SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

"DNYANTEERTH', VISHNUPURI,

NANDED

PROPOSED SYLLABUS FOR

B.E. (MECHANICAL ENGINEERING)

w.e.f. 2017-18

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Teaching & Examination Scheme for Final Year Mechanical Engineering

w.e.f. 2017-18

Sem.-VII

Sr. No	Subject	Teaching Scheme			Examination Scheme					Credits		
		Th	Pr/ Tut	Total	ESE	MSE	CE Pr / WS	ESE	Total	Th	Pr	Total
M-401	Refrigeration & Air Conditioning	04	02	06	80	20	30	70	200	04	01	05
M-402	Finite Element Methods	04	02	06	80	20	30	70	200	04	01	05
M-403	Advanced Machining& Manufacturing	04	02	06	80	20	30	70	200	04	01	05
M-404	Operation Research Techniques	04	02	06	80	20	30	70	200	03	01	04
M-405	Elective – II	04	-	04	80	20	-	-	100	03	-	03
M-406	In-plant Training	-	02	02	-	-	25	25	50	-	01	01
M-407	Project –I	-	02	02	-	-	50	-	50	-	01	01
	Total	**20**	**12**	**32**	**400**	**100**	**195**	**305**	**1000**	**18**	**06**	**24**

EL-II: 1. Tribology 2. Renewable Energy 3. M&N Mfg
4. IPD 5. PLM

Sem.-VIII

Sr. No	Subject	Teaching Scheme			Examination Scheme					Credits		
		Th	Pr/ Tut	Total	ESE	MSE	CE	ESE	Total	Th	Pr	Total
M-408	Automobile Engg	04	02	06	80	20	30	70	200	04	01	05
M-409	Production Planning & Control	04	02	06	80	20	30	70	200	03	01	04
M-410	Quality Engg.	04	02	06	80	20	30	70	200	04	01	05
M-411	Elective – III	04	-	04	80	20	-	-	100	03	-	03
M-412	Project- II		06	06	-	-	30	70	100	-	03	03
	Total	**16**	**12**	**28**	**320**	**80**	**120**	**280**	**800**	**14**	**6**	**20**

CE – Continuous Evaluation **ESE – End Semester Exam**
MSE – Mid Semester Exam **Pr. – Practical**
Th – Theory **Tut – Tutorial** **W/S- Workshop**

EL-III 1. CFD 2. Cryogenics 3. A&R
4. MMT 5. Entrepreneurship Development

B. E. (Mechanical) Part - I
Refrigeration and Air Conditioning

Teaching Scheme	**Examination Scheme**		
Theory : 4 Hrs/Week	MSE	:	20 Marks
Practical: 2 Hrs/Week	(Theory) ESE	:	80 Marks
	CE	:	30 Marks
	(Practical) ESE	:	70 Marks

Course Objectives:

The major Power Consuming devices are refrigerators and Air Conditioners. The main objective of this course is to understand the working principle of Refrigerator and Air conditioning and to operate them with minimum consumption of power in minimum time.

The student should understand how to operate the Refrigerator and Air conditioner, their working principle, various operating cycles such as vapor compression cycle, Air compression cycle, multi compression system, Vapor absorption cycle with numerical calculations.

He/she should know the psychrometry and various properties of air, GSHF, RSHF, humidification, Dehumidification, various components and their types for air conditioners and Refrigerators such as compressors, condensers, evaporators, throttle device and temperature and pressure controllers.

Except understanding of working principle, he should know various types of Refrigerants and how to choose them in a system to operate it smoothly with minimum cost and minimum maintenance.

Course Outcomes:

In order to assess the students progress in the subject towards achieving knowledge and learning. He/She is assessed by conducting three tests in the semester , He/She is assigned minimum five assignments, home work problems, Solving University Question papers to grasp knowledge in the subject.

The various experiments were performed during practical hours to understand the basic concept and working of the Refrigeration cycle. A local cold storage plant is visited to understand the cycle of Refrigeration and Air conditioning. Finally the student is examined by conducting Practical/Oral Examination based on Term Work, Test performance and finally theory paper of University level, based on the syllabus.

The student is expected to use his subject knowledge to design the Refrigeration or Air Conditioning plant and to optimize the performance of the same.

.

Unit-I **(07hrs)**

Introduction & Refrigeration Review of thermodynamics: Refrigeration, unit of refrigeration, COP and exegetic efficiency, applications of refrigeration such as domestic, industrial, medical, cryogenics and transportation. Definition, classification nomenclature desirable properties satiation of refrigerants for particular application from group of refrigerants, ozone depletion need for eco-friendly refrigerants, charging of refrigerants, detection of leakages. Green house effect from CFCs & CO2, Alternative refrigerants for CFCS & HCFCS, Antifreeze solutions.

Unit-II **(07hrs)**

Vapor Compression Cycle: Different types of compressors, condensers, evaporators and expansion devices controls such as pressure cutouts, thermostat, humidistat, solenoid valve, oil pressure cutout, relays, Thermostatic Expansion valve. Carnot cycle reversed Carnot cycle for refrigerants, limitations of reversed Carnot cycle, theoretical vapor compression cycle, Effects of working parameter on VCC, deviation of actual cycle from theoretical cycle, Frosting methods of defrosting.

Unit-III **(07hrs)**

Multi Pressure system: Removal flash gas inter cooling one evaporator and one compressor system, Multi evaporator and one compressor system one evaporator and Multi compressor system cascade refrigeration system and production of solid CO2.

Unit-IV **(07hrs)**

Air Cycle Refrigeration: Bell-Coleman cycle, joule and Bray ton cycle of air refrigeration different methods used for aircraft cooling, advantage of using air refrigeration over VCC, Mortinovsky-Dubinsky cycle.

Unit-V **(07hrs)**

Psychrometry & Air conditioning: Necessity of air conditioning human requirements of comfort study of psychometric and psychometric process such as mixing of air streams sensible heating sensible cooling humidification dehumidification cooling and dehumidification heating and dehumidification, cooling and humidification heating and humidification. bypass factor sensible hear factor. Factors affecting control Air-conditioning, Classification of Air-conditioning. Winter, summer & year round Air-conditioning system.

Unit-VI **(07hrs)**

a. Factors considered to calculate air conditioning cooling load calculation: Solar refrigeration solar air conditioning, Air-conditioning of special type buildings, Marine air conditioning, Mobile air conditioning

b. Vapor Absorption System: Principle components working modifications use of enthalpy concentration charts for studying performance of refrigeration system different types of absorption system like aqua ammonia lithium bromide Electrolux etc.

.**TermWork:**

Term work shall consist of any eight experiments from the following.

1. Trial on vapor compression refrigeration system
2. Trial on air conditioner. (Test Rig)
3. Trial on ice refrigeration system
4. Demonstration of different compressors used in refrigeration.
5. Demonstration of household refrigeration and its wiring diagram.
6. Study of different controls used in refrigeration system such as thermostat, solenoid valve, compressor capacity control.
7. Study of different controls such as H.P. & L.P. control OLP, relays.
8. Study of psychrometer used in determination of D.B.T. W.B.T study of humidistat.
9. Charging refrigerant in refrigeration system or finding refrigeration capacity of refrigerating unit.
10. Visit to cold storage plant or any such application of refrigeration.
11. Visit to air-conditioned / air-cooled premises (visit report should be included in the journal).
12. Visit to ice factory.

Practical Examination

It shall consist of an oral based on the above syllabus and term work.

References

1. Refrigeration & Air-conditioning- C.P. Aroa -Tata McGraw Hill
2. Refrigeration & Air-conditioning – W.F.Stoecker, J.W.Jones McGraw Hill
3. Refrigeration & Air-conditioning – Roy J. Dossat.- Pearson Education
4. A course in Refrigeration & Air-conditioning – S.Domkundwar, S.C. Arora.
5. A course in Refrigeration & Air-conditioning – R.S. Khurmi & J.K.Gupta
6. A course in Refrigeration & Air-conditioning – Manohan Prasad

E. (Mechanical) Part - I
Finite Element Methods

Teaching Scheme	**Examination Scheme**		
Theory : 4 Hrs/Week	MSE	:	20 Marks
Practical: 2 Hrs/Week	(Theory) ESE	:	80 Marks
	CE	:	30 Marks
	(Practical) ESE	:	70 Marks

Course Objectives:

1. To acquaint with applications of numerical techniques for solving problems.
2. To introduce the concepts of Mathematical Modeling of Engineering Problems.
3. To study the applicability of FEM to a range of Engineering Problems.

Course Outcomes: Learner will be able to…

1. Develop the finite element equations to model engineering problems
2. Apply the basic finite element formulation techniques to solve engineering problems.
3. Use commercial FEA software, to solve problems related to mechanical engineering

Unit-I **(06 hrs)**

FUNDAMENTAL CONCEPT OF FEM:

Introduction, History background, Applications of FEM in various fields, stresses and equilibrium boundary conditions, straindisplacement relations, stress – strain relations, temperature effects, variational approachsolution techniques.

Unit-II **(08 hrs)**

DESCRIPTION OF THE METHOD: Step wise procedure of Finite element method, variational techniques for derivation of finite element equations, assembly procedure, solution methods.

Unit-III **(06 hrs)**

FEA OF ONE DIMENSIONAL PROBLEMS: Introduction, finite element modeling, shape functions, variational approach, weighted residual approach, Assembly of finite element equations, Higher- order element, Boundary conditions, Temperature effects.

Unit-IV **(06 hrs)**

FEA OF TWO DIMENSIONAL PROBLEMS:

Introduction, FE modeling, formulation of constant strain triangular element, problem modeling and boundary conditions.

Unit-V **(06 hrs)**

ISOPARAMETRIC ELEMENTS:

Introduction, 2-D Isoparametric elements, the 4-nodes quadrilateral, computation of stiffness, matrix & load vectors, numerical integration,

Unit-VI **(08 hrs)**

COMPUTER IMPLEMENTATION OF THE FINITE ELEMENT METHOD:

Preprocessing: model definition – nodal coordinates, element connectivity, material and element type and property definitions, type of analysis (static/modal), loading and boundary conditions. Meshing techniques - free and mapped meshing, Quality checks – aspect ratio, warp angle, skew, jacobian, distortion, stretch, included angle, taper.

Post Processing: strain and stress recovery (integration and nodal points), interpretation of results (results validation and data interpretation) and design modification

TERM WORK

List of Assignment

Students should use the commercial software or programs from the text-books or self developed programs, to verify the results obtained by manual calculations. The input data and output results of the problem solved using the computer programs should be included in the Journal. The proposed list is as given below;

1 Any two problem using bar element

2 Any two problems using truss element

3 Any two problems using CST element

4 Any one problem using axisymmetric element

5 Any one problem of free vibration analysis using bar element

6 Any one problem on Steady State Heat conduction.

7 Static stress concentration factor calculation for a plate with center hole subjected to axial loading in tension.

Course Project

A group of not more than four (04) students, shall do Finite Element Analysis of any mechanical engineering element/system, which involves element selection, assigning properties, meshing, assigning loads and boundary conditions, analysis and result interpretation.

Reference Books:

1. Introduction to Finite Element Method in Engineering by S.S.Rao, Butterworth HeinmannPublication.
2. Finite Elements in engineering, Chandrupatla T. R., 2nd Edition, PHI,2000
3. Finite Element Procedures by Bathe K.J., Prentice Hall of India, New Delhi.
4. Finite Element Method with applications in Engineering – Desai- Pearson Education
5. ANSYS & other software manuals.

B. E. (Mechanical) Part - I
Advanced Machining & Manufacturing

Teaching Scheme	**Examination Scheme**		
Theory : 4 Hrs/Week	MSE	:	20 Marks
Practical: 2 Hrs/Week	(Theory) ESE	:	80 Marks
	CE	:	30 Marks
	(Practical) ESE	:	70 Marks

Course Objectives:

1. To introduce the students to Advanced Manufacturing Processes.
2. To introduce the students to Modern Measurement Techniques for Micro Machining.
3. To introduce the students to

Course Outcomes:

1. Selection of appropriate manufacturing process for Advance components.
2. Characterization of work piece materials.

Unit I: **(08 hrs)**

Advanced Machining Processes: Need of Advanced Machining Processes, Working Principle, Process variables, cutting parameters and process capabilities of ECG, ECD, ECDM, ESD, MAF, AFM, STEM, EJT, ELID and Laser based heat treatment.

Unit II: **(06 hrs)**

Advanced Sheet Metal Forming: Shearing processes, Sheet metal characteristics, Test methods for formability of sheet metals, Stretch forming, Rubber forming, Super plastic forming, Explosive forming, Magnetic Pulse forming.

Unit III: **(08 hrs)**

Advanced Forming & Shaping of Plastics: Extrusion, Inject moulding, Blow Moulding, Rotational moulding, Thermoforming, Compression moulding, Transfer moulding.

Processing of Composites: Processing of Elastomers, Processing of Reinforced Plastics, Processing of Metal matrix composites. Processing of Ceramic matrix composites, Design considerations.

Unit IV: **(06 hrs)**

Additive Manufacturing Processes: Introduction and principles, development of additive manufacturing technologies, Steriolithiography, FDM, SLS, SGC and LOM

Unit V: **(06 hrs)**

Modern Machining Tools: Machining and Turning Centres, Machine Tool Structures, Vibration and Chatter in Machining, Machining economics

Unit VI **(06 hrs)**

Measurement Techniques in Micro Machining: Introduction, classification of measuring systems, Microscope: Optical Microscope, Electron Microscope, Laser based system, Interference Microscope and Comparators, CMM.

Surface Profilers: Scanning Tunneling Microscope, Scanning Electron Microscope, Atomic Force Microscope and applications.

Term Work: It shall consist of at least six assignments based on above syllabus.

Practical Examinations: It shall consist of Oral Examinations based on above syllabus.

References:

1. Manufacturing Process, B.H. Amstead, Philip F Ostrrold & Myhron L. Begmon, John Wiley & sons.
2. Advanced Manufacturing Proceses, G.F. Benidiet, Mareel Dekker publishers.
3. Non-Conventional Machining Processes, P.K. Mishra, Narosa Publicaitons.
4. Rapid Prototyping Process, A Ghosh.
5. Manufacturing Engineering & Technology, Serope Kalpank Jian Stee R. Schimid.
6. Additive Manufacturing Techinques – Ian Gibson- Springer.
7. Micro Machining of Engineering Materials- Josheph Mcgeough, Marcel Dekker.

B.E. (Mechanical) Part – I
Operations Research Techniques

Teaching Scheme	**Examination Scheme**		
Theory : 4 Hrs/Week	MSE	:	20 Marks
Practical: 2 Hrs/Week	(Theory) ESE	:	80 Marks
	CE	:	30 Marks
	(Practical) ESE	:	70 Marks

Course Objectives:

1. To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources.
3. Apply the various models of operation research such as assignment model, transportation model, Linear programming model, Network Model and Sequencing Model.

Course Outcomes:

1. Upon successful completion of this course, the student will be able to.....
2. Illustrate the need to optimally utilize the resources in various types of industries.
3. Apply and analyze mathematical optimization functions to various applications.
4. Demonstrate cost effective strategies in various applications in industry.

Unit I: **(08 hrs.)**

Linear Programming

Operations Research - introduction, characteristics, phases,limitations; classification of O.R.Models.Linear Programming- formulation, objective function, decision variables, general and standard forms , graphical method for two variables, simplex method, Big-M method, Two phase method, Dual simplex method, primaldual relationship,feasible , degenerate problems of LPP, duality concepts.

Unit -II: **(06 hrs.)**

Dynamic Programming

Introduction, Bellman's principle of optimality, recursive equation approach, characteristics of dynamic programming problems. Introduction to Non-linear programming.

Unit-III: **(06 hrs.)**

Transportation Models

Introduction, Formulation, Basic Method of Solving Transportation Problem, Optimization Methods likeUV (MODI) method for testing optimality for balanced and unbalanced problems and Stepping Stone Method, degeneracy in transportation problem, minimization and maximization problems of transportation.

Unit-IV: **(06 hrs.)**

Assignment Models

Hungarian Method to solve Assignment Problem, variations of assignment problems, typical assignment problems, travelling salesman problems as the special case of assignment problem. Branch and bound method for solving travelling salesman problem.

Unit-V: **(02 hrs.)**

Simulation

Introduction, elements of simulation model event type simulation generation ofrandom phenomenon, Monte-Carlo simulation.

Sequencing models: **(04 hrs.)**

Solution of sequencing Problem - Processing of n jobs through two machines,Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing ofn jobs through m Machines.

Unit-VI: **(10 hrs.)**

Network Models

fundamental concept of network modelsand construction of network diagrams, Fulkerson's rule, concept and types of floats, CPM – Construction of networks, critical path, Forward and backward path,Floats and their significance, PERT – Time estimates, Construction of networks, probability ofcompleting projects by given date, start and finish times of activities.

Optimization of project time and cost in network ,network crashing application. Resource allocation and load smoothening, resource leveling, updating a project.

Term Work:

At least seven assignments based on theoretical concepts and problems / case studies.

Practical Examination:

It shall consist of an oral based on above syllabus and term work.

References :

1. Operations Research – Hamdy A Taha
2. Operations Research –Hira and Gupta
3. Operations Research – S.D. Sharma
4. Operations Research –KantiSwarup
5. Introduction to Operations Research –Hiller, Tata McGra

B. E. (Mechanical) Part - I
EL-II-Tribology

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Course Objectives:

1. This course is designed to understand the basic concepts of Tribology.
2. To understand the recent advances in the field of Tribology.

Course Outcomes:

1. Students will be able to explain various wear mechanisms.
2. Students will be able to predict theoretically as well as experimentally the life of Bearings and the components subjected to rolling and sliding friction.

Unit -I **(06 hrs.)**

Introduction, Properties and Testing Of Lubricants, Viscosity, Effect of Temperature and Pressure on Viscosity, Basic Equations, Generalized Reynold's Equation, Energy Equation, Equation of State.

Unit -II **(06 hrs.)**

Idealized Hydrodynamic Bearings, Plane Slider Bearings, Slider Bearing with Pivoted Shoes, Step Bearings, Idealized Journal Bearings, Finite Bearings, Electrical Analogy Method, Analytical Solution, Numerical Solutions, Oil flow and Thermal Equilibrium, Circumferential and Axial flow, Heat Balance.

Unit-III **(06 hrs.)**

Bearing Design, Practical Considerations, Design of Journal Bearings, Squeeze Film Bearings, Parallel Surface Bearing, Step Bearings, Hydrodynamic Instability, Stiffness and Damping coefficients, Stability.

Unit- IV **(08 hrs.)**

Externally Pressurized Oil Bearings, Circular Step Bearings, Rectangular Thrust Bearings, Opposed Pad Bearings, Multi-Races Bearings, Gas Lubricated Bearings, Governing Equations,

Infinitely Long Plane Slider Bearings, Infinitely Long Journal Bearings, Finite Journal Bearings, Externally Pressurized Gas Bearings, Porous Gas Bearings, Elasto-hydrodynamic Lubrication, Dimensionless Parameters, Film Thickness Equations.

Unit-V **(06 hrs.)**

Ball Bearings, Deep Groove Radial Bearings, Angular Contact Bearings, Thrust Ball Bearings, Surface Roughness On Hydrodynamic Bearings and Elasto-hydrodynamic Line Contacts, Derivation Of Average Reynold's Equation for Partially Lubricated Surface, Effect of Surface Roughness on Journal Bearings.

Unit-VI **(08 hrs.)**

Friction of Metals, Friction Theories, Surface Contaminants, Frictional Heating, Wear of Metals, Classification of Wear, Mechanisms of Wear, Quantitative Laws of Wear, Wear Resistance Materials.

Text Book:

1. Bassani R. and Piccigallo B., "Hydrostatic Lubrication", Elsevier Publication, London, 1992.
2. Stolarski T.A., "Tribology of Machine Design", Butterworth Heinemann, Oxford, 2000.
3. Barwell F.T., "Bearing System, Principles and Practice", Oxford University Press, 1979.

Reference Books:

1. Bowden F.P. and Tobor D., "Friction and Lubrication of Solids", Clarendon Press, oxford, 1986.
2. Denis Summers Smith J., "An Introductory Guide to Industrial Tribology", Mechanical Engineering Publication, London, 1992.
3. Bharat Bhushan and Gupta B.K., "Handbook of Tribology", Mc Graw Hill, New Delhi, 1991

B. E. (Mechanical) Part - I
EL-II-Renewable Energy

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Course Objectives

1. Introduce to the technology of renewable source of energy
2. Learn about the solar radiation, its applications and radiation measuring instruments.
3. Learn about the various types of geothermal resources and its applications.
4. Study the biomass energy resources.
5. Learn methods of energy extraction from the wind and oceans.
6. Learn to the technology of direct energy conversion methods.

Course Outcomes: Learner will be able to..

1. Apply the technology to capture the energy from the renewable source like Sun, Wind, Ocean, Biomass and Geothermal.
2. Apply the direct energy conversion methods.

Unit I: **(08 hours)**

Introduction : Energy Scenario, Need for renewable energy resources,

Solar Energy: The Sun-Sun-earth relationship Solar radiation, Radiation measuring instruments, Power Development in India

Solar Collectors: Flat plate collection, performance analysis of flat plate collector, Concentrating collectors, performance analysis, Tracking and solar swing, performance analysis.

Unit II: **(08 hours)**

Solar Energy Application: Solar water heating, space heating- active and passive heating, energy storage, solar ponds, solar pumping system, solar crop drying, solar cooker, solar air conditioning and refrigeration.

Solar Photovoltaic System: Semi conductor materials and doping p-n junction, photovoltaic effect, efficiency of solar cells, solar photovoltaic system, plastic solar cells with nanotechnology.

Unit III: **(08 hours)**

Wind Energy: Wind, Beaufort number, characteristics, wind energy conversion systems, types, Betz model, Interference Factor, Power coefficient, Torque coefficient and thrust coefficient, Lift machines and drag machines, matching, electricity generation, Power Development in India.

Unit IV: **(06 hours)**

Geothermal Energy: Introduction, structure of earth, plate tectonic theory, geothermal field, geothermal gradients, geothermal power generation, preheat hybrid with conventional plant, Power Development in India.

Bio Energy: Operating principle, wood gassifier, pyrolsysis, applications, Power Development in India.

Unit V: **(06 hours)**

Ocean Energy: Introduction, Characteristics double cycle stream, components of power plant, global scenario, Power Development in India.

Fuel Cell: Principle of working, construction and applications, Power Development in India.

Unit VI: **(06 hours)**

Hydrogen Energy: Hydrogen as a renewable energy source, Sources of Hydrogen, Production of Hydrogen, Direct electronics of water, thermal decomposition of water, biological and biochemical methods of hydrogen production, Hydrogen generation in India.

Reference Books:

1. Solar Energy- Principles of Thermal collection & storage; Sukhatme S.P., TataMcGraw Hill Publishing Co.
2. Non-Conventional Energy Sources, G.D. Rai, Khanna Publisher, New Delhi.
3. Biomass Technology – A practical Handbook, Khandelwal K.C. Mahdi S.S. Tata McGraw Hill.
4. Wind Energy Conversion System, Freris L.L Prentice Hall.
5. Hydrogen Technology for Energy, D.A. Maths, Noyes Data corp.
6. Solar Hydrogen Energy System, T.Ohta Perpamon Press.
7. Wind Turbine Technology, Fundamental concepts of Wind turbine technology-Spera. D.A., ASME press, NewYork.

B. E. (Mechanical) Part - I

EL-II-Micro & Nano Manufacturing

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	**MSE : 20 Marks**
	ESE : 80 Marks

Course objective:

1. To understand the scope of micro and nano technology:
2. To understand the concepts and Applications of micro- and nanofabrication
3. To understand Nano technology in India
4. To understand the scope for Microfabrication
5. To understand commercialization Issues of Micro-Nano Technology

Course outcome:

Students will have a complete understanding of scope, concepts and applications of micro and nano technology in the field of manufacturing.

Unit-I **(06 hrs)**

Introduction: Need, evolution, fundamentals and trends in micro and nano technologies; Consequences of the technology and society Moore's law , challenges to manufacturing technology; evolution of precision in manufacturing, tooling and current scenario micro nano fabrication tool requirements and scales.

Unit-II **(08 hrs)**

Introduction:principle, tools and application of Turning and Diamond turning, Micro Milling, Micro Drilling, Micro Grinding, Honing Lapping, Supper Finishing

Unit-III **(06 hrs)**

conventional micro-nano manufacturing and finishing approaches and Classification, WAJM, USM, AFM, MAF, micro: ECM chemical machining, micro: , EDM, WEDM, LBM, EBM, Focused ion beams (IBM) Hybrid processes, ELID- process principle mechano chemical finishing **(ANS-Applied Nano Surfacefinishing).**

Unit-IV **(06 hrs)**

Modeling and Analysis approach Meaning and Method, Modeling and Analysis approach for EDM as Example size effect for micro machining, Introduction to Nano machining.

Unit-V **(08 hrs)**

Generative and other processing routes: Lithography techniques, PVD and sputtering deposition, CVD, LIGA, Electro and Electroless deposition, Nano structured films and coatings.

UNIT-VI **(06 hrs)**

Introduction MEMS, NEMS, Market prospects assembly problems and Flip chip technology and joining of micro partsmicro robots and applications.

References:

1. Fundamentals of Machining Processes, Hassan El-Hofy, Taylor and Francis, 2007.
2. Non traditional Manufacturing Processes – G.F.BENEDICT (MARCEL DEKKER JNC.)
3. Non-conventional machining by – P.K. MISHRA (NAROSA PUBLICATIONS)
4. Advanced Machining Processes, by V. K. Jain, Allied Publishers Pvt. Ltd, (2005)

B**. E. (Mechanical) Part - I**

EL-II-Industrial Product Design

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Objectives

1.To understand the structure of Industrial product design processes

2. To understand the contributions and role of multiple functions for creating a new product

3. To apply engineering knowledge for the design of new style innovative and market acceptable products.

4. To develop an ability to coordinate multiple, interdisciplinary tasks in order to achieve the mission and goals of the product design.

Outcomes: Learner will be able to..

1. Acquire the skills in understanding the Industrial Product Design.

2. Acquire the skill in style, colors, lines & forms while design the new product.

3. Develop skills in understanding various techniques of data collection, brain storming, Anthropometric & Aesthetic in product design.

Unit I: (06 hrs)

An approach to Industrial Design: Technical requirements, Ergonomic requirements, Aesthetic requirements. Ergonomics and Industrial, Anthropometric data, Agronomical design aspects of machine tools; Testing machines; instruments automobiles; process equipments; etc.

Unit II: (06 hrs)

Visual Effects of Line and Formal: Mechanics of seeing psychology of seeing , general inference of line and form, color and light, color terms color combinations, color of engineering equipments/color and machine, their forms

Unit III: (08 hrs)

Aesthetic Concepts: Concept of unity; concept of order with variety; concept of purpose; style and environment; Aesthetic expression; symmetry balance; contract continuity proportion; rhythm radiance

Style : Component of style; Basic factor; environment factor ; social factor; Basic style; observing style in capital goods.

Unit IV: **(06 hrs)**

Industrial Design in Practice: General design situation, specifying design requirement, rating the importance of industrial design; industrial design in the design process analysis; Market question influencing industrial design, "Production" questions, synthesis presentation working with the specialist

Unit V: **(08 hrs)**

New Product Development: Initiation, Idea collection, creative design; brain storming; creative thinking; creative development, inventiveness ; concept ional design. Function and use: What will it do? Legal standard requirement; international standards; do by dimensions, vision, interpretation of information. Design of Production; Costs; standardization; design evolution techniques, estimation of production cost; Reduction of cost, impact of DFP on other factors, prototype design pre production, inspection. Design for maintenance: Life test; classification of components for facilitating maintenance.

Unit VI: **(06 hrs)**

Decision Making: Optimization, Probability, Reliability

Computer Aided Product Design: Manufacturing consideration: For casting, welding, machining, forgoing, forming etc.

References:

1. Product Design and development – Kari T. Ulrich Steven D. Eppinge.
2. Industrial Design for Engineers – W.H. YALI iifff Books Ltd., London.
3. Cost Reduction in product Design – Willian Chow – Ven Nostand Reinhold Co.,
4. Engineering Design Connectional stage – N.J. French. Heinmenn Educational Books.
5. Product Design – Otto- Pearson Education
6. Principles of Machine Design – R.C. Pujara.
7. Design Engineering John Diwan McGraw Hill Ltd.,

B. E. (Mechanical) Part - I

EL-II- PLM (Product Life Cycle Management)

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Course objective:

1. Establishing industry partnerships that guide, support, and validate PLM research and education activities.
2. Assisting with the integration of PLM .
3. Serving as a knowledge base for the PLM discipline.

Course out comes:

1. Identify the need of PLM
2. Interpret the Product development process.
3. Creat and document the product data.
4. dicuss the advantage of software tools in plm.

UNIT-I **(08 hrs.)**

Introduction to PLM: Background, Overview, Need, Benefits, and Concept and definition of Product Life Cycle, Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement. Plm and ERP, change management in PLM. Legacy Data Transfer. Different software in PLM.

UNIT-II **(10 hrs.)**

Components of PLM: Different phases of product lifecycle and corresponding technologies, Product development processes and methodologies, Foundation technologies and standards (e.g. visualization, collaboration and enterprise application integration) Core functions (e.g., data vaults, document and content management, workflow and program management), Functional applications. (e.g., configuration management)

UNIT-III **(08 hrs.)**

PDM Technology(Product Data Management) : Introduction to PDM,PDM function and definition**,** Benefits and Terminology, CIM Data, Engineering data, engineering workflow and PDM acquisition and implementation, Resolving Data Issues, product data interchange, present market constraints, need for collaboration, Internet and developments in client server computing.

UNIT-IV **(06 hrs.)**

DBMS (Data Base Management system): Introduction to DBMS, Entity Relationship model ,SQL Concept, Distribution of DBMS, Object base data, XML (Extensible mark-up Language),HTML (Hypertext Markup language) Concepts of Client-Server Architecture (2-Tier, 4-Tier, n-Tier).

UNIT-V **(04 hrs.)**

Product Development Process: Concept of Design, Design details, validation and analysis. Realise-plan, manufacturing, build/assembly, Testing and service, Sell and delivery, use, maintainance , support, Disposal, Product structure, Bom,Types of Bom.

UNIT-VI **(04 hrs.)**

PLM Software Modules (Teamcenter):

My Teamcenter, Product Structure, Organization, Workflow manager, Access Manager, Command suppression ,authorization.

References:

1. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
2. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, SpringerVerlag, 2004. ISBN 1852338105
4. Kari Ulrich and Steven D. Eppinger, Product Design & Development, McGraw Hill International Edns, 1999
5. Silberschatz, Korth and Sudarshan, Database System Concepts, McGraw Hill, 2002
6. Burden Rodger, PDM: Product Data Management, Resource Pub, 2003. ISBN 0970035225

B. E. (Mechanical) Part - II
Automobile Engineering

Teaching Scheme	**Examination Scheme**		
Theory : 4 Hrs/Week	MSE	:	20 Marks
Practical: 2 Hrs/Week	(Theory) ESE	:	80 Marks
	CE	:	30 Marks
	(Practical) ESE	:	70 Marks

Course Objectives:

1. This course is designed to understand the basic concepts of Automobile and its components.
2. To understand the recent advances in the Automobile Technology.

Course Outcomes:

1. Students will be able to demonstrate and explain various automobile systems.
2. Students will be able to explain the importance of various important systems like differential, steering, Brakes, Suspensions etc.
3. Students will be able to explain principle of operation, construction and application of latest sensor Technology used in automobiles.

Unit I: **(08 hrs)**

Introduction: Classification of Automobiles, major components, different automobile layouts.

Automobile Power Plants: Requirements, constructional features of different power plants, IC engines, Fuel cells, Electric vehicles, Hybrid vehicles their advantages and limitations.

Automobile Body: Requirements of automobile body, types and materials for body work, safety considerations, Crash tests.

Aerodynamic drag: Aerodynamic lift and Pitching moments, Side force, Yawing & Rolling moments.

Unit II: **(06 hrs)**

IC Engine Parts & their functions: Cylinder Block, Cylinder Head, Cylinder Liners, Piston, Piston Rings, Gudgeon Pin, Connecting Rod, Crankshaft, Valve and Valve actuating mechanism, Vibration Dampers.

Fuel System for Carburetted engine, MPFI engine and Diesel engine.

Unit III: **(08 hrs)**

Clutches: Types of Clutches; their construction and working

Gear Box: Necessity of Gear box, types of Gear boxes, Gear selector mechanism, Torque converter, Troubleshooting and remedies.

Drive line & Rear axle: Propeller shaft, Final drive, Hotchkiss and Torque tube drive, Rear axles, types and construction, Differential and function of Differential.

Unit IV: **(08 hrs)**

Brakes: Requirements of Brakes, Classification of Brakes, Mechanical, Hydraulic, Pneumatic, Electro and Vacuum brakes, ABS.

Steering System: Function of Steering, Steering Mechanisms, Ackerman And Davis Steering Mechanism, Steering Geometry, Types Of Steering Gears Boxes, Steering Linkages, Understeer, Over Steer, Wheel Alignment, Power Steering,

Unit V: **(05 hrs)**

Suspension System: Function of Suspension, types of Suspension Springs, Shock absorbers, Conventional and Independent Suspension, Sprung and unsprung mass, Stabilizers, Air Suspension, Suspension Troubleshooting.

Wheels and Types: Types of Wheels, Tyre types, Desirable tyre properties, Comparison radial & Bias ply tyres, Tyre material, Factors affecting Tyre life.

Unit VI: **(08 hrs)**

Electrical System: Storage batteries Capacity rating, Charging and Testing,

Charging System: DC Dynamo, AC Dynamo, Combined regulators. Staring Motor drives, Lighting and Signaling circuits, Wiper motor, electric Horn, Air Conditioning.

Recent Advances in Automobiles: Electronic Control Unit (ECU), Power Train Control Module (PCM), Transmission Control Unit (TCU), Event Data Recorders (EDR), Cruise Control, Collision avoidance system, Adaptive lighting, Active Suspension, Electronic Brake force Distribution (EBD). Safety Air Bags, Electronic Power Steering.

List of Practical Exercises:

1. Dismantling and assembly of Automobile Engine.
2. Dismantling and assembly of Automobile Gear Box.
3. Dismantling and assembly of Automobile Steering Mechanism.
4. Dismantling and assembly of Automobile Brakes.
5. Dismantling and assembly of Automobile Differential
6. Demonstration of Battery Charging and starting system.
7. Visit to nearby Workshop/Service centre.

Term Work:

Term Work shall consist of reporting the above **Practical Exercises** in a Journal.

(Any Five)

Reference Books:

1. Automobile Engineering, VolI, & Vol II, Kirpal Singh, Standard. Publishing House.
2. Automobile Mechanics, Josheph Heitner, CBS Publishers and distributors.
3. Automobile Engineering, Vol I, II, PS Gill, Kataria & Sons
4. Automobile Engineering, Vol I & Vol II, R K Mohanty, Standard Book house.
5. Automotive Mechanics, William Crouse & Donald L Anglin, Tata McGrwa Hill.
6. Computerized Engine Control, Dick King, Delular Publisher.
7. Automotive Mechanics, S. Srinivasan, Tata McGraw, Hill.
8. Fundamentals of Automobile Engineering, K.K. Ramlinjgam, Scitech Publications (India) Pvt. Ltd.
9. Automobile Engineering, K.K. Jain & R.B. Asthana, Tata McGraw Hill.

   System Approach to Automobile Technology, Jack Enjavec , Cen

B.E. (Mechanical) Part – II
Production Planning & Control

Teaching Scheme	**Examination Scheme**		
Theory : 4 Hrs/Week	MSE	:	20 Marks
Practical: 2 Hrs/Week	(Theory) ESE	:	80 Marks
	CE	:	30 Marks
	(Practical) ESE	:	70 Marks

Course Objectives:

1. To introduce the students to the types of productions in the industries as well as they should be familiar with the functions of PPC used in the shop floor of the industry.
2. To introduce the students to the design and development of the product as well as importance of product characteristic for the design and development of product.
3. To familiarize the students with the batch production of the shop floor for optimization for the cost or profit .
4. To introduce the students by using the multi activity chart for calculation of machine cycle efficiency also familiarize with line balancing problems of shop floor.
5. To introduce with calculation of cost of the product as well as replacing the machine after its life time.
6 To introduce the students the necessity of maintaining the inventory.

Course Outcomes:

Upon successful completion of this course, the student will be able to.....

1. Illustrate the types of production and use of functions of PPC on the shop floor.
2. Illustrate the design and development of the product on the shop floor.
3. Illustrate the optimization technique used in batch production.
4. To calculate the idle time and machine cycle efficiency to improve the productivity.
5. To develop the balanced line of production with minimum idle time.
6. To understand how to maintain the inventory for shop floor.

Unit –I **(03 hrs)**

Introduction:- Definition and function of PPC, Production cycle, factors affecting the place of PPC in an organization viz; type of production, size of plant, type of industry, organization of PPC department.

Product development and Design: **(03 hrs)**

Company policy, product analysis considering marketing aspect, product characteristics, economic and production aspect, break even analysis should include step and slop changes in cost lines, multiple products etc.

Unit-II **(06 hrs)**

Demand forecasting: Introduction, methods of sales forecasting ,sources of forecasting, time series analysis, time series calculating methods viz; least square method with linear quadratic and exponential curve fitting, simple and moving average method, Exponential smoothing correlation, selection of forecasting method.

Unit-III **(08 hrs)**

Capacity planning and analysis: Life cycle analysis and capacity planning ,labor machine output, multi machine provision of operator machine interference, line balancing , analysis of production capacities in multi product system and profit maximization, assembly line balancing, largest candidate and ranked position weight method.

Unit-IV **(04 hrs)**

Plant location and layout: Introduction to plant location, factors affecting location and their evaluation. Introduction to layout flow system, types of layout , Products process statics and group technology. Layout symptoms of bad layout , layout analysis, introduction to computerized layout, draft corelap.

Elements of Cost: **(03 hrs)**

Direct cost, indirect costs, over heads , method of allocation of overheads, finding the total cost of the product including the cost deprecation, methods of deprecation.

Unit-V **(04 hrs)**

Quantities in Batch Production: Stock control methods of determining optimal batch size based on the following criteria.

0 Maximum cost per piece

0 Maximum profit for the batch.

0 Maximum profit to the cost ratio.

0 Maximum rate of return.

Inventory control: **(03 hrs)**

Purchasing, inventory concepts, inventory models considering certainty risk, discounts and shortage, inventory manufacturing.

Unit- VI **(04 hrs)**

Replacement Problems: Introduction, replacement of items that deteriorate with time, replacement of items whose maintenance cost increase with time and value of the money remain same during the period. Replacement of items whose maintenance cost increases with time and value of the money also changes with time. Recruitment and promotion problems.

Production Scheduling: **(02 hrs)**

Forms of schedule, basic scheduling problems , the assignment problems, effects of overtime or sub contracting .

Term Work:

It shall consist of any eight assignment out of the following.

1. Assignment on the one type of production for a particular product. (This assignment should include the study of function of PPC with respect to the corresponding product.)
2. Assignment of analysis of product from product development and design point of view considering at least marketing product and production aspects.
3. Assignment on break even analysis.
4. Assignment on lay out analysis.
5. Assignment of machine capacity and line balancing.
6. Assignment on assembly line balancing.
7. Assignment on order scheduling with random arrivals.
8. Assignment on inventory control.

Practical Examination

Oral based on above term work and syllabus.

References:

1. Production planning and control by Samuel Eilon.
2. Production planning and control by Jain and Agarwal.
3. Production planning and inventory control by Narasimhan, Mc Leavey and Billington.
4. Industrial engineering and product management by Martand Telang.
5. Production and operation management by S.N Chary
6. Production and operation management by Robert Russel, Bennard W.Taylor III.
7. Industrial Engineering and Manegment : O.P. Khanna
8. Management Today: Principals and practice by Gene Burton, Manab Thakur-McGraw Hill(1996)
9. Industrial Organization and management : Banga, Sharma.
10. Production systems by J.L.Riggs

B. E. (Mechanical) Part - II
Quality Engineering

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
Practical: 2 Hrs/Week	ESE : 80 Marks
	CE : 30 Marks
	Practical Exam : 70 Marks

Course Objectives: After learning the subject students will be able to:

(i) Identify job requirement.

(ii) Identify job responsibility.

(iii) Create work culture towards organizational excellence.

(iv) Develop and strengthen quality view point.

Course Outcomes: After studying the subject students will become experts in applying the various tools and able to operate the skill in taking sharp decisions in business.

Unit I: (05 hrs)

Introduction to Quality Engineering: Meaning and Importance of Engineering by function, measurement verses inspection, various definitions and dimensions of quality, spiral of progress in quality, cost of quality verses value of quality, Concept of quality and quality control, Relevance of quality to organizational excellence.

Unit II: (08 hrs)

Product Quality Control: Inspection; sampling and Acceptance sampling methods as single, double, multiple and sequential sampling plans. Recent development in inspection methods.

Unit III: (07 hrs)

Statistical Quality Control: Statistical concepts, importance of data analysis; frequency diagrams, concept of variance analysis, control charts for variables and attributes; confidence interval testing, statistical process control ($C_{p,}$ C_{pk} etc)

Unit IV: (06 hrs)

Quality Cost: Concept, quality cost categories, Product operating quality cost; optimum quality cost model. Interpretation and predictions of existence of quality cost. Concept of optimum cost of conformance and cost reduction programs.

Unit V: **(07 hrs)**

Philosophy behind Quality: Philosophy by Deming; Juran; Crosbey and Ishikawa. Various quality tools (7 new and 7 old), identify and selecting the specific tools for problem identification and/or problem solving.

Unit VI: **(07 hrs)**

Total Quality Management Perspective: Concept and use of QFD, Kaizan, Kan-bad, Poka-Yoke, 5S, JIT, TPM, Zero defect, Six Sigma, Quality Audit. (Introductory treatment in quality context)

Practical Exam: It shall consist of an oral based on above syllabus and term work.

Term work:

1. Collect and arrange data of any industrial component in order to study its behavior and determine x & sigma of the same.
2. Determine the process capability &process capability index of a machine.
3. Plot any two of the charts given below by taking real time case & interpret the behavior of the chart.
    a. x & R chart
    b. x & sigma chart
    c. p chart
    d. np chart
    e. c chart
    f. u chart
4. Study of Quality Cost (Collect & arrange the data of any Industry).
5. Preparation of QFD by taking any one Domestic Product.
6. By taking suitable situation, application of any two of the following:
    a. Kaizan
    b. Kanban
    c. Poka-Yoke
    d. 5S
    e. Zero defect
    f. Quality Audit

References:

1. Quality Plg. & Analysis by J.M. Juran, Frank M. Gryns.
2. Quality Control by E.L. Grant Legvenwoorth, T.T. McGraw.
3. Quality Control & TQM by Jain Tata Ma.
4. Quality Control by Besterhel Pre hall news.
5. Fundamentals of Quality Control and Improvement: Amitava Mitra, Prentice Hall

B E. (Mechanical) Part - I

EL-II-Computation Fluid Dynamics

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Course Objectives:

1. Equip students with the knowledge base essential for application of computational fluid dynamics to engineering flow problems.
2. Provide the essential numerical background for solving the partial differential Equations governing the fluid flow

Course Outcomes: On successful completion of the course, students will be able to:

1. Understand both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution.
2. Learn how to formulate and solve computational problems arising in the flow of fluids.

Unit -I **(09 hrs)**

Introduction: Insight into power and philosophy of CFD. CFD ideas to understand. CFD application. Need for parallel computers for CFD algorithms. Models of flows. Substantial derivative, Divergence of velocity.

Governing Equations: Continuity, Momentum and Energy equations; derivation in various forms. Integral versus Differential form of equations. Comments on governing equations. Physical boundary conditions. Forms of the governing equations particularly suited for CFD work: Shock fitting and Shock capturing methods. Generic form of equations.

Unit II **(04 hrs)**

Mathematical Behavior of Partial Differential Equations:

Classification of partial differential equations. Cramer rule and Eigen value method. Hyperbolic, parabolic and elliptic forms of equations. Impact on physical and computational fluid dynamics; case studies: steady in viscid supersonic flow; unsteady in viscid flow; steady boundary layer flow; and unsteady thermal conduction.

Unit- III **(07 hrs)**

Discretization: Essence of discretization. Taylor series approach for the construction of finite difference quotients. Higher order difference quotients. Up-wind differencing. Midpoint leap frog method. Reflection boundary condition.Difference equations. Explicit and Implicit approach: definition and contrasts. Errors and analysis of stability. Error propagation. Stability properties of Explicit and Implicit methods.

Unit-IV **(05 hrs)**

Grid Generation: Body–fitted coordinate system. Need for grid generation. Essential properties of grids. Types of grids (O-type, C-type and H- type). Various grid generation techniques- Algebraic, and Numerical grid generation. Elliptic grid generation. Structured, Un-structured grids, Adaptive grids, Grid collapse. Multi-Grid methods.Grid accuracies.

Unit -V **(05 hrs)**

Appropriate Transformation: General transformation of equations. Metrics and Jacobians. Generic form of the governing flow equations with strong conservative form in the transformed space. Transformation of continuity equation from physical plane into computational plane; application of Grids stretching .

Unit- VI **(10 hrs)**

Finite Volume Techniques: Finite Volume Discretization - Cell Centered Formulation. High resolution finite volume upwind Scheme. Runge-Kutta Time Stepping . Multi - Time –Step Integration scheme. Cell Vertex Formulation. Numerical dispersion.

CFD Application to Some Problems : Time and space marching. LAX-WENDROFF Technique .Relaxation technique. Point iterative mehod. Successive over-relaxation/under relaxation. Aspects of numerical dissipation and dispersion; artificial viscosity. The Alternating Direction-(ADI) Implicit Technique. Approximate factorization scheme. Upwind schemes; Flux vector splitting.

Text Books:

1. John D Anderson Jr. Computational Fluid Dynamics,'The Basics with Applications', McGraw Hill International Edn; 1995 .

2. Tapan K. Sengupta, 'Fundamentals of Computational Fluid Dynamics', Universities Press
(India) Private Limited; 2005.

References:

1. F. Wendt (Editor), "Computational Fluid Dynamics -An Introduction", Springer – Verlag,
Berlin; 1992.

2. Charles Hirsch, "Numerical Computation of Internal and External Flows", Vols. I and II.
John Wiley & Sons, New York; 1988.

3. JiyuanTu, Guan HengYeoh, and Chaoqun Liu,' Computational Fluid Dynamics- A Practical
Approach', Elsevier Inc; 2008.

4. Suhas V. Patankar, 'Numerical heat transfer and fluid flow' Butter-worth Publishers

5. Niyogi, 'Computational Fluid Flow and Heat Transfer'- Pearson Publications

B. E. (Mechanical) Part - II

EL-III-Cryogenic Engineering

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Course Objectives

1. Learn about low temperature applications in engineering
2. Learn to the technology of gas liquefaction, separation and purification.
3. Study of measurement system at low temperature.
4. Learn to stored Cryogenic fluids.

Course Outcomes:

1. Ability to understand various gas liquefaction, gas separation and purification systems.
2. Ability to evaluate the performance of different Cryogenic systems
3. Apply to analyze low temperature systems for various applications.

Unit I: **(06 hrs)**

Introduction : Historical background, present areas involving Cryogenic Engineering,

Low Temperature properties of Engineering materials: Mechanical properties, Thermal properties, Electric and Magnetic properties, properties of Cryogenic fluids.

Unit II: **(08 hrs)**

Gas Liquefaction: Introduction, Joule-Thomson effect, Adiabatic expansion, simple Linde-Hampson system, Precooled Linde-Hampson system, Linde dual pressure system, Cascade system, Claude system, Liquefaction system for LPG.

Unit III: **(08 hrs)**

Separation and Purification Systems: Thermodynamically ideal separation system, principle of gas separation, Hydrogen separation system, Helium separation systems, Gas Purification methods.

Unit IV: **(06 hrs)**

Cryogenic Refrigeration Systems: Ideal refrigeration systems, Refrigerators for temperature above 2K, Refrigerators for temperature below 2K.

Unit V: **(06 hrs)**

Measurement Systems: Temperature, Flow rate, Liquid level measurement.

Unit VI: **(06 hrs)**

Cryogenic Fluid Storage: Fluid storage vessels, insulations, Vacuum technology in Cryogenic.

Reference Books:

1. Cryogenic Systems, Randall F. Barron, McGraw Hill.
2. Cryogenic Process Engineering, Klaus D. Timmerhouse and Thomas M. Flynn plenum Press, New York.
3. Scott R.B.,Cryogenic Engineering, Van Norstand and Co.

B. E. (Mechanical) Part - II
EL-III-Automation & Robotics

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Objectives

1. To familiarize the students with the significance of Automation & Robotic system in agile and automated manufacturing processes.

2. To prepare the students to be conversant with robotic elements/ peripherals, their selection and interface with manufacturing equipments.

3. To familiarize the students with the basics of robot kinematics.

Outcomes: Learner will be able to.

1. Acquire the skills in understanding Automation in Industry & Robot programming Language.
2. Acquire the skill in robot task planning for problem solving.
3. Develop skills in understanding various sensors, robot peripherals and their use.
4. Develop skills in identifying areas in manufacturing, where robotics can be deployed for enhancing productivity.

Unit-I **(06 hrs)**

Introduction of Automation: Automated manufacturing systems, fixed /programmable /flexible automation, Need of automation, Basic elements of automated systems- power, program and control. Advanced automation functions, Levels of automation; Industrial control systems in process and discrete manufacturing industries, Continuous and discrete control; Low cost automation, Economic and social aspects of automation.

Unit-II **(06 hrs)**

Assembly Automation: Types and configurations, Parts delivery at workstations- Various vibratory and non-vibratory devices for feeding and orientation, Product design for automated assembly.

Unit-III **(06 hrs)**

Introduction of Robotics: Definition & History of robots, Automation and Robotics, Robot-Anatomy, Robot classification – Drive technologies, Work –Envelope Geometries, Motion control methods, Robot specifications – Payload, Reach, Precision, Accuracy and Repeatability.

Unit –IV **(08 hrs)**

Robot Kinematics: Matrix representations of coordinate transformation, Transformation about reference frame and moving frame, Forward & Inverse Kinematics. Examples of 2R, 3R & 3P manipulators, RPY and Euler's angle. Homogeneous coordinate transformation and examples, D-H representation of kinematics linkages. Forward and Inverse kinematics of various manipulators using D-H representations.

Unit-V **(06 hrs)**

Robot End Effectors and Vision System:

End Effectors: – Types of end effectors, mechanical, vacuum, magnetic, adhesive grippers, tools as end effectors, Gripper force analysis and design.

Sensors: - Need of sensors in a robotic system, Robotic sensors – Types of sensors based on working principle, desirable features of sensors, various sensing devices used in robot work cells, sensor characteristics, selection of sensors, photo-sensors, limit switches. Range sensors, proximity sensors, touch / sensors, Remote Center Compliance (RCC) device.

Vision Systems: - Need of vision in a robotic system, Image acquisition, Illumination Techniques, Image conversion, Cameras, sensors, Camera and system interface, Frame buffers and Grabbers.

Unit-VI **(08 hrs)**

Robot Programming Languages: Lead through method, Robot program as a path in space, Methods of defining positions in space, Motion interpolation, branching; Textual robot programming languages-VAL II.

Industrial Applications: General considerations in Robot applications, Material transfer, Machine loading, Welding, Spray painting, Assembly, Inspection.

References:

1. S.R.Deb- ‘Robotics Technology and Flexible Automation- Tata McGraw Hill

M.P.Groover, M. Weiss R.N. - ‘Industrial Robotics’ - McGraw Hill

2. K.S.Fu, R.C.Gonzalez and C.S.G.Lee- ‘Robotics: Control , sensors , vision and intelligence- McGraw-Hill.

3. J.J.Craig- ‘Introduction to Robotics ‘- Pierson Publications

4. Klafter , Richard D., et al- ‘Robotics Engineering’ - Prentice Hall of India Pvt. Ltd.

5. Robert J. Schilling - ‘Fundamentals of Robotics Analysis and control- Prentice Hall of India

6. R K Mittal and I J Nagrath- ‘Robotics and Control’ - Tata McGraw Hill

7. Saeed B Niku- ‘Fundamentals of Robotics Analysis and control’ - Prentice Hall of India Pvt. Ltd

8. Groover, M.P., “Automation, Production Systems & Computer Integrated Manufacturing” (Pearson Edu.)

9. Groover, M.P.; Weiss, M.; Nagel, R.N. & Odrey, N.G. “Industrial Robotics, Technology,

10. Programming & Applications”, McGraw Hill Intl.

11. Keramas, James G. “ Robot Technology Fundamentals”, Thomson Learning

12. Noff, Shimon Y. “Handbook of Robotics”, John Wiley & Sons

13. Niku, Saeed B. “Introduction to Robotics, Analysis, Systems & Applications”,Prentice

Hall of India

14. Koren, Yoram “Robotics for Engineers”, McGraw Hill

15. Edwin Wise - ‘Applied Robotics Volume I & II ,- Cengage Learning.

B. E. (Mechanical) Part - II
EL-III-Modern Management Techniques

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Objectives

1. To familiarize the students with the significance of Modern Management Techniques in Manufacturing,

2. To prepare the students to be aware about Kaizen, Just in Time, SMED Poka-Yoke in manufacturing systems.

Outcomes: Learner will be able to.

1. Acquire the skills in understanding Modern Management Techniques in Manufacturing,
2. Acquire the skill in FMS & Group Technology and SMED.

Unit-I **(06 hrs)**

Creativity: Definition, barriers of creativity, lateral thinking, Definition, scope, mechanism of mind, Techniques for lateral thinking, six thinking hats, practical thinking techniques, mathematical techniques.

Unit-II **(08 hrs)**

Kaizen: Continuous method improvement , Kaizen concept, Kaizen Umbrella for quality improvement, Kaizen and Management, implications of QC for Kaizen, Kaizen and TQC, Kaizen and suggestion systems, Kaizen and Competition, Process oriented management versus result oriented management, Kaizen and innovation, Kaizen and measurement, PDCA cycle, Kaizen the practice, Kaizen management.

Unit-III **(06 hrs)**

Just in Time: Concept, scope, objectives, push and pull system, reduced inventories and improved setup times, source of profit in the manufacturing process, TOYOTA production system, basic assumptions behind the TOYOTA production system, leveling, smoothening out the production system, JIT and automation, workplace control through the Kaizen system. Concept of flexible manufacturing and group technology, customization of manufacturing.

Unit –IV **(08 hrs)**

Single Minute Exchange of Dies: Aspects of setup activities, internal and external setup, fundamentals of SMED, setup improvement conceptual stages, Techniques for streamlining the aspects of setup, effects of SMED, one touch exchange of dies (OTED).

Unit-V **(08 Hrs)**

POKA-YOKE Systems: Basic concepts, approaching to zero quality control, methods successive and self checks, Cycle for manufacturing errors and defects, checks based on sensory inspections, source of inspections and its significance.

Inspection and automation: Classification on Poka-Yoke systems, control types, warning type, contact method, fixed value method, detection measures for Poka-Yoke system, Poka-Yoke system implementation and limitations, examples of Poka-Yoke system.

Unit-VI **(06 hrs)**

LPG & Indian Industry: Concept, its requirement for Indian industry, need of fastening LPG, evaluation of LPG in context of new industrial policy 1991, relevance of MMT for LPG.

References:

1. JIT-David Hukhins
2. SMED-Hingo-Shingo-Shingora, Daudri, Tokyo.
3. Kaizen-Massaki Imai.
4. Industrial Economy of India.-Kuchal S.G.
5. Poka-Yoke- Hiroyuthi Hirame - Productivity press. Cambirdge.
6. Anon, 1987 Quick Changeover Training Module, Achieving quick Productivity Inc. Connceticut

B.E. (Mechanical) Part-II

EL-III – Entrepreneurship Development

Teaching Scheme	**Examination Scheme**
Theory : 4 Hrs/Week	MSE : 20 Marks
	ESE : 80 Marks

Course Objective:

To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

Course outcomes: Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

UNIT-I **(09 hrs)**

Entrepreneurship- Definition; Growth of small scale industries in developing countries and their positions large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries Government policy for small scale industry; stages in starting a small scale industry,Human traits ,Heslay's need Hiararchy, requirements to be an entrepreneur, SWOT Analysis..

UNIT-II **(07 hrs)**

Projects: Identification and Selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method. Risk Analysis.

UNIT-III **(04 hrs)**

Market Assessment and Product feasibility

Marketing -Concept and Importance Market Identification,

Customer needs assessment, Market Survey Product feasibility analysis.

UNIT-IV **(08 hrs)**

Business Finance & Accounts

Business Finance: Costing basics, Sources of Finance, Break Even Analysis,

Business Accounts: Preparation of balance sheets and assessment of economic viability, decision, making, expected costs, marketingpractices , Book Keeping**,** Financial Statements, Financial Ratios and its importance, Concept of Audit.

UNIT-V **(06 hrs)**

Project Planning and control:

The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures. Profit planning and programming, planning cash flow, capital expenditure and operations. Control of financial flows, control and communication.

UNIT-VI **(06 hrs)**

Institutional Support and Policies: institutional support towards the development of entrepreneurship in India, technical consultancy organizations: Concept and process,resent government policies for small scale enterprises.

Reference Book:

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi

2. Saini, J. S., 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.

3. Khanka, S. S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi

4. Badhai, B 'Entrepreneurship for Engineers', DhanpatRai& co. (p) Ltd.

5. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.

6. Gupta and Srinivasan, 'Entrepreneurial Development', S. Chand & Sons, New Delhi.