aims at providing students with practical knowledge and skill of processing and interpreting empirical data as realted to students´ research. The course has the following components: • Understanding research and Research process • Research problems formulation • Research design Qualitative and quantitative research designs • Research publications and presentation • Research ethics and morals

1	**Introduction**: Meaning of Research, objectives of Research ,Types of research, Various Steps in Researchprocess, Types of Research, Research Approaches, Significance of Research,
2	**Problem formulation**: Review of Research Literature: Purpose and use of literature review, locating relevant information, use of library & electronic databases, preparation & presentation of literature review, research article reviews, theoretical models and frame work. Identification of gaps in research, formulation of research problem, definition of research objectives.
3	**Research Design**: Qualitative Methods: Types of hypothesis and characterization. Quantitative Methods: Statistical methods for testing and evaluation. Characterization of experiments: Accuracy, reliability, reproducibility, sensitivity, Documentation of ongoing research.
4	**Research Publication & Presentation**: Structure and Components of thesis and reports, formatting issues, citation methods, references, effective oral presentation of research. Quality indices of research publication
5	**Research Ethics and Morals:** Issues related to plagiarism, collaborative models and ethics, acknowledgements. Intellectual Property Rights: copy rights, copy left: patents, Industrial designs, Trademarks.

Learning Outcomes :-

- Students successfully completing the Master degree have an understanding of the content, methods, theories, and professional ethics associated with research methodology.
- Research Methodology as a subject should help researchers to prepare the literature in chronological pattern and should logically analyze the concerns.
- This subject should help in framing the research problems to enhance the scale of understanding.
- This subject should help researchers to use tools, techniques, concepts and world's best practices to present a unique research.
- Acquisition of skills for developing a research proposal for a master thesis project

Books Recommended:-

1. Research Methodology (Methods and Techniques) **Kothari, C.R**., New Age Publisher
2. Research Methods- A Process of Inquiry **Graziano, A.M., Raulin, M.L**, Pearson Publications, 7th Edition, 2009.
3. How to Write a Thesis: **Murray, R**. Tata McGraw Hill, 2nd Edition, 2010.
4. Writing For Academic Journals **Murray, R**., McGraw Hill International, 2009.
5. Writing for Publication **Henson, K.T.**, Allyn&Bacon, 2005.

Research Reference:-

1. ASME journal of Research methodology
2. www.springer.com

3. www.sciencedirect.com

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGME 202
NAME – Finite Element Methods (FEM)

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					
PGME202	Finite Element Methods(FEM)	4	2	0	6	30	1.5	70	2.5	100	30	20	50	150

Objectives:-

- To understand the need in Design for the Finite Element Method.
- To tie his/her understanding of mechanical engineering design concepts to use the Finite Element Method software correctly and efficiently.
- To analyze a physical problem, develop experimental procedures for accurately investigating the problem, and effectively perform and document findings.

Prerequisites:-
A basic understanding of vectors, matrices and partial differential equations for thermal and mechanical problems.

Course outline:-

Sr. No.	Course Contents
1	Introduction to FEM: basic concepts, historical back ground, application of FEM, general description, comparison of FEM with other methods, Variational approach, Galerkin's Methods.
2	Co-ordinates, basic element shapes, interpolation function. Virtual energy principle, Rayleigh- Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain displacement relations
3	1-D structural problems – axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape function. Analysis of Trusses – Plane Truss and Space Truss elements

4	Analysis of beams – Hermite shape functions – stiffness matrix – Load vector – Problems 2-D problems –CST, LST, force terms, Stiffness matrix and load vector, boundary conditions.
5	Isoparametric element – quadrilateral element, Shape functions – Numerical Integration – sub parametric and super parametric elements. 3-D problems – Tetrahedral element – Jacobian matrix – Stiffness matrix.
6	Dynamic Analysis : Weak form, Lagrange's Approach, Consistent and Lumped mass matrices, FE equations for vibration problems, Eigenvalue problems, Transient Vibration analysis.
7	Scalar field problems - 1-D Heat conduction – 1-D fin element – 2-D heat conduction problems – Introduction to Torsional problems – Potential Flow, Seepage, Flow in Ducts, Laminar Pipe Flow.
8	Introduction to Non linearity, Non linear problems; Geometric Non-linearity, Material Non-linearity, Non linear dynamic problems, analytical problems

Learning Outcomes:-

- The student will be able to understand the numerical methods involved in Finite Element Theory.
- Students will able to derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.
- Students will able to apply the steps required for FEM solution to variety of physical systems and obtain engineering design quantities.
- Students will demonstrate an ability to determine engineering design quantities (deformation, force, strain, stress) for truss, beam and frame structures.

Books Recommended:-

1. Introduction to finite elements in engineering **Tirupathi K. Chandrupatla and Ashok D.Belegundu.**
2. An Introduction to Finite Element Methods **J. N. Reddy** – Mc Graw Hill.
3. CAD / Cam and Automation **Farazdak Haidery**, Nirali Prakashan.
4. The finite element methods in Engineering **S.S. Rao** - Pergamon, New York.
5. A Textbook of Finite Element Analysis **P. Seshu**
6. Practical Finite Element Analysis **Nitin S. Gokhale, Sanjay S.Deshpande, Sanjeev V. Bedekar and Anand N. Thite**, Finite to infinite, Pune.
7. Finite Element Procedures in Engineering analysis **K.J Bathe**.
8. An Introduction to Nonlinear Finite Element Analysis **J.N.Reddy**, Oxford University Press.
9. The Finite Element Method in Engineering science **O.C. Zienkowicz**, Mc Graw Hill.Concepts and applications of finite element analysis – Robert Cook

Research Reference:-

1. www.mece.ualberta.ca/Tutorials/ansys/
2. www.ansys.com
3. www.owlnet.rice.edu/~mech403/FEA

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGME203
NAME – Computer Integrated Manufacturing (CIM)

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					
PGME203	Computer Integrated Manufacturing (CIM)	4	0	2	6	30	1.5	70	2.5	100	30	20	50	150

Objectives:-

1. To study advanced features of CIM so as to be capable of accepting professional responsibilities and to understand the associativity between design and manufacturing.
2. To develop in the engineering students the ability to analyze any engineering problem related to CIM, introduction of Group Technology, Material handling systems and integrated process planning system and its components

Prerequisites:-

- Basic knowledge of computer, CNC Machines, workings of Industrial departments etc…

Course outline:-

Sr. No.	Course Content
1	**UNIT – I** **Introduction to CIM:** Types of Manufacturing; Basic Concepts of CIM: Elements of CIM, CIM wheel, Evolution of CIM, Hardware and software. Fundamentals of Communication: Communications Matrix. Product Development Cycle, Concurrent Engineering, Sequential Engineering , Concurrent Engineering Techniques, Integrated Product Development(IPD), Product Life-Cycle Management (PLM), Collaborative Product Development.
2	**UNIT – II** **GT: Group Technology:** - Introduction, objectives part families, algorithms and models for G.T. - Rank order clustering, Bond energy, mathematical model for machine – component cell formation.

	Design and manufacturing attributes. Parts classification and coding, concept of composite job machine group, cell group tooling, design rationalization, CAD/CAM and GT benefits. **Cellular Manufacturing**: Design of Cellular Manufacturing Systems, Cell Formation Approaches: Machine–Component Group Analysis, Similarity Coefficients-Based Approaches. Evaluation of Cell Design.
3	**UNIT – III** **NC/CNC SYSTEMS:** Basic components of NC/CNC Systems, Desig of Workstations, Fundamentals of Part Programming, Subroutines, Do Loops and Canned Cycles. Computer-aided Part Programming. **FMS:** Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout; Operational Problems of FMS. FMS benefits.
4	**UNIT – IV** **CIM database and database management systems** Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete). Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM. Data Logging and Acquisition, Automated Data Collection, Shop-floor Control.
5	**UNIT –V** **Enterprise Wide Integration in CIM and CIM Models** Introduction to Networking, Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration. CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.
6	**UNIT – VI** **Future Trends in Manufacturing Systems:** Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web Based Manufacturing systems, Nano Manufacturing.

Learning Outcomes:-

- Students can gain the knowledge about group technology and improve the process planning of any given part.
- Can gain the knowledge about ERP & MRP.
- Corellate design and manufacturing very well.

Books Recommended:-

1. Automation, Production Systems and Computer Integrated Manufacturing **Mikell. P. Groover**, Pearson Education 2001.
2. CAD/CAM **Mikell. P. Groover and Emory Zimmers Jr**., Prentice hall of India Pvt. Ltd., 1998.

3. Computer Integrated Manufacturing **James A. Regh and Henry W. Kreabber**, Pearson Education second edition, 2005.
4. CAD CAM Principles, Practice and Manufacturing Management **Chris McMahon and Jimmie Browne**, Pearson Education second edition, 2005.
5. Computer Integrated Manufacturing Ranky**, Paul G.,** Prentice hall of India Pvt. Ltd., 2005.
6. Computer Integrated Manufacturing **Yorem Koren**, McGraw Hill, 2005.
7. CAD/CAM Principles and Applications P **N Rao,** TMH Publications, 2007.
8. CAD/CAM/CIM **P. Radhakrishnan, S. Subramanyan & V. Raju**, New Age International Publishers
9. Computer Aided Manufacturing By P. N. Rao,N. K. Tiwari, T. K. Kundra; TMH Publications
10. CNC: technology and programming By Stephen F. Krar & Arthur Gill; MacGraw-Hill Publication, 2012.
11. Flexible Manufacturing Cells and Systems By William W. Luggen, Prentice-Hall International, 1991

Research Reference:-

1. www.enotes.com
2. *www.journals.elsevier.com*
3. www.simflow.net
4. *www.SME-ON-LINE.com*

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGME204
NAME – Advanced Manufacturing Processes & Analysis (AMPA)

Teaching & Evaluation Scheme:-

ubject 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					
PGME204	Advanced Manufacturing Processes & Analysis (AMPA)	4	0	0	4	30	1.5	70	2.5	100	-	-	-	100

Objectives:-

- This course provides a broad introduction to advanced manufacturing processes and Student study all types of manufacturing processes including conventional, non-conventional process.
- This course would be used by engineers to design and implement future manufacturing systems and subsystems.

Prerequisites:-

An introductory course on Manufacturing Processes, Heat Transfer, and knowledge of Engineering materials.

Course outline:-

Sr. No.	Course Contents
1.	**Forming:** Fundamental theories of plasticity and mechanics of plastic deformation. Stress-strain relationships, deformation equations, methods for solution of problems in metal forming such as slab analysis, upper bound analysis etc., deformation zone, geometry, Hydrostatic pressure, workability, residual stresses, classification of metal forming processes and analysis of any one forming process. Design of Press Tools.
2.	**Casting:** Basic concepts of engineering analysis of casting, factors influencing the production of engineering casting to customer's specifications, Design for casting, functional design, dimensional features, metallurgical factors, strength/weight considerations, sources of

	fluctuation in properties, influence of form and environment, permanent mould casting, centrifugal casting, continuous casting, vacuum casting, flask less moulding, shell, investment, polystyrene (full mould casting), Co_2 moulding and analysis of any one of the above processes.
3.	**Welding:** Advanced Welding Techniques, General concepts of weld design, analysis of stresses in welded structures, permissible stresses, standards, calculation of the size of welds for static and dynamic loading, location and orientation of welds in an assembly, residual stresses, distortion and their control, weldability.
4.	**Machining:** Hot machining, deep hole drilling, metal spinning, cryogenic machining, micro-Machining.
5.	**Non Conventional Machining:** Mechanism, transfer medium, immediate source of energy and application of all non conventional processes, identification of variables and analysis of EDM chemical machining, Laser machining, AJM and USM.
6.	**Rapid prototyping and tooling**: Geometrical modeling, Reverse engineering, Virtual / Augmented reality, DFX, RP Methods, Stereo lithography, Fused-deposition modeling, Selective laser sintering, Laminated-object manufacturing, Ballistic particle Manufacturing, Solid-base curing and Direct manufacturing and rapid tooling

Learning Outcomes:-

- To teach students to perform mathematical analyses of conventional and non-traditional manufacturing processes
- Students will demonstrate the ability to break down manufacturing processes for analysis.
- Students will demonstrate the ability to identify known and unknown parameters including initial and boundary conditions for major manufacturing processes.
- To teach students to integrate core mechanical engineering principles to design manufacturing processes
- Students will demonstrate the ability to integrate the relevant core principles in mechanical engineering (mechanics, materials and thermo-fluids) to solve problems in manufacturing.
- Students will demonstrate the ability to carry out manufacturing process design based on first principles.

Books Recommended:-

1. Mechanical metallurgy **George E Dieter** , McGraw Hill
2. Metal Forming Analysis by Avitzer, McGraw Hill.
3. Principles of industrial metal working process Rowe **G. W.**
4. Principles of metal casting **Heine & Rosenthal**
5. Welding and its application **Rossi B. E.**
6. Fundamentals of Metals Casting by Flin R.A; Addison Wesley
7. Welding Processes & Technology by Dr. R.S.Parmar Khanna Publishers
8. Machining of Metals, by Brown; Prentice Hall.
9. Modern machining processes **P. C. Pandey**, H. S. Shan
10. Manufacturing Processes for Engineering Materials **Serope Kalpakjion and Steven R. Schmid** - Pearson Education.

Research Reference:-

1. ASME – Journal of Manufacturing Science and Engineering
2. www.springer.com
3. www.sciencedirect.com

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGME 205
NAME – Advanced Optimization Techniques (AOT)

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					
PGME205	Advanced Optimization Techniques (AOT)	2	2	0	4	30	1.5	70	2.5	100	30	20	50	150

Objectives:- The course aims to develop the engineering – analysis capability for engineering problems using basic statistical tools and techniques. Detailed treatment of various data analysis and handling technique leading to complete understanding and modeling the processes including its optimization is envisaged in this course.

Prerequisites: - Basic Introduction about optimization and its applications.

Course Outline:-

Sr. No.	Course Contents
1	General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints, classification of optimization problems. Single and multivariable optimization techniques.
2	Technique of unconstrained minimization. Golden section, Random, Pattern and Gradient search methods, interpolation methods, equality and inequality constraints.
3	Direct methods and indirect methods using penalty function, Lagrange multipliers. Geometric programming and stochastic programming, Genetic algorithms.
4	Engineering applications, structural-design application axial and transverse loaded members for minimum cost, minimum weight. Design of shafts, bars, columns and torsion

	members, design optimization of springs, gears.
5	Use of MATLAB optimization toolbox for the solution of problem on hand.

Learning Outcomes: - After studying the course, the student shall:

- be able to identify optimization problems and classify them according to their properties, for example, network problems or discrete problems
- be able to construct mathematical models of more complex optimization problems
-
- have knowledge about and be able to apply basic solution principles for some classes of commonly appearing optimization problems, such as, for example, the simplex method for network flows.
- be able to use commonly available software for solving optimization problems that appear regularly in applications

Books Recommended:-

1. "Engineering Optimization -Theory and Practice **Singeresu S. Rao**, New Age, 2000
2. Optimum Design of Mechanical elements **Johnson Ray C**., Wiley, John & Sons.
3. Genetic Algorithms in search, Optimization and Machine **Goldberg D. E**Addison-Wesley – New York, 1989
4. Optimization for Engineering Design Algorithms and Examples **Kalyanamoy Deb**, Prentice Hall of India.

Research Reference:-

1. ASME journal of Advanced Optimization Techniqes
2. www.springer.com
3. www.sciencedirect.com

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - I I **CODE**: - PGME 206
NAME – FEA Software. (FEAS)

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					
PGME206	FEA Software (FEAS)	0	0	4	4	---	---	---	---	--	80	20	100	100

Objectives:

- To impart students greater depth of technical knowledge in the areas of analysis software to solve real life mechanical problems.
- To learn detailed engineering of 1D, 2D and 3D models & application of computer system to a solution of design problems.

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

Course outline :-

Sr. No.	Course Contents
1	Study of Finite Element Analysis and its different approaches.
2	Basic procedure of Finite Element Method and Mathematical formulation of problems.
3	Analysis of 1D structural members and verification of the same through manual calculation.
4	Beam analysis problems and their verification.
5	Analysis of 1D and 2D trusses, their formulation and use of software.

6	Formulation of 1D and 2D heat transfer problem and verifying solution using software
7	Analysis of 2D symmetric problem and its verification
8	Preparation of 3D model of a part and its analysis.
9	Preparation of 3D assembly model and its structural analysis.
10	Project

Learning Outcomes :-

- Students can use designing & analysis software for their project work.
- Students will learn the importance of designing & analysis software in the product cycles with the advent of CAD systems.
- This course will give the student some insight, to the working behind readily available analysis software.

Books Recommended:-

1, Engineering Analysis with ANSYS Software **Tadeusz Stolarski, Y. Nakasone, S. Yoshimoto**, Elsevier Butterworth-Heinemann

Research Reference:-

1. ASME journal of FEA software
2. www.springer.com
3. www.sciencedirect.com

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGME207
NAME – Computational Fluid Dynamics (CFD) (DEPT ELECT-II)

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					
PGME207	Computational Fluid Dynamics(CFD)	4	0	0	4	30	1.5	70	2.5	100	--	-	-	100

Objectives:-Student can gain deep knowledge about the fluid dynamics with the help of discretization technic and finite volume methods etc.

Prerequisites: - Basic knowledge of fluid theories.

Course outline:-

Sr. No.	Course Contents
1	**Introduction:** Definition and overview of CFD, Advantages and applications, CFD methodology
2	**Governing Differential Equations:** Governing equations for mass, momentum and energy; Navier-Stokes equations; Mathematical behaviour of PDE's viz. parabolic, elliptic and hyperbolic, Initial and boundary conditions, Initial and Boundary value problems.
3	**Discretization Techniques:** Introduction to Finite difference Method, Finite Volume method and Finite Element method Finite difference methods; Finite difference representation of PDE's; Solutions to Finite Difference Equations; Implicit, semi-implicit and explicit methods; Errors and stability criteria
4	**Finite Volume Methods:** FVM solutions to steady one, two and three dimensional diffusion problems and unsteady one and two dimensional diffusion problems FVM solutions to convection-diffusion problems - one and two dimensional, steady and unsteady; Advection schemes; Pressure velocity coupling; SIMPLE family of algorithms
5	**Grid Generation:**

	Structured and Unstructured Grids; General transformations of the equations; body fitted coordinate systems; Algebraic and Elliptic Methods; multi block structured grids; adaptive grids
6	**Turbulence Modeling:** Effect of turbulence on governing equations; RANS, LES and DNS Models

Learning Outcomes: - Student will be expert in the area of fluid dynamics and gain knowledge of grid generation turbulence modelling and can analyse the flow of various fluids.

Books Recommended:-

1. Computational fluid flow and heat transfer **Muralidhar, K., Sundararajan, T.,** Narosa Publishing House, New Delhi1995
2. Computer simulation of flow and heat transfer **Ghosdhasdidar, P.S.,** TataMcGraw-Hill Publishing company Ltd., 1998.
3. Numerical heat transfer fluid flow **Subas, V.Patankar**, Hemisphere publishing Corporation.
4. Finite Element Programming of the Navier Stokes Equation **Taylor, C and Hughes J.B.,** Pineridge Press Ltd., U.K , 1981.
5. Computational fluid Mechanics and Heat Transfer **Anderson, D.A., Tannehill , I.I., and Pletcher, R.H.,** Hemisphere Publishing Corporation, New York , USA, 1984.
6. Computational Techniques for Fluid Dynamics 1 **Fletcher, C.A.J**.,Fundamental and General Techniques, Springer- Verlag , 1987

Research Reference:-

1. ASME – Journal of Fluid Engineering
2. www.springer.com
3. www.sciencedirect.com

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGME208
NAME –Industrial Automation (IA) (DEPT ELECT-II)

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					
PGME208	Industrial Automation (IA)	4	0	0	4	30	1.5	70	2.5	100	--	-	-	100

Objectives:-Nowadays it is a time of automation so the knowledge of automation is required. To provides the knowledge about automation correlation with manufacturing, machining operations, assembly systems, material handling system etc…, Basic automation machines like CNC operate with PLC so to provide PLC basics.

Prerequisites:-

- Basics of manufacturing processing, flow line, machining operations, Material handling systems, inspection and testing lines, Electrical circuits etc…

Course outline:-

Sr. No.	Course Contents
1	**Introduction:** Definition of automation, Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break-Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in-process.
2	**Detroit-Type Automation**: Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, Automation for Machining Operations, Design and Fabrication Considerations. Analysis of Automated Flow Lines: General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines.
3	**Assembly Systems and Line Balancing**: The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Computerized Line Balancing Methods, Other ways to improve the Line Balancing,

	Flexible Manual Assembly Lines. Automated Assembly Systems: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine.
4	**Automated Materials Handling:** The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Carousel Storage Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing.
5	**Automated Inspection and Testing:** Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. Modelling Automated Manufacturing Systems: Role of Performance Modelling, Performance Measures, Performance Modelling Tools: Simulation Models, Analytical Models. The Future Automated Factory: Trends in Manufacturing, The Future Automated Factory, Human Workers in the Future Automated Factory, The social impact.
6	**Introduction to Programmable Logic Controllers:** advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC. **PLC programming methodologies:** ladder diagram, STL, functional block diagram, creating ladder diagram from process control descriptions, introduction to IEC61131 international standard for PLC, SCADA. **PLC functions:** Bit logic instructions, ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer & Counter functions on-delay timer, off-delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics.

Learning Outcomes: - Student can gain knowledge of automation with respect to manufacturing and machining processes. Also achieve knowledge of basic PLC programming and Modeling of system.

Books Recommended:-

1. Automation, Production Systems and Computer Integrated Manufacturing", by **Mikell P.Grover** Pearson Education Asia.
2. Robots and manufacturing Automation, **C.Ray Asfahl** , John Wiley and Sons New York.
3. Performance Modeling of Automated Manufacturing Syetms **N.Viswanadham and Y.Narahari,** , Printice Hall India Pvt. Ltd.
4. Design of Automatic Machinary **Stephen J. Derby**, Special Indian Edition, Marcel Decker, New York, Yesdee publishing Pvt. Ltd, Chennai
5. Automated Manufacturing Systems PLCs **Hung Jack**

Research Reference:-

1. www.**automation**direct.com
2. *www.**automation**.com*
3. www.springer.com

4. www.sciencedirect.com

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGME209
NAME – Experimental Techniques and Data Analysis (ETDA) (DEPT ELECT-II)

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					
PGME209	EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS	4	0	0	4	30	1.5	70	2.5	100	--	-	-	100

Objectives: - Student can achieve the knowledge about measurement and taguchi method. They also gain knowledge of gauge theories.

Prerequisites: - Basic knowledge of Mechanical Measurment and Strength of Material Subjects.

Course outline:-

Sr. No.	Course Contents
1	**Basic concepts of Measurement** Statistical Analysis of Experimental Data Method of Least Squares, Uncertainty Analysis. Response characteristics of Instruments – 1st & 2nd order instrument. Transducers, Vibration & Noise measurements.
2	**Theory of strain gauges** Advance & Specific measurements –Stress & Strain Measurement by Photo Elastic Bench, Hotwire & Laser Doppler Anemometry. Thermal & Transport property measurement, Thermo gravimetric, Gas Chromatography, Air Pollution & Nuclear radiation measurement.
3	NDT, Radiography, U ltrasonography, Wind Tunnel Testing , Data Acquisition System, Advance measurement techniques, Optical measurement, Portable coordinate measurement system ,Software analysis
4	**Tensile & Bend Testing** Impact & Hardness Testing, Fracture Toughness Test Corrosion & Creep Test, Visual Check, Radiography

	Ultrasonic test, Magnetic Particle / Dye Penetrate Test Other Non Destructive Tests (e.g. Acoustic Emission Current etc.)
5	**Experiment design & data analysis**: Statistical methods, Randomised block design, Latin and orthogonal squares, factorial design. Replication and randomization. Data Analysis: Deterministic and random data, uncertainty analysis, tests for significance: Chi-square, student's _t' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.
6	**Taguchi Methods**: Experiment design and planning with Orthogonal arrays and linear graphs. Additive cause effect model. Optimization of response level. Identification of Design and noise factors. Performance evaluation and Optimization by signal to noise ratios. Concept of loss function and its application.
7	**Response Surface Methodology for Design of Experiments.**

Learning Outcomes:- Student can give solid conclusion on the bases of data given with the use of various techniques.

Books Recommended:-

1. Experimental Methods for Engineers 5 th Ed. **Holman, J.P**, McGraw hill International Edition, 1989
2. Measurement System – Application and Design **Doeblin, E.O**., McGraw Hill International Ed., 1990
3. Industrial Instrumentation **Eckman**, **D.P. Wiley** Eastern Ltd., New Delhi, 1990
4. Dynamics and Bifurcation s **Hale, J. and Kocak,** H., Springer-Verlag, N.Y. 1991
5. Nonlinear Dynamics and Chaos Strogatz**, S.H.,** Addison Wesley, Massachusetts, 1995.
6. Modern Electronic Instrumentation & Measurement Techniques Helfrack**, A.D. and Cooper, W.D.**, Prentice Hall of India Pvt. Ltd., New Delhi -2001.
7. Design Analysis of Experiments 7th Edition By Douglas C. Montgomery. Wiley Publication, 2012

Research Reference:-

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

FACULTY OF: - Technology & Engineering
DEPARTMENT OF: - Mechanical Engineering
SEMESTER: - II **CODE**: - PGME210
NAME – Design of Material Handling Equipments (DMHE) (DEPT ELECT-II)

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					
PGME210	Design of Material Handling Equipments (DMHE)	4	0	0	4	30	1.5	70	2.5	100	--	-	-	100

Objectives:-

- To give knowledge of various material handling equipments and design of it.
- To expose the students to different types of material handling equipments.

Prerequisites: - Knowledge of design related subject and basics of material handling equipments. Knowledge of subjects like MD-I, MD-II, IDMD etc..

Course outline:-

Sr. No.	Course Contents
1	**Materials Handling Equipments**: Types, Selection and applications.
2	**Design of Hoists:** Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, Pulley systems, Sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks, Crane grabs, Lifting magnets, Grabbing attachments, Design of arresting gear, Brakes: shoe, Band and cone types.
3	**Drives of Hoisting Gear**: Hand and power drives, Travelling gear, Rail travelling mechanism, Cantilever and monorail cranes, Slewing, Jib and lifting gear, Cogwheel drive, selecting the motor ratings.
4	**Conveyors:** Types, Description, Design and applications of Belt Conveyors, Apron Conveyors and Escalators Pneumatic Conveyors, Screw conveyors, Roller Conveyors and vibratory conveyors.

5	**Elevators:** Bucket elevators: design, Loading and bucket arrangements, Cage elevators, Shaft way, Guides, counter weights, Hoisting machine, Safety devices, Design of fork lift trucks. Walking Beams.

Learning Outcomes: - After this course student can design the material handling equipment for particular load and size.

Books Recommended:-

1. Material Handling Equipments **Rudenko**, MIR Publishers.
2. Conveying Machines, Volumes I and II **Spivakovsy, A.O. and Dyachkov, V.K**., MIR Publishers, 1985.
3. Materials Handling Equipments **Alexandrov M**., MIR Publishers, 1981.
4. Materials Handling Handbook **ASME**,Wiley -Interscience, 1985
5. Materials Handling Handbook **Boltzharol, A**., The Ronald Press Company, 1958
6. Conveying Machines Spivakovsy **A.O. and Dyachkov, V.K**., Volume I and II, MIR Publishers, 1985.
7. Design Data Book **Tech. P.S.G**., Kalaikathir Achchagam, Coimbatore, 2003

Research Reference:-

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