

SU/BOS/Sci & Tech/470

Date : 26/06/2023

To,

1) The Director,
Departments of Technology,
Shivaji University, Kolhapur

2) The Principal/ Director,
All affiliated Engineering Colleges/ Institute,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **Ph. D. Coursework** under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabus of **Ph. D. Coursework** under the Faculty of Science and Technology.

1.	Civil Engineering & Technology
2.	Mechanical Engineering & Technology
3.	Electrical Engineering & Technology
4.	Electronics Engineering & Technology
5.	Electronics and Telecommunication Engineering & Technology
6.	Textile Engineering & Technology
7.	Computer Science Engineering & Technology
8.	Environmental Engineering & Technology
9.	Pharmacy

This syllabus will be implemented from the academic year 2023-24 i.e. from June 2023 onwards.

You are therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,


Dr. S. M. Kubal
Dy. Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	Computer Centre (IT)
2	The Chairman, Respective Board of Studies	8	Affiliation Section (T.1)
3	Director, Examination and Evaluation	9	Affiliation Section (T.2)
4	Eligibility Section	10	P.G.Admission Section
5	O.E. – 4	11	P.G Seminar Section
6	Appointment Section	12	Meeting Section

**STRUCTURE AND SYLLABUS FOR Ph.D. COURSE WORK
(MECHANICAL ENGINEERING)
June 2023**

Sr. No./ Paper No.	Name of Course	Teaching Scheme				Examination Scheme			
		Theory (Total Hrs)	Seminar (Total Hrs)	Library Work	Credits	Theory Marks	Internal Marks	Total Marks	Minimum Passing (40%)
01	Research Methodology	40	10	10	04	80	20	100	40
02	Recent Trends in Mechanical Engineering	40	10	10	04	80	20	100	40
03	Optional/ Elective (Based on Specialization)	40	10	10	04	80	20	100	40
	Total	120	30	30	12	240	60	300	

Assessment Guidelines:-

A) Theory Examination: is to be conducted by the university with duration of 3 hours per paper.

B) Internal Examination is to be conducted by the concerned departments or research centres in the following form:

1. For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each

2. for paper – 3 the internal evaluation will be as follows:

a) Seminars (Submission and Presentation)- 10 marks

b) Review s Literature: Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation
32+8=40)

Paper 3: Optional/ Elective (Based on Specialization)

(Select any one subject/course out of the following)

- **Specialization (Mechanical -DESIGN ENGINEERING)**

1. Advanced Theory of Vibrations
2. Mathematical Modeling and Optimization
3. Analysis and Synthesis of Mechanisms
4. Advanced Finite Element Analysis
5. Noise and Vibration Harshness
6. Optimization Techniques
7. Mechatronics System Design
8. MEMS and Nano technology
9. Product Design and Development
10. Advanced Tribology
11. Experimental Design

- **Specialization (Mechanical -HEAT POWER / THERMAL ENGINEERING)**

12. Advanced Thermodynamics
13. Advanced Heat Transfer
14. Advanced Fluid Dynamics
15. Energy Analysis of Thermal Systems
16. Advanced Refrigeration and Air Conditioning
17. Advanced IC Engines
18. Cryogenic Engineering
19. Alternative Fuels for Ic Engines
20. Design of Heat Transfer Equipment's
21. Modeling and Analysis in Thermal Engineering

- **Specialization (Mechanical -PRODUCTION ENGINEERING)**

- 22. Supply chain management & Logistics
- 23. Decision Making in Manufacturing Environment
- 24. Metal Forming Technology
- 25. Advanced casting technology
- 26. Manufacturing Systems
- 27. Precision Engineering
- 28. Advanced Materials & Processing
- 29. Modern manufacturing systems
- 30. Low Cost Automation
- 31. World Class Manufacturing

- **Specialization (Mechanical -CAD/ CAM/CAE)**

- 32. Advances In Computer Aided Manufacturing And Reverse Engineering
- 33. Advances In Manufacturing Low Cost Automation And Robotics
- 34. Advances In Material Processing And Work System Design
- 35. Advances In Computer Aided Process Planning And Graphics
- 36. Advances In Computer Aided Planning
- 37. Advances In Additive Manufacturing
- 38. Advances In Green Manufacturing
- 39. Advances In Automation In Manufacturing
- 40. Advances In Computer Aided Process Planning

Specialization (Mechanical -DESIGN ENGINEERING)

1. Advanced Theory of Vibrations

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

1 Fundamentals of Vibration

Review of Single and Two degree freedom systems subjected to Forced and Motion Excitation. Response to arbitrary periodic and a periodic excitations Impulse response - Transient vibration - Laplace transformation formulation. Fourier transforms- definition, Relation to transfer functions, first order systems, applications. Basic Concepts like Passive, Semi active and Active Parameters.

2 Two Degree Freedom System

Optimum design of single, two degree of freedom systems, Vibration Absorber and Vibration isolators.

Unit II:

1 Multi Degree Freedom System

Normal mode of vibration - Flexibility matrix and stiffness matrix- Eigen value and Eigen vector – Orthogonal properties - Modal matrix - Modal analysis – Forced vibration by matrix inversion - Modal damping in forced vibration - Numerical methods of determining natural frequencies.

2 Vibration of Continuous Systems

Systems governed by wave equations - Vibration of strings -Vibration of rods - Euler's equation for beams - Effect of rotary inertia and shear deformation -Vibration of plates.

Unit III

Experimental Methods in Vibration Analysis: Vibration instruments - vibration exciters
Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Collection of FRF, experimental modal analysis methods, Examples of vibration tests - Industrial case studies.

Analytical Dynamic Analysis: Dynamic analysis - Equation of motions - Mass matrices – Free vibration analysis - Natural frequencies of Longitudinal - Transverse and torsional vibration - Introduction to transient field problem.

Validation of Analytical Models: Preliminary check, correlation of analytical model with experimental model, model updating- fundamentals.

Unit IV

Non-Linear Vibrations: Introduction, Sources of nonlinearity, Qualitative analysis of nonlinear systems. Phase plane, Conservative systems, Stability of equilibrium, Limit cycles-van der polo scillator, Perturbation method, Chaos, Method of iteration, Self-excited oscillations, Lind stedt's Method.

Random Vibrations: Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms, FTs and response.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Rao, J.S. & Gupta K., "Ind. Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., 1984.
2. Thomson, W.T., "Theory of Vibration with Applications" CBS Publishers and Distributors, New Delhi ,1990
3. Den Hartog, J.P., "Mechanical Vibrations", Dover Publications, 1990.
4. Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman, 1995.
5. D.J. Ewins, Modal Testing: Theory and Practice, Research Press Ltd, Letch worth (Herefordshire,England) (1984).
6. M.I. Friswell, J.E. Mottershead, Finite Element Model Updating in Structural Dynamics (Solid Mechanics & Its Applications.) Kluwer Academic Publishers (1995)
7. Mechanical Vibrations - S. Graham Kelly, Schaum's Outlines, Tata McGraw Hill, 2007.
Elements of Vibration Analysis, Lenord Meirovitch, McGraw Hill Ltd, 2004
8. Vibration: Fundamental and Practice, Clarence W. de Silva, CRC Press LLC, 2000.
9. Fundamentals of Mechanical Vibration. - S. Graham Kelly. 2 nd edition McGraw Hill.

2. Mathematical Modelling and Optimization

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Research Modelling: The Reality, the experiment and the model, Concept of modelling, Models as Approximations, Types of Modelling, Need and Classification of mathematical modelling, Use of Analogy, Data consideration and Testing of Models, Modelling of dynamic systems with differential equations

Unit II

Simulation: Simulation of data in the form of mathematical equations, Linear-Non-linear equations, determining the Unknowns of Equations using Least Square Criterion, Process of Simulation, Steps and Features of Simulation Experiments and their Validation.

Unit III

a. Classical Optimization Techniques: Single-variable and Multi-variable Optimization, Hessian Matrix, Saddle Point, Lagrange Multipliers Method and Kuhn-Tucker Conditions.

b. Single-variable Optimization Techniques: Linear and Non-Linear behavior, Unrestricted Search, Solution using Graphical Method and Numerical Methods, Interval-halving Method, Golden section Method, Newton Method, Secant Method c. Multi-variable Optimization Techniques:, Non-linear Equations, Steepest Descent Method, Conjugate Gradient Method, Davidson- Fletcher-Powell Method

Unit IV

Taguchi Method: Introduction, Loss Function and Signal –to-noise ratios, Control Factors and Noise Factors, Orthogonal Design, Design of Experiments, steps in carrying out experiment, analysis of variances etc. Term Work: Term paper based on literature survey on any advance topic in this subject.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Wilkinson K.P.L. Bhandarkar, Formulation of Hypothesis, Himalaya Publishing House
2. Ranjit Kumar, (2006), Research Methodology – A Step-By-Step Guide for Beginners, (Pearson Education, Delhi) ISBN : 81-317-0496-3
3. C.R. Kothari, "Research Methodology", Wiley Eastern Publication.
4. Dr S.S. Rao, "Optimization Theory and Applications", Wiley Eastern Ltd., New Age International, New Delhi, 2nd Edition, 1994.
5. Adler and Granovsky, "Optimization of Engineering Experiments", Meer Publications

3. Analysis and Synthesis of Mechanisms

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Basic Concepts

Definitions and assumptions, planar and spatial mechanisms, kinematic pairs, degree of freedom

Kinematic Analysis of Complex Mechanisms

Velocity-acceleration analysis of complex mechanisms by the normal acceleration and auxiliary point methods.

Unit II

Dynamic Analysis of Planar Mechanisms: - Inertia forces in linkages, kinetostatic Analysis of mechanisms by matrix method. Analysis of elastic mechanisms, beam element, displacement fields for beam element, element mass and stiffness matrices, system matrices, elastic linkage model, equations of motion.

Curvature theory: Fixed and moving centroids, inflection circle, Euler- Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell Mechanisms

Unit III

Graphical Synthesis of Planar Mechanisms: Type, number and dimensional synthesis, function generation, path generation and rigid body guidance problems, accuracy (precision) points, Chebyshev Spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre point and circle point curves, Burmester points, Synthesis for five accuracy points, Branch and order defects, Synthesis for path generation.

Unit IV

Analytical synthesis of Planar Mechanisms:- Analytical synthesis of four-bar and slider- crank mechanism, Freudenstein's equation, synthesis for four accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers. Complex numbers method of synthesis, the dyad, center point and circle point circles, ground pivot specifications, three accuracy point synthesis using dyad Method, Robert Chebychev theorem, Cognates

Kinematic Analysis of Spatial Mechanisms : Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Theory of Machines and Mechanisms, A. Ghosh and A.K.Mallik, Affiliated East-West Press.
2. Kinematic Synthesis of Linkages, R. S. Hartenberg and J. Denavit, McGraw-Hill.
3. Mechanism Design - Analysis and Synthesis (Vol.1 and 2), A. G. Erdman and G. N. Sandor, Prentice Hall of India.
4. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, 2nd Ed., McGraw-Hill.
5. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L. Norton, Tata McGraw-Hill, 3rd Edition.
6. Kinematics and Linkage Design, A.S.Hall, Prentice Hall of India.

4. Advanced Finite Element Analysis

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

1. Introduction to Finite Element Method:

Engineering Analysis, History, Advantages, Classification, Basic steps, Convergence criteria, Role of finite element analysis in computer-aided design., Mathematical Preliminaries, Differential equations formulations, Variational formulations, weighted residual methods.

2. One-Dimensional Elements-Analysis of Bars and Trusses:

Basic Equations and Potential Energy Functional, 1-D Bar Element, trusses, Admissible displacement function, Strain matrix, Stress recovery, Element equations, Stiffness matrix, Consistent nodal force vector: Body force, Initial strain, Assembly Procedure, Boundary and Constraint Conditions, Single point constraint, Multi-point constraint, 2-D Bar Element, Shape Functions for Higher Order Elements.

Unit II

3. Two-Dimensional Elements-Analysis of Plane Elasticity Problems:

Three-Noded Triangular Element (TRIA 3), Four-Noded Quadrilateral Element (QUAD Shape functions for Higher Order Elements (TRIA 6, QUAD 8).

4. Axi-symmetric Solid Elements:

Analysis of Bodies of Revolution under axi-symmetric loading: Axisymmetric Triangular and Quadrilateral Ring Elements. Shape functions for Higher Order Elements.

5. Three-Dimensional Elements:

Applications to Solid Mechanics Problems: Basic Equations and Potential Energy Functional, Four-Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8), Tetrahedral elements, Hexahedral elements: Serendipity family, Hexahedral elements: Lagrange family. Shape functions for Higher Order Elements

Unit III

6. Beam Elements:

Analysis of Beams and Frames: 1-D Beam Element, 2-D Beam Element, Problems, plate bending and shell elements.

7. Heat Transfer and Fluid Flow:

Steady state heat transfer, 1 D heat conduction governing equation, boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1 D heat transfer in thin fins. Basic differential equation for fluid flow in pipes, around solid bodies, porous media. [09 Hrs]

Unit IV

8. Dynamic Considerations:

Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix, Evaluation of Eigen values and Eigen vectors, Applications to bars, stepped bars, and beams. Introduction to FE Software Packages, Algorithmic approach for developing the code by the individuals

9. Non-linear Analysis

Sources and types of non-linearity, Incremental approach to solution of nonlinear problems, Iterative solution methodologies, Considerations for simulation of non-linear problems

Term Work :

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books :

1. Rao S. S. "Finite Elements Method in Engineering"- 4th Edition, Elsevier, 2006
2. Frank L. Stasa," Applied finite Element Analysis for Engineers", CBS International Edition, 1985.
3. J.N.Reddy, "Finite Element Method"- McGraw -Hill International Edition.
4. Bathe K. J. Finite Elements Procedures, PHI. Cook R. D., et al. "Concepts and Application of FinitenElements Analysis"- 4th Edition, Wiley & Sons, 2003.
5. Chandrupatla T. R., "Finite Elements in engineering"- 2nd Editions, PHI, 2007.2.
6. Zeinkovich, "The Finite Element Method for Solid and Structural Mechanics, 6th Ed., Elsevier 2007.

5. Noise Vibration and Harshness

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

1. Introduction to NVH:

Sources of noise and vibration. Design features, Common problems, Marke values, Noise quality. Pass by Noise requirements. Target vehicles and objective targets. Development stages in a new vehicle programme and the altering role of NVH engineers.

2. Sound and vibration theory:

Sound measurement, Human sensitivity and weighting factors. Combining sound sources. Acoustical resonances. Properties of acoustic materials. Transient and steady state response of one degree of freedom system applied to vehicle systems. Transmissibility, Modes of vibration

Unit II

3. Test facilities and instrumentation:

Laboratory simulation: rolling roads (dynamometers), road simulators, semi-anechoic rooms, wind tunnels, etc. transducers, signal conditioning and recording systems. Binaural head recordings, sound intensity technique, Acoustic holography, statistical Energy Analysis

Unit III

4. Signal Processing:

Sampling, aliasing and resolution. Statistical analysis. Frequency analysis. Campbell's plots, cascade diagrams, coherence and correlation functions

Unit IV

5. NVH control Strategies & comfort:

Source ranking. Noise path analysis. Modal analysis. Design of Experiments, optimization of dynamic characteristics. Vibration absorbers and Helmholtz resonators. Active control techniques.

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Norton M. P., Fundamental of Noise and vibration, Cambridge University Press, 1989
2. Munjal M. L., Acoustic Ducts and Mufflers, John Wiley, 1987
3. Baxa, Noise Control of Internal Combustion Engine, John Wiley, 1984
4. Ewins D. J., Model Testing: theory and practice, John Wiley, 1995
5. Boris and Kornev, Dynamic Vibration Absorbers, John Wiley, 1993
6. McConnell K, "Vibration testing, Theory and practice", John Wiley, 1995.
7. Wong J Y, "Theory of Ground Vehicles", John Wiley & Sons, New York, 1978.

6. Optimization Techniques

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

A. Linear models

1. Linear programming-extensions: Revised simplex method, Dual Simplex method, Bounded variables method, primal-dual relationships, duality theorems, economic interpretation of dual, dual of transportation model, sensitivity analysis in LPP and transportation models, Karmarkar's interior point algorithm
2. Dynamic programming: formulation, recursive approach, Goal programming: formulation, graphical solution,

Unit II

3. Integer programming: Formulation, Cutting plane algorithm, Branch and bound algorithm
nonlinear models:
4. Classical Optimization: Single and Multi-variable Optimization, Hessian Matrix, Saddle Point, Lagrange Multipliers, Kuhn-Tucker Conditions

Unit III

5. Single-variable Optimization: Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval-halving Method, Fibonacci Method, Golden section Method, Quadratic Interpolation Method, Newton Method, Quasi- Newton Method, Secant Method
6. Multi-variable Optimization: Evolutionary Optimization Method, Simplex Search Method, Pattern Search Method

Unit IV

7. Conjugate Direction Method, Steepest Descent Method, Newton's Method, Conjugate Gradient Method, Davidon-Fletcher-Powell Method

8. Introduction to Constrained Optimization: Interior Penalty Function Method, Exterior Penalty function Method

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Introduction to Operations Research, Hillier and Lieberman, Tata McGraw Hill
2. Quantitative techniques in Management by N D Vohra, McGraw Hill
3. Deb K (2004). Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India.
4. Rao S (1996). Engineering optimization, Theory and Practice, New Age International Publishers
5. Ravindran A, Ragsdell K and Reklaitis G (2006). Engineering Optimization: Methods and Applications, 2nd edition, John Wiley and Sons Inc.

7. Mechatronics System Design

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

1. Introduction

Introduction to mechatronic system, evolution, scope and components of mechatronic systems, mechatronics in product and measurement system, control system and modes of control, traditional design and mechatronic design

2. Actuators, Sensors and Transducers

Hydraulic, pneumatic and electrical actuators and their system modeling, performance terminology, system modeling of sensors; displacement, position and proximity sensors, velocity and acceleration sensors, flow sensors, force sensors, temperature sensors, ultrasonic and fibre-optic sensors, selection of sensor, piezo-electric sensors.

Unit II

3. Hardware Components:

Number systems in Mechatronics, binary logic, Karnaugh map minimization, transducer signal conditioning process, principals of analogue and digital signal conditioning, protection, filtering, operational and instrumentation amplifiers and their gains, analogue to digital and digital to analogue conversion, multiplexers, pulse modulation.

4. Programmable Logic Controller

Review of logic gates, basic structure, features, input/output processing, programming, functional block diagram (FBD), ladder diagram, logic functions, latching, sequencing, jumps, internal relays, counters, shift registers, master and jump control, data handling, data movement, data comparison, arithmetic operations, code conversion, analog input and output, applications for automation, diagnostics and condition monitoring.

Unit III

5. Microcontroller: Comparison between microprocessor and microcontroller, organization of microcontroller system, architecture of MCS 51 controller, pin diagram of 8051, addressing modes, programming of 8051, interfacing input and output devices, interfacing D/A converters and A/D converters, Various applications for automation and control purpose.

6. Real-Time Interfacing: Introduction, Elements of Data Acquisition and Control System, Overview of I/O Process, Installation of the I/O Card and Software, Installation of the application Software, Examples, Over framing.

Unit IV

Advanced Applications in Mechatronics

Mechatronic control in automated manufacturing, Artificial Intelligence in mechatronics, Fuzzy Logic application in Mechatronics, Micro sensors in Mechatronics, Case studies of Mechatronic systems.

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Mechatronics, 3/e --- W. Bolton (Pearson Education)
2. Mechatronics -Dan Neacsulescu (Pearson Education)
3. The 8051 Microcontroller: Architecture, Programming and Applications, 2/e—Kenneth J. Ayala (Penram International)
4. Mechatronics: Principles, Concepts and Applications - N.P.Mahalik (TMH)
5. Introduction to Mechatronics & Measurement Systems – David G. Alciatore & Michael B. Histanal (TMH)
6. Process Control & Instrumentation Technology –Crisis D. Johnson (Pearson Education)
7. Mechatronics System Design - Devdas Shetty, Richard A. Kolk (CENGAGE)
8. Computer Control of Manufacturing Systems - Yoram Koren (McGraw Hill)

9. Automated Manufacturing Systems: Sensors, Actuators - S. Brain Morriss (McGraw Hill)
10. Industrial Automation – David W. Pessen (John Wiley & Sons)
11. Examples of Pneumatic Applications – FESTO Controls Pvt. Ltd. Bangalore.
12. Modular Pick and Place Device– FESTO Controls Pvt. Ltd. Bangalore.
13. Rationalization with Handling Technology– FESTO Controls Pvt. Ltd. Bangalore.
14. Rationalization with Small Workpiece Feeding- FESTO Controls Pvt. Ltd. Bangalore.
15. Sensors for Handling & Processing Technology- FESTO Controls Pvt. Ltd. Bangalore.
16. Sensors in Production Engg. - FESTO Controls Pvt. Ltd. Bangalore.
17. Handbook of Industrial Automation – Richard L. Shell & Ernest L. Hall (Marcel Decker Inc.)
18. Programmable Logic Controllers” Programming Methods and Applications (with CD Rom) –
19. Jack R. Hackworth & Fredrick D. Hackworth,Jr.(Pearson Education)

8. MEMS and Nano Technology

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

1. Introduction:

Micro-Electro-Mechanical Systems (MEMS), Microsystems and their products, miniaturization, applications, mechanical MEMS, thermal MEMS, micro-opto electro-mechanical systems, magnetic MEMS, radio frequency (RF) MEMS, micro fluidic systems, bio and chemo devices, Nanotechnology – definition, nano scale, consequences of the nano scale for technology and society, need and applications of nano electromechanical systems (NEMS)

2. Micro Fabrication Processes & Materials

Materials for MEMS – substrate and wafers, silicon as a substrate material, crystal structure, single crystal and polycrystalline, mechanical properties, silicon compounds, silicon piezo-resistors, gallium arsenide, quartz, piezo-electric crystals, polymers, packaging materials; Fabrication Processes – Bulk micro manufacturing, photolithography, photoresists, structural and sacrificial materials, X-ray and electron beam lithography, Thin film deposition – spin coating, thermal oxidation, chemical vapour deposition (CVD), electron beam evaporation, sputtering; Doping – diffusion, ion implantation; Etching – wet etching, dry etching; Surface micromachining, bulk vs. surface micromachining; Wafer bonding – glass-frit, anodic and fusion bonding; LIGA process and applications.

Unit II

3. Micro sensors and actuators

Sensing and actuation, Chemical sensors, Optical sensors, Pressure sensors, Thermal sensors – thermopiles, thermistors, micro machined thermocouple probes, thermal flow sensors, MEMS magnetic sensor, Piezoelectric material as sensing and actuating elements – capacitance, piezo mechanics, Piezo actuators as grippers, micro grippers, micro motors, micro valves, micro pumps, relay, micro spring thermal actuator, data storage cantilever.

4. Microsystem Design

Design constraints and selection of materials, selection of manufacturing process, selection of signal transduction technique, electromechanical system and packaging.

Unit III

4. Nano materials

Molecular building blocks to nanostructures – fullerenes, nano scaled biomolecules, chemical synthesis of artificial nanostructures, molecular switches and logic gates, nano composites; Carbon nanotubes - structure, single walled, multi walled, properties of carbon nanostructures and their synthesis, Potential applications of nano-structures.

Unit IV

5. Nano finishing Techniques

Abrasive flow machining, magnetic abrasive finishing, magnet orheological finishing, elastic emission machining, ion beam machining, chemical mechanical polishing, Nano manipulation, Nanolithography, Top-down versus bottom –up assembly, Visualisation, manipulation and characterization at the nanoscale; Applications - in Energy, Tribology, Informatics, medicine, etc.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Bharat Bhushan (Ed.), (2004), Handbook of Nanotechnology, Springer-Verlag Berlin Heidelberg New York, ISBN 3-540-01218-4
2. Hsu, Tai-Ran, (2003), MEMS & MICROSYSTEMS: Design & Manufacture, TMH, ISBN:0-07-048709-X
3. Mahalik, N. P., (2007), MEMS, TMH, ISBN: 0-07-063445-9

4. Mahalik, N.P. (Ed.) (2006), Micro manufacturing & Nanotechnology, Springer India Pvt. Ltd., ISBN: 978-81-8128-505-8 (Distributed by New Age International, New Delhi)
5. Nano systems: Molecular Machinery, Manufacturing & Computation, K E Drexler, (Wiley), (1992), ISBN 0471575186
6. P.Rai- Choudhury, Handbook of Microlithography, Micromachining & Micro fabrication, SPIE,1997.
7. David Ferry, Transports in Nanostructures, Cambridge University Press, 2000.
8. Poole, Charles & Owen, Frank J., - Introduction to Nanotechnology, Wiley (India) Pvt. Ltd. ISBN: 978-81-265-10993
9. Various Internet resources: www.nanotechweb.org, www.nano.gov, www.nanotec.org.uk

9. Product Design & Development

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Introduction to Design Engineering: Morphology of design, need analysis, specification of a problem. Problem formulation and problem analysis, design process and design cycle, creative design and introduction to decision making. Analysis of the product, standardization, simplification. Basic design considerations. Design for Production: Producibility requirements in the design of machine components. Design for forging, casting, machining ease and powder metallurgical parts. Strength, stiffness and rigidity considerations in product design.

Unit II

Design Optimisation: Search for alternative solution and optimization aspects in design, qualitative discussions of various optimisation techniques

Unit III

Human factors in engineering design: Aesthetic and ergonomic considerations. Design of controls and displays. Value Engineering: Nature and measurement of value, maximum value, normal degree of value, importance of value, the value analysis job plan. Steps to problem solving and value analysis, value analysis tests, material and process selection in value engineering.

Unit IV

Economic Factors Influencing Design: Product value. Design for safety, reliability and environmental considerations. Economic analysis, profit and competitiveness, break-even analysis. Economics of a new product design. Modern Approaches to Product Design: Concurrent Design, Quality Function Deployment (QFD).

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Chitale and Gupta: Product Design and Manufacturing, Prentice Hall of India.
2. Ulrich, K. T., and Eppinger, S.D., Product Design and Development, McGraw-Hill.

10. Advanced Tribology

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT-I Introduction

Introduction to tribology and its historical background. Industrial importance. Factors influencing tribological phenomena. Engineering Surfaces-Properties and Measurement Engineering surfaces - surface characterization, computation of surface parameters. Surface measurement techniques. Apparent and real area of contact. Contact of engineering surfaces.

UNIT-II Surface Contact

Hertzian and Non-hertzian contact. Contact pressure and deformation in non-conformal contacts. Friction Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, various laws and theory of friction. Stick slip friction behaviour, frictional heating and temperature rise. Friction measurement techniques.

UNIT-III Wear

Wear and wear types. Mechanisms of wear -Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., wear of metals and non-metals. Wear models – asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear controlling techniques. Lubrication Introduction to lubrication. Lubrication regimes. Lubricants and their properties. Solid Lubricants.

UNIT-IV Nano tribology

Introduction to micro and nano tribology. Measurement tools used in nano tribology: SFA, STM, AFM micro scale and nano scale wear Nano fabrication /nano machining Nano hydrodynamics Nano lubrication Tribological issues in MEMS

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. "Engineering Tribology" by Prasanta Sahoo, PHI.
2. "Engineering Tribology" by Stachowiak & Batchelor, Elsevier.
3. "Nano tribology and Nano mechanics: An Introduction" by Bharat Bhushan, Springer.
4. "Nano tribology" by Hsu & Ying, Springer

11. Experimental Design

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT-I Introduction

Objectives for experimental design. Basic design concepts. Steps for the design of experiments. Types of experimental designs. Analysis of Means. Experimental designs and six sigma Completely Randomized Design: Model for a completely randomized design \with a single factor. ANOM for a completely randomized design. ANOM with unequal variances. Randomized Block Design. Incomplete Block Designs. Latin Square Design. Graeco - Latin Square Design

UNIT-II Full Factorial Design with Two Levels:

Nature of Factorial Designs. Deleterious Effects of Interactions. Effect Estimates. The 2³ Design. Built-in-Replication. Role of expected mean squares in experimental design Fractional Factorial Designs with Two Levels: 2^k - 1 Designs. Effect Estimates and Regression Coefficients; 2^k-2 Designs. Basic Concepts; Design Efficiency; John's 3/4 Designs

UNIT-III Design with more than two levels:

3^k Designs; Conditional Effects; 3²-P Designs; Orthogonal Arrays with mixed levels

UNIT-IV Robust Design:

DOE and Taguchi Approach; Experimental Design using orthogonal arrays; Experimental Designs with Two-Level Factors only; Experimental Designs with Three and Four Level Factors; ANOVA; Analysis using Signal- to- Noise Ratios; Some case studies; QT4 Software Response Surface Methodology; Response surface experimentation; Process improvement with Steepest Ascent; Analysis of Second-order response surfaces; Central Composite Designs; Box -Behnken Designs; Analyzing the fitted surface; Design-Expert Software

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Modern Experimental Design by Thomas P Ryan. John Wiley
2. Response Surface Methodology by Myers R H and Montgomery Dc. John Wiley
3. Design of Experiments using the Taguchi Approach by Ranjit K Roy. John Wiley

Specialization (Mechanical -HEAT POWER / THERMAL ENGINEERING)

12. Advanced Thermodynamics

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Equation of State: State postulate for Simple System and equation of state, Ideal gas equation, Deviation from ideal gas, Equation of state for real gases, generalized Compressibility chart, Law of corresponding states

Unit II

Properties of Pure Substances: Phase change process of pure substances, PVT surface, P-v & P- T diagrams, Use of steam tables and charts in common use

Unit III

1. Laws of thermodynamics

2nd law Analysis for Engg. Systems, Entropy flow & entropy generation, Increase of entropy principle, entropy change of pure sub, T-ds relations, entropy generation, thermo electricity, Onsager equation. Exergy analysis of thermal systems, decrease of Exergy principle and Exergy destruction, Third law of thermodynamics, Nerst heat theorem and thermal death of universe.

2. Thermodynamic Property Relations

Partial Differentials, Maxwell relations, Clapeyron equation, general relations for du, dh, ds, and Cv and Cp, Joule Thomson Coefficient, Δh , Δu , Δs of real gases.

Unit IV

Combustion Technology: Chemical reaction - Fuels and combustion, Enthalpy of formation and enthalpy of combustion, First law analysis of reacting systems, adiabatic flame temperature
Chemical and Phase equilibrium - Criterion for chemical equilibrium, equilibrium constant for ideal gas mixtures, some remarks about Kp of Ideal-gas mixtures, fugacity and activity,

Simultaneous relations, Variation of K_p with Temperature, Phase equilibrium, Gibb's phase rule, Gas Mixtures – Mass & mole fractions, Dalton's law of partial pressure, Amagat's law, Kay's rule.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Thermodynamics – An Engineering Approach, Yunus Cengel and Michael Boles, 7th Ed., Tata McGraw Hill
2. Modern Engineering Thermodynamics, Robert Balmer, Elsevier.
3. Advanced Thermodynamics for Engineers, Winterbone, John Wiley
4. Advanced Thermodynamics for Engineers, Kenneth Wark, McGraw Hill
5. Thermodynamics for Engineers, Mathur, Gupta, Metropolitan Book Co. Pvt. Ltd.
6. Fundamentals of Engineering Thermodynamics, Michael Moran, Howard Shapiro, John Wiley

13. Advanced Heat Transfer

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

1. Brief introduction to different modes of heat transfer

Conduction: general heat conduction equation-initial and boundary conditions. Finite difference methods for conduction: 1d & 2d steady state and simple transient heat conduction problems-implicit and explicit methods.

2. Transient heat conduction

Lumped system analysis, Heisler charts, semi-infinite solid, use of shape factors in conduction, 2d transient heat conduction, product solutions.

Unit II

Forced Convection

Equations of fluid flow-concepts of continuity, momentum equations, derivation of energy equation-methods to determine heat transfer coefficient: Analytical methods-dimensional analysis and concept of exact solution. Approximate method, integral analysis

Unit III

External flows

Flow over a flat plate: integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to various geometries for laminar and turbulent flows. Internal flows: Fully developed flow: integral analysis for laminar heat transfer coefficient types of flow-constant wall temperature and constant heat flux boundary conditions hydrodynamic & thermal entry lengths; use of empirical correlations.

Unit IV

Free convection

Approximate analysis on laminar free convective heat transfer, Boussinesque approximation, different geometries, combined free and forced convection. Boiling and condensation: Boiling curve, correlations, Nusselt's theory of film condensation on a vertical plate, assumptions & correlations of film condensation for different geometries.

Radiation heat transfer: Radiant heat exchange in grey, non-grey bodies, with transmitting. Reflecting and absorbing media, specular surfaces, gas radiation-radiation from flames. Radiative heat transfer through participating medium

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Yunus A. Cengel, Heat and Mass Transfer – A practical Approach, 3rd edition, Tata McGraw - Hill, 2007.
2. Holman J.P, Heat Transfer, Tata Mc Graw Hill, 2002.
3. S. P. Sukhatme, A Textbook on Heat Transfer
4. Ozisik M.N., Heat Transfer – A Basic Approach, McGraw-Hill Co., 1985
5. Incropera F.P. and DeWitt. D.P., Fundamentals of Heat & Mass Transfer, John Wiley & Sons, 2002.
6. Ghoshdastidar. P.S., Heat Transfer, Oxford University Press, 2004
7. M.M. Modest, Radiative Heat Transfer, Tata-McGraw-Hill

14. Advanced Fluid Dynamics

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Concept of continuum and definition of a fluid. Body and surface forces, stress tensor, Scalar and vector fields, Eulerian and Lagrangian approach. Motion of fluid element - translation, rotation and vorticity; strain rate tensor, continuity equation, stream function and velocity potential. Transport theorems, constitutive equations

Unit II

Derivation of Navier Stokes equations for compressible flow. Exact solutions of Navier Stokes equations: plane Poiseuille flow and Couette flow, Hagen-Poiseuille flow, flow over a flat plate, cylinders and spherical bodies, Stoke's first and second problem, Hiemenz flow, flow near a rotating disk, flow in convergent- divergent channels. Slow viscous flow: Stokes and Oseen's approximation, theory of hydrodynamic lubrication

Unit III

Boundary layer: derivation, exact solutions, Non dimensionalization of Boundary layer equation, Blasius (similarity solution) , Falkner Skan, Von-karmon integral equation series solution and numerical solutions. Approximate methods. Momentum integral method

Unit IV

1.Turbulent flow

algebraic models, hydrodynamic stability, velocity correlations, Reynold's stresses, Prandtl's Mixing Length Theory, Karman's velocity defect law, universal velocity distribution, Plane and axi-symmetric jets, Two equation model(k-epsilon), large eddy simulation.

2.Compressible flow

1D flow, speed of sound, variable c/s flow , converging-diverging nozzle, normal shock relation, past slender bodies, compressible boundary layer. Computational fluid dynamics: Introduction, fundamentals of numerical analysis of partial differential equations (PDE).

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. F. M. White ,Fluid Mechanics, McGraw-Hill
2. K. Muralidhar and Bishwas, Advance Engineering fluid mechanics, Alpha science international limited
3. Fox and McDonald, Introduction to Fluid Mechanics, J.H. Wiley and Sons.
4. S. M. Yahya, Fundamentals of Compressible Flow, Wiley Eastern Ltd.
5. H. Schlichting, Boundary Layers Theory, McGraw-Hill.
6. J. M. Robertson, Hydrodynamics in Theory and Application, Prentice Hall.
7. A. H. Shapiro, The Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald

15. Energy Analysis of Thermal Systems

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Energy Destruction: Lost available work referred to heat engine cycle, refrigeration cycle, heat pump cycle, non-flow and steady flow processes, Mechanism of energy destruction, modified Gouy-Stodola theorem, concept of effective temperature

Unit II

1. Energy Analysis of Simple Processes

Mixing and separation process of fluids of different temperature, heat transfer across a temperature difference, expansion and compression process, combustion process.

2. Energy Analysis of Power Plant Cycles

Maximum power subject to size constraint with fixed heat input and its application to Brayton cycle Steam turbine power plants: External and internal irreversibility, superheater, reheater, vacuum condenser, regenerative feed water heating, combined feed water heating and reheating.

Unit III

1. Gas turbine power plant: External and internal irreversibility, regeneration, reheater, and intercooler, combined steam and gas turbine power plant.

2. Energy analysis of Refrigeration cycle: Joule-Thomson Expansion, Work-Producing Expansion, Brayton Cycle, Optimal Intermediate Cooling, Exergy analysis of Air-conditioning applications: Mixtures of air and water vapour, total flow exergy of humid air & liquid water, Evaporative cooling process and other aspects, Cryogenic systems and small capacity units.

Unit IV

Energy-economic Analysis: Fundamental of exergy-economics, exergy costing of different thermal components: steam or gas turbine, boiler, cogeneration system.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Advanced Engineering Thermodynamics by Adrian Bejan, John Wiley & Sons, Inc.
2. The Exergy Method of Thermal Plant Analysis by T J Kotas, Krieger Publishing Company
3. Thermal Design and Optimization by Adrian Bejan, George Tsatsaronis, Michael Moran, John Wiley & Sons, Inc.
3. Advance Thermodynamics for Engineers by Winterbore D E, Arnold Publication
4. Advanced Thermodynamics for Engineers by Kenneth Wark, McGraw Hill Publishing Co. Ltd.
5. Fundamentals of Engineering Thermodynamics by Michel J Moran, Howard N Shapiro, Daisie D Boettner, Margaret B Bailey, John Wiley & Sons, Inc.

16. Advanced Refrigeration and Air Conditioning

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

1. Vapour compression refrigeration, actual cycle, second law efficiency, multistage compression with inter-cooling, Multi-evaporator systems, cascade systems.
2. Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor, compressor motor selection.
3. Design, selection of evaporators, condensers, system balance, control systems.

Unit II

History, Nomenclature, Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations, action with lubricating oil, retrofitting, refrigerant blends, effects on refrigeration components. Thermoelectric and nonconventional refrigeration systems, adiabatic de-magnetization.

Unit III

Vapour absorption refrigeration, Li-Br and aqua ammonia system, calculation of mass flow rate and system performance, energy balance, controls, analysis of rectifier and analyser, single effect and double effect systems, vapour transformer.

Unit IV

Air-conditioning systems: central and unitary systems, design of various components, humidification and dehumidification equipment's, automatic controls. Energy conservation and air conditioning for special applications, Waste heat recovery, industrial air-conditioning, textile processing.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute

Reference Books

1. Stoecker W. F. and Jones J. P., Principles of Refrigeration and air-conditioning, McGraw Hill
2. Arora C. P., Refrigeration and air-conditioning, Tata McGraw Hill.
3. Gosney W. B., Principles of refrigeration, Cambridge University Press.
4. Stoecker W. F., H. B. of Industrial refrigeration, McGraw Hill Companies, Inc.
5. Dossat R. J., Principles of Refrigeration, Pearson Education
6. ASHARAE Hand Book

17. Advanced IC Engines

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

1. Spark Ignition Engines Mixture requirements, Fuel Induction systems, Stages of combustion, Normal and abnormal combustion, factors affecting knock, Combustion chambers, Engine design, Basic concepts of SI engine simulation technique.
2. Compression Ignition Engines Stages of combustion in C.I. Engine, Direct and indirect Injection systems, Combustion chambers, Fuel spray behavior, spray structure, spray characteristics, air motion, engine design, Basic concepts of CI engine simulation technique.
3. Fuels for SI and CI Engines Qualities of SI & CI engine fuels, rating of SI & CI engine fuels, fuel additives for SI & CI engines, Fuel supply systems for SI and CI engines to use gaseous fuels like hydrogen, CNG, biogas and, other possible fuels.

Unit II

Super-charging and Turbo-charging Purpose of supercharging, effects of supercharging on SI & CI engines performance and its limitations, different types of turbo-charges, methods of turbo charging & its limitations.

Unit III

Engine Emissions & Control: Air pollution due to IC engines, Emissions-HC, CO, NO_x, particulates, GHGs (CO₂, CH₄ and N₂O), emission norms, emission control methods-exhaust gas recirculation, three-way catalytic convertor, particulate trap, modern methods.

Unit IV

Recent Trends Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Data Acquisition System –pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. E.F. Obert, Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1973.
2. John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill
3. M. L. Mathur and R.P.Sharma, Internal Combustion Engines, DhanapatRai Publications, New Delhi.
4. L.C. Litchy, Combustion Engines Processes, McGraw Hill, 1967.
5. V. Ganesan, Int. Combustion Engines, II Edition, TMH, 2002.
6. V. Ganesan, Computer simulation of spark ignition process: University process, Hyderabad 1993.

18. Cryogenic Engineering

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Introduction: Industrial applications, research and development, properties of cryogenic fluids- oxygen, nitrogen, air, hydrogen and helium. Behaviour of Structural Materials at Cryogenic temperature: Mechanical properties, thermal properties, thermoelectric properties.

Unit II

Liquefaction of Cryogenic Gases: Inversion Temperature, Liquefaction Performance Parameters, Ideal cycle, liquefaction of air, Hydrogen and helium, critical components of liquefiers, efficiency, Cryogenic heat exchangers. Separation of Gases: Ideal separation, properties of mixtures, Rectifiers column, separation of air, purification.

Unit III

1. Cryogenic Refrigeration Systems

Ideal refrigeration systems, J-T Refrigeration systems, Philips refrigerator, Vuilleumier refrigerator, Solvey refrigerator, G-M refrigerator.

2. Insulation

Vacuum insulation, fibrous materials, Solid foams, Gas filled power, comparison, critical thickness.

Unit IV

1. Storage

Size and shape of vessel, portable commercial containers, large stationary container, power, transport, storage system, Liquid level indicators.

2. Transfer of Liquefied Gases

Two phase flow transfer through insulated and uninsulated lines, cryogenic pumps and valves.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. R. F. Barron, Cryogenic Systems, Oxford University Press, 1985.
2. Advanced Cryogenic Engineering, Proceedings of Cryogenic Engineering Conference, Vol 1-145, Plenum press, New York, 1968.

19. Alternative Fuels for IC Engines

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Introduction Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources. Like Electric vehicle, hybrid, fuel cell and solar cars.

Unit II

1. Alcohols Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, DEE properties performance analysis, performance in SI & CI Engines.

2. CNG, LPG, Hydrogen and Biogas Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG, LPG and Biogas using in SI & CI engines, Hydrogen; storage and handling, performance and safety aspects.

3. Vegetable Oils Various vegetable oils for engines, transesterification, biodiesel and its properties, performance, emission and combustion characteristics of engine

Unit III

Electric and Hybrid Vehicle Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle.

Unit IV

Fuel Cell and Solar Fuel cell vehicles, specifications, system components, selection of fuel cell, thermal management, maintenance, advantage and limitations, Solar powered vehicles, specifications, system components, advantage and limitations

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. M.K. Gajendra Babu, K.A. Subramanian, Alternative Transportation Fuels: Utilization in Combustion Engines, CRC Press, 2013.
2. Richard L. Bech fold, Alternative Fuels Guide Book - SAE International Warrendale 1997. 3. B. P. Pundir, Engine Emissions, Alpha Science International Limited, 2007
3. B. P. Pundir, IC Engines Combustion and Emissions, Alpha Science International Limited, 2010.
4. Nagpal, Power Plant Engineering, Khanna Publishers - 1991.

20. Design of Heat Transfer Equipment's

Teaching Scheme:	Examination Scheme:
Lectures: 3 hrs./week	Theory Examination: 80 Marks
Tutorial: 1hr/week	Term Work: 20 Marks

Unit I

1. Classification of Heat Exchangers

Introduction, Classification, Overview of Heat Exchanger Design Methodology, Process and Design Specifications, Thermal and Hydraulic Design, Mechanical Design, Optimum Design, Heat Exchanger Variables and Thermal Circuit, Assumptions, Basic Definitions, ϵ - NTU Method, The P-NTU Method , TEMA , Multi-pass Exchangers, LMTD, Heat Exchanger Arrays and Multi-passing, Sizing and Rating Problems, Kern Method, Bell Delaware Method, Numerical on Shell and tube HEX.

2. Solution Methods for Determining Exchanger Effectiveness

Exact Analytical Methods, Approximate Methods, Numerical Methods, Matrix Formalism, Chain Rule Methodology, Flow-Reversal Symmetry, Design Problems, Longitudinal Wall Heat Conduction Effects, Multipass Exchangers, Non-uniform Overall Heat Transfer Coefficients, Temperature - Length - Combined

Unit II

1. Heat Exchanger Pressure Drop Analysis

Importance of Pressure Drop, Devices, Extended Surface Heat Exchanger Pressure Drop, Tubular Heat Exchanger Pressure Drop, Tube Banks, Shell-and-Tube Exchangers, Plate Heat Exchanger Pressure Drop, Pipe Losses, Non-dimensional Presentation of Pressure Drop Data

2. Heat Transfer Characteristics

Dimensionless Surface Characteristics, Experimental Techniques for Determining Surface Characteristics, Steady-State Kays and London Technique, Wilson Plot Technique, Transient Test Techniques, Friction Factor Determination, Hydrodynamically Developing Flows, Thermally Developing Flows, Extended Reynolds Analogy, Heat Exchanger Surface Geometrical Characteristics, Selection of Heat Exchangers and Their Components, Temperature Difference Distributions

Unit III

Cooling tower fundamentals: Types, Nomenclature, material for construction, Structural components in details, Mechanical components (Fan, Speed reducer, Valves, Safety), Electrical components, Thermal performance testing – conduction and evaluation

Unit IV

1. Furnaces

Furnace, Types, Parts used in furnace, Nozzles used, Heat transfer related design of systems, Insulations, Applications in process industries.

2. Thermal Devices

Heat pipe, Thermal interface material, use of nano particle in heat transfer equipments, Steam Trap, Electronics cooling systems, Thermal interface materials, Heat transfer augmentation techniques

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Cooling Tower, Fundamentals- John C. Hensley, SPX Cooling Technologies
2. Heat exchangers Selection, Rating and Thermal Design – Sadik Kakac, Hongtan Liu, Anchasa Pramunjanaroenkij, CRC Press
3. Process Heat Transfer – Donald Q. Kern, Tata McGraw-Hill
4. Process Heat Transfer – Hewitt, Shires & Bott, CRC Press
5. Heat Pipes Theory, Design & Applications – D.A. Reay, P.D. Dunn, Pergamon
6. Cooling Techniques for Electronic Equipment– Dave S. Steinberg, Wiley-InterScience Publication
7. Fundamentals of Heat Exchanger Design -Ramesh K. Shah, Dusan P. Sekulic, WileyIndia

21. Modelling and Analysis in Thermal Engineering

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Introduction: Engineering Design, design and analysis, Workable and optimum system, formulation Thermal systems, basic characteristics and analysis.

Unit II

1. Modelling of Thermal systems

Procedure of mathematical modelling, basic features of modelling, System and types of Model, characteristic of models, Curve fitting, exact fit, best fit.

2. Modelling and analysis of thermal systems, including

Thermodynamics, fluid mechanics, heat and mass transfer, refrigeration and air-conditioning, system components (heat exchangers, expansion devices, pumps, compressors, turbines, boilers).

Unit III

1. Thermal system simulation Sequential simulation, simultaneous simulation, successive substitution, Newton-Raphson method.

2. Optimization of thermal systems, formulation, optimization methods; Lagrange Multipliers, Search Methods, Linear programming, Dynamic programming and geometric programming.

Unit IV

Develop methodologies for the design and optimization of thermal systems. A non-linear equation solver, Engineering Equation Solver (EES), Pinch technology: basic concepts, T-h, h-s diagrams, design of recovery system using pinch technology

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Yogesh Jaluria, Design and Optimization of Thermal Systems, McGraw Hill Companies, Inc.
2. W.F.Stoecker: "Design of Thermal Systems", 3rd Ed., McGraw Hill, 1989.
3. B.K.Hodge: "Analysis and Design of Thermal Systems", Prentice Hall Inc., 1990.
4. I.J.Nagrath & M.Gopal: "Systems Modeling and Analysis", Tata McGraw Hill.
5. D.J. Wide: "Globally Optimal Design", Wiley- Interscience, 1978.
6. R.F.Boehm, Design Analysis of Thermal systems, John Willey and son's
7. A. Bejan, M.moran, Thermal Design and Optimization, John Willey and son's

Specialization (Mechanical -PRODUCTION ENGINEERING)

22. Supply Chain Management & Logistics

Teaching Scheme:	Examination Scheme:
Lectures: 3 hrs./week	Theory Examination: 80 Marks
Tutorial: 1hr/week	Term Work: 20 Marks

Unit I

1. Introduction and overview of supply chain management, inbound and outbound logistics, supply chain as a source of competitive advantage. Definition of logistics and SCM, evolution, scope, importance and decision phases – drivers of sc performance and obstacles.
2. Supply chain network design: distribution in supply chain – factors in distribution network design

–design options-network design in supply chain – framework for network decisions - managing cycle inventory and safety.
3. Sourcing, and pricing in supply chain: supplier selection and contracts - design collaboration - procurement process. Revenue management in supply chain
4. Strategic considerations for supply chain: porter's industry analysis and value-chain models, the concept of total cost of ownership, supply stream strategies, classification and development guidelines, measuring effectiveness of supply management, logistics engineering.

Unit II

5. Operations research models for operational and strategic issues in supply chain management. The bullwhip effect and supply-chain management game. Coordination and technology in supply chain, effect of lack of co-ordination and obstacles – Information Technology and SCM - supply chain-IT framework. E-business and SCM. Metrics for supply chain performance

6. Logistics Management: Definition of logistics and the concepts of logistics. Logistics Activities: Functions of the logistics system – facility location, transportation, warehousing, order Processing, information handling and procurement, Logistics environment, Logistics information systems, Logistics audit and control

Unit III

7. Inbound logistics. Buyer-Vendor co-ordination, Procurement, Vendor development, reduced sourcing and supplier partnership - benefits, risks and critical success factors, multi-level supply control.
8. Distribution Management, Outbound logistics, Facility location, Classical location problems, Strategic planning models for location analysis, location models, multi objective analysis of location models.
9. Transportation alternatives and technologies; transportation performance analysis; total transportation cost analysis; fleet development and management; fleet performance indicators; routing and scheduling; shipment planning; vehicle loading; transportation management and information systems requirements.
10. Logistics Customer Service, Modeling logistics systems, Simulation of logistic systems, cost effective distribution strategies, Value of information in logistics, E-logistics, risk pooling effect, International and global issues in logistics, Integrated functional activities in logistics, Role of government in international logistics and Principal characteristics of logistics in various countries and regions
11. Logistics in different industries: Third party, and fourth party logistics, Reverse logistics, Airline Schedule Planning, Railway Networks, Postal services, the maritime industries, health care industry and other service industries.

Unit IV

12. Logistics in the Design and Development Phase: Design Process, Related Design Discipline, Supplier Design Activities, Design Integration and Reviews, Test and Evaluation. Logistics in The Production / Construction Phase: - Production / Construction Requirements, Industrial Engineering and Operations Analysis, Quality Control, Production Operation, Transition from Production to user operation.

13. Logistic in the Utilization and Support Phase: - System / Product Support, TPM, Data Collection, Analysis and System Evaluation, Evaluation of Logistic Support Elements, System Modification.
14. Logistics in the System Requirement, Material Recycling and Disposal Logistic Management: Logistic Planning, Development of a Work Breakdown Structure, Scheduling of Logistics Tasks, Cost Estimation and control, Organization for Logistics, Management and control.
- 15.

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. David Bloomberg, Stephen LeMay, Joe Hanna: Logistics, Prentice Hall, 2002
2. Thomas Teufel, Jurgen Rohricht, Peter Willems: SAP Processes: Logistics, Addison-Wesley, 2002.
3. Julien Bramel, David Simchi-Levi. "The logic of logistics: theory, algorithms, and applications for logistics management", Springer, 2006
4. Murphy, G.J. "Transport and Distribution", 2nd Edition, Business Books
5. Ballou, R.H., Business Logistics Management/Supply Chain, 5th edition, 2004, Prentice-Hall
6. Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service. Martin Christopher, Pearson Education Asia, Second Edition
7. Supply Chain Management, Strategy, Planning, and operation – Sunil Chopra and Peter Meindl- PHI, Second edition, 2007
8. Logistics, David J.Bloomberg, Stephen Lemay and Joe B.Hanna, Prentice Hall India 2002
9. Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service. Martin Christopher, Pearson Education Asia, Second Edition
10. Modeling the supply chain, Jeremy F.Shapiro, Thomson Duxbury, 2002
11. Handbook of Supply chain management, James B.Ayers, St.Lucle Press, 2000.

23. Decision Making in Manufacturing Environment

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I Introduction to Decision Making

Introduction, Decision-making Methods Used, Group Decision Making (GDM), A Logical Approach to Fuzzy DM Problems, i) Method Proposed by Chen and Hwang (1992) ii) Converting Linguistic Terms to Fuzzy Numbers iii) Converting Fuzzy Numbers to Crisp Scores iv) Demonstration of the Method

Unit II Multiple Attribute Decision-making Methods

Simple Additive Weighting (SAW) Method, Weighted Product Method (WPM), Analytic Hierarchy Process (AHP) Method, Revised Analytic Hierarchy Process (RAHP) Method, Multiplicative Analytic Hierarchy Process (MAHP), TOPSIS Method, Entropy Method, Standard Deviation Method, AHP Method , Modified TOPSIS Method, Sensitivity Analysis [09 Hrs]

Unit III Applications of Fuzzy MADM Methods in the Manufacturing Environment

Material Selection for a Given Engineering Application, Evaluation of Product Designs Machinability Evaluation of Work Material, Cutting Fluid Selections for a Given Machining Application, Evaluation of Flexible Manufacturing Systems, Machine Selection in a Flexible Manufacturing Cell.

Unit IV Robot Selection for a Given Industrial

Application, Selection of Automated Inspection Systems, Selection of Material Handling Equipment, Selection of Rapid Prototyping Process in Rapid Product Development, Vendor Selection in a Supply Chain Environment

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Rao, R.V. (2007). Decision making in the Manufacturing Environment Using graph Theory and Fuzzy Multiple Attribute Decision Making Methods. Springer Verlag, London
2. Saaty, T.L., *Analytic Hierarchy Process*, (1980) McGraw Hill Publications: New York, NY.
3. Yoon, Y.P. and Hwang, C.L., (1995). *Multiple Attribute Decision Making*, SAGE Publications: Beverly Hills, CA.
4. Related journal papers

24. Metal Forming Technology

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Mechanics of metal working, stress strain relationship, yield criteria, Slip line field theory, Equilibrium in Cartesian, cylindrical and spherical coordinates

Unit II

Slab method and lower and upper bound methods for load, their significance in investigating and modeling of metal working operations

Unit III

Plastic work, work hardening, strain rate and temperature, deformation zone geometry

Unit IV

Formability, forming limit diagram, workability in sheet metal forming, forging, rolling, and in extrusion and wire drawing

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. George E. Dieter - Mechanical Metallurgy, McGraw Hill, London, 1988
2. G. E. Dieter - Workability Testing Techniques, American Society for Metals, Metals Park, 1984
3. Metal Forming Handbook, -Schuler, Springer-Verlag Berlin Heidelberg New York, (2008)
ISBN 3-540-61185-1

25. Advanced Casting Technology

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Casting Design & Pattern / Die Making, pattern and die design considerations, Computer aided casting component design, Computer aided design and manufacturing of patterns and dies.

Unit II

Sand Moulding & Core Making Practices: High pressure moulding technology, flask less moulding technology, magnetic moulding, Core shooters used in shell core making and cold box process.

Unit III

Permanent Mold & Special Casting Techniques: Process parameters for Die casting- gravity, pressure and low pressure, Centrifugal casting, Vacuum casting, Investment casting, squeeze casting.

Unit IV

Casting defects and their classification, rejection analysis, remedial measures

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Principles of Metal Castings - Heine, Loper and Rosenthal (TMH)
2. Advanced Pattern Making – Cox I. L. (The Technical Press, London.)
3. ASM Handbook – Vol. 15 Castings.
4. AFS and Control hand book – AFS.
5. Fundamentals of Metal Casting Technology - P.C. Mukherjee (Oxford, IBH)
6. Foundry Engineering – Taylor, Fleming & Wulff (John Wiley)
7. The Foseco Foundryman's Handbook, -Foseco, CBS Publishers & Distributors , ISBN: 9780750619394
8. The New Metallurgy of Cast Metals Castings – Campbell, CBS Publishers & Distributors, ISBN- 9788131200919
9. Fundamentals of Metal Casting – Flinn, Addison Wesley
10. Principles of Metal Manufacturing Processes, J. Beddoes & M.J. Bibby (Elsevier, Butterworth, Heinemann) (2003)

26. Manufacturing Systems

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Manufacturing Systems: Structural aspects, transformational aspects, procedural aspects, integrated manufacturing systems, Mass Customization, Multi-Product Small Batch Production- Economies of Scope with Diversification.

Unit II

Logistic Systems- Material flow: conversion / transportation / storage

Unit III

Manufacturing Optimization: Criteria for Evaluation, Optimization of single stage manufacturing- Unit production time and cost; Optimization of multistage manufacturing

Unit IV

Shop Floor Data Collection Systems- Types of data, on-line and off-line data collection, Automatic data collection systems. Lean Production- concept, principles, Agile Manufacturing- concept, principles

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Katsudo Hitomi, (1998), " Manufacturing Systems Engineering", Viva Low Priced Student Edition, ISBN 81-85617-88-0
1. B. Wu, "Manufacturing Systems Design & Analysis: Context and Techniques" (2/e), Chapman & Hall, UK, ISBN 041258140X
2. Mikell P. Groover, (2002), "Automation, Production Systems and Computer Integrated Manufacturing", (2/e), Pearson Education, ISBN 81-7808-511-9
3. Radhakrishnan P., Subramaniyan S. and Raju V., "CAD / CAM / CIM", (3/E), New Age International Publication

27. Precision Engineering

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Definition, difference in precision and accuracy, need for high precision, Classes of achievable machining accuracy – normal, precision, high precision and ultra-precision machining; Concept of accuracy – part accuracy

Unit II

Precision Machining Processes: Classification of material removal processes in terms of the energy source used and the tool-work piece reaction

Unit III

Diamond turning and milling – machines, tool design and alignment.

Unit IV

Fixed abrasive processes - Basic mechanics of grinding, bondless diamond grinding wheels, jig grinding, electrolytic in-process dressing, Ultra-precision grinding, nano- grinding; Loose abrasive processes – polishing, modes of material removal.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Murty, R. L. (2009), - Precision Engineerin g in Manufacturing, (New Age International Publishers) ISBN: 81-224-0750-1
2. Venkatesh, V.C. & Izman, S. (2007), - Precision Engineering, (TMH), ISBN: 0-07-062090-3
3. Dornfeld, David & Lee, Dae-Eun, (2008), - Precision Manufacturing, (Springer Science + Business Media, LLC), ISBN: 978-0-387-32467-8

28. Advanced Materials and Processing

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Compositions, properties and applications of: Inter-metallic, Ni and Ti aluminides, Smart materials, shape memory alloys.

Unit II

Metallic glass-quasi crystals, Dielectrics, semiconductors, conductors & super conducting materials, Polymer materials, formation of polymer structures, production techniques of fibers, foams, adhesives and coatings.

Unit III

Composites: Fibers-glass, boron, carbon, organic, ceramic and metallic fibers.

Unit IV

Electrochemical grinding, physical vapor deposition, chemical vapor deposition, electro-less coating and thermal metal spraying.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Willer, "Non- traditional Machining Processes", SME publications.
2. G.F.Benidict, "Advanced Manufacturing Processes", Marcel Dekker Publisher
3. E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, "Materials & Processes in Manufacturing", (PHI)
4. Geoff Eckold "Design & Manufacturing of Composite Structures", (Jaico Publishing House)
5. S. Kalpaljian & Steven R. Schmidt, (Pearson Education) "Manufacturing Processe for Engineering Materials",
6. Krishnan K.Chawla, "Composite Material Science and Engineering", Springer- Verlog, 1987

29. Modern Manufacturing Systems

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Concept of F.M. Cell and F. M. System, Functions of a manufacturing cell, Types and components of FMS.

Unit II

Tests of flexibility, Group Technology and FM S, Architecture of typical FMS, Shop Floor Control system, dynamic scheduling in FMS.

Unit III

Flexible Assembly Systems: Basic concepts, classification, planning and scheduling in FAS.

Unit IV

Reconfigurable Manufacturing Systems: Definition, goals, elements, rationale, characteristics, principles, RMS and FMS.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Ranky, Dr. Paul, (1984), "The Design & Operation of FMS",
2. Groover, Mikell P., 3/e, "Automation, Production Systems & Computer Integrated Manufacturing", Pearson Education or PHI
3. Viswanadhan, N. & Narahari, Y., "Performance Modelling of Automated Manufacturing Systems" 2/e, PHI
4. Sewik, "Production Planning & Scheduling in Flexible Assembly Systems", Springer Verlag, ISBN 3-540-64998-0
5. Changeable and Reconfigurable Manufacturing Systems (Springer Series in Advanced Manufacturing) (Ed. Hoda A. Elmaraghy)

30. Low Cost Automation

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit I

Automated manufacturing systems, reasons to justify automation, automation principles and strategies, Developing an Electro pneumatic control system- project design, selection and configuration of components and implementation.

Unit II

Programmable Logic Controllers: Brief review of structure, operation and functions, input/output of PLC, shift registers, data movement and comparison.

Unit III

Multiple actuator circuits with PLC control- sequence, latching, timers, counters; interfacing with sensors and actuators for analog input/outputs.

Unit IV

Supervisory Control And Data Acquisition (SCADA): Concept of SCADA, its industrial significance and applications.

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books

1. Automation, Production Systems & C.I. M. – Groover, Michell P. 3/e, Pearson Education
2. Pneumatic Controls – Joji P. (2008), (Wiley India), (ISBN 978-81-265-1542-4)
3. Electropneumatics, Basic Level - G. Prede, D. Scholz, (FESTO Didactic), (2002), FESTO Controls Pvt. Ltd., Bengaluru.
4. Programmable Logic Controllers: Programming Methods & Applications – John R, Hackworth & Frederick D. Hackworth, Jr. (PHI)
5. Programmable Logic Control: Principles & Applications – NIIT, (2008), (PHI)
6. SCADA, Stuart A. Boyer (ISA Publi.) ISBN 1-55617-660-0.
7. Practical SCADA for industry, David Bailey, (Elsevier Publi.) ISBN 0-7506-5805-3.

31. World Class Manufacturing

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT I: INDUSTRIAL DECLINE AND ASCENDANCY

Manufacturing excellence - US Manufacturers - French Manufacturers - Japan decade – American decade - Global decade.

UNIT II: BUILDING STRENGTH THROUGH CUSTOMER – FOCUSED PRINCIPLES

Customer - Focused principles - General principles - Design - Operations - Human resources Quality and Process improvement - Promotion and Marketing.

UNIT III: VALUE AND VALUATION

Product Costing - Motivation to improve - Value of the enterprises QUALITY - The Organization :Bulwark of stability and effectiveness - Employee stability – Quality Individuals Vs. Teams – Team stability and cohesiveness - Project cohesiveness and stability

UNIT IV: STRATEGIC LINKAGES AND IMPEDIMENTS

1. Product decisions and customer service - Multi-company planning - Internal manufacturing planning - Soothing the demand turbulence
2. Bad plant design - Mismanagement of capacity - Production Lines - Assembly Lines – WholePlant Associates - Facilitators - Teamsmanship - Motivation and reward in the age of continuous Improvement

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. By Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs – “Operations Management for Competitive Advantage”, McGraw-Hill Irwin, ISBN 0072323159
2. Moore Ran, “Making Common Sense Common Practice: Models for Manufacturing Excellence”, Elsevier Multi worth
3. Narayanan V. K., “Managing Technology & Innovation for Competitive Advantage”, Pearson Education Inc.
4. Korgaonkar M. G., “Just In Time Manufacturing”, MacMillan Publishers India Ltd.,
5. Sahay B. S., Saxena K. B. C., Ashish Kumar, “World Class Manufacturing”, MacMillan Publishers

Specialization (Mechanical -CAD/ CAM/CAE)

32. Advances in Computer Aided Manufacturing and Reverse Engineering

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit. I. Advances in Reverse Engineering

Systems RE Methodology, RE Steps, Contact systems Active non-contact systems Manipulation of acquired data Interface between Reverse Engineering and Computer-Aided Design System level Design, and Examples, Computer-Aided RE Reverse Engineering in Computer Applications, Re-engineering of PLC programs, Identify electronic components, PCB RE

Unit. II. Advances in Manufacturing Systems Manufacturing Systems

Structural aspects, transformational aspects, procedural aspects, integrated manufacturing systems, Mass Customization, Multi-Product Small Batch Production- Economies of Scope with Diversification; Logistic Systems- Material flow: conversion / transportation / storage, Manufacturing Optimization: Criteria for Evaluation, Optimization of single stage manufacturing- Unit production time and cost; Optimization of multistage manufacturing system Shop Floor Data Collection Systems- Types of data, on-line and off-line data collection, Automatic data collection systems. Lean Production- concept, principles, Agile Manufacturing- concept, principles

Unit. III. Advances in Computer Aided Manufacturing

Part programming on Lathe and machining centres using G & M codes Different types of tools and tool holders used on CNC Machines, parameters for selection of configuration of cutting tools Modular tools and fixtures, use of pallets for work holding, palletizing of fixtures Advanced CNC processes - EDM, Wire cut EDM, Abrasive water jet, LASER cutting, Optimization of tool path

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Vinesh Rajaand KiranJFernandes, "ReverseEngineering– AnIndustrialperspective", Springer, London, 2008
2. Pham DandDimovS, "Rapidmanufacturing- he technologies and applications of rapid prototyping and rapid tooling. Springer-Verlag, London, 2001.
3. Katsudo Hitomi, (1998), "Manufacturing Systems Engineering", Viva Low Price D Student Edition, ISBN81-85617-88-0
4. B.Wu, "ManufacturingSystemsDesign&Analysis:ContextandTechniques" (2/e), Chapman & Hall, UK, ISBN 041258140X

33. Advances in Manufacturing Low Cost Automation and Robotics

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit. I Advances in Modern manufacturing systems

Concept of F. M. Cell and F. M. System, Functions of a manufacturing cell, Types and components of FMS, Tests of flexibility, Group Technology and FMS, Architecture of typical FMS, Shop Floor Control system, dynamic scheduling in FMS, Flexible Assembly Systems: Basic concepts, classification, planning and scheduling in FAS, Reconfigurable Manufacturing Systems: Definition, goals, elements, rationale, characteristics, principles, RMS and FMS

Unit. II Advances in Low Cost Automation

Automated manufacturing systems, reasons to justify automation, automation principles and strategies, Developing an Electro pneumatic control system- project design, selection and configuration of components and implementation Programmable Logic Controllers: Brief review of structure, operation and functions, input/output of PLC, shift registers, data movement and comparison Multiple actuator circuits with PLC control- sequence, latching, timers, counters; Interfacing with sensors and actuators for analog input/outputs Supervisory Control And Data Acquisition (SCADA): Concept of SCADA, its industrial significance and applications.

Unit. III. Advances in Robotics

Model-based learning approaches, Model-free learning approaches, Optimization methods and case studies, Soft Robotics (2L; F lida): Soft material/body robot modelling, Soft actuators and sensors, Control and learning of soft robots, Human-Robot Interaction :Introduction to human-robot interaction, Theoretical frameworks (spatial, nonverbal,

verbal interactions), Research methods, applications, robots in society, Distributed Robotics, Multi-Agent Systems: Planning and control in multi-robot systems

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Mikell P. Groover, (2002), "Automation, Production Systems and Computer Integrated Manufacturing", (2/e), Pearson Education, ISBN 81-7808-511-9
2. Radhakrishnan P., Subramaniyan S. and Raju V., "CAD/CAM/CIM", (3/E), New Age International Publication
3. Jon Stenerson and Kelly Curran "Computer Numerical Control", Prentice Hall of India Pvt. Ltd. New Delhi, 2008
4. P. N. Rao "CAD/CAM principles and operations", Tata Mc Graw Hill
5. Ronald C. Arkin 1949. Behavior-Based Robotics / Ronald C. Arkin. Cambridge, Mass. : MIT Press, c1998.; 1998.
6. Bruno Siciliano 1959; Oussama Khatib editor., eds. Springer Handbook of Robotics / Edited by Bruno Siciliano, Oussama Khatib. 2nd Edition. Cham : Springer International Publishing, 2016.; 2016.

34. Advances in Material Processing and Work System Design

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit. I. Advances in Advances Materials & Processing

Compositions, properties and applications of: Inter-metallic, Ni and Ti aluminides, Smart materials, shape memory alloys Metallic glass-quasi crystals, Dielectrics, semiconductors, conductors & super conducting materials, Polymer materials, formation of polymer structures, production techniques of fibers, foams, adhesives and coatings. Composites: Fibers-glass, boron, carbon, organic, ceramic and metallic fibers, Electrochemical grinding, physical vapor deposition, chemical vapor deposition, electro-less coating and thermal metal spraying

Unit. II. Advances in Work system design Work System Design

Introduction, Introduction and Concept of Productivity, Measurement of Productivity, Productivity Measures, Productivity Measurement Models Factors Influencing Productivity, Causes of Low P Work Study: Basic Concept, Steps Involved in Work Study, Concept of Work Content, Techniques of Work Study, Human Aspects of Work Study productivity, Productivity Measurement Models, Productivity Improvement Techniques, Method Study: Basic Concept, Steps Involved in Method Study, Recording Techniques, Operation Process Charts, Operation Process Charts: Flow Process Charts, Flow Process Charts: Examples, Two-Handed-Process Charts, Multiple Activity Charts, Flow Diagrams. Work Sampling: Basics, Procedure of Work Sampling Study, Numerical Problems on work sampling, Introduction to Synthetic Data and PMTS, Introduction to MTM and MOST, Ergonomics: Basic Concept, Industrial Ergonomics, Ergonomics: Anthropometry, Man-Machine System-1 , Man-Machine System-2, Case Study: Office Chair, Case Study: Tower Crane Cabin, Case Study: Car Seat, Case Study: Computer System, Case Study: Assembly Line

Unit. III. Advances in Precision Engineering

Definition, difference in precision and accuracy, need for high precision, Classes of achievable machining accuracy – normal, precision, high precision and ultra-precision machining; Concept of accuracy – part accuracy Precision Machining Processes: Classification of material removal processes in terms of the energy source used and the tool-work piece reaction Diamond turning and milling – machines, tool design and alignment Fixed abrasive processes - Basic mechanics of grinding, bondless diamond grinding wheels, jig grinding, electrolytic in-process dressing, Ultra- precision grinding, nano grinding; Loose abrasive processes – polishing, modes of material removal

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Katsudo Hitomi, (1998), "Manufacturing Systems Engineering", Viva Low Priced Student Edition, ISBN 81-85617-88-0Willer,"Non- Traditional Machining Processes", SME publications.
2. G.F.Benidict,"Advanced Manufacturing Processes",Marcel Dekker Publisher
3. E.Paul De Garmo,J.T.Black& RonaldA.Kohser,"Materials & Processes in Manufacturing", (PHI)
4. Murty, R. L. (2009), - Precision Engineering in Manufacturing, (New Age International Publishers) ISBN: 81-224-0750-1
5. Venkatesh, V.C. & Izman, S. (2007), - Precision Engineering, (TMH), ISBN: 0-07 062090-3
6. Dornfeld, David & Lee, Dae-Eun, (2008), - Precision Manufacturing, (Springer Science Business Media, LLC), ISBN: 978-0-387-32467-8
7. Introduction to Work Study: International Labor Office (ILO), Geneva.

8. Motion and Time Study Design and Measurement of Work: Ralph M. Barnes, Wiley, The University of California.
9. Industrial Engineering and Production Management: M. Telsang, S. Chand and Company Ltd.

35. Advances in Computer Aided Process Planning and Graphics

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT - I

Introduction to computer graphics fundamentals; Curves and surfaces modelling; Concepts of Solid modelling; Visual realism; Assembly of parts and product data Exchange. Finite Element Analysis related to 1D and 2D problems. Problems of static and dynamic analysis using Finite Element Analysis.

UNIT - II

NC, CNC and DNC –CNC Programming Basics - Computer Aided Process Planning- Group technology - Part families - classification and coding - Production flow analysis - Machine cell design - Benefits. Components of FMS- Characteristics of JIT-Kanban system- lean production system.

UNIT - III

Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM) -Additive manufacturing processes-Benefits Applications – rapid tooling - Reverse Engineering – Digitizing technique

Term Work :

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books :

1. Katsudo Hitomi, (1998), "Manufacturing Systems Engineering", Viva Low Priced Student Edition, ISBN 81-85617-88-0Willer,"Non- Traditional Machining Processes", SME publications.
2. G.F.Benidict,"Advanced Manufacturing Processes",Marcel Dekker Publisher
3. E.Paul De Garmo,J.T.Black& RonaldA.Kohser,"Materials & Processes in Manufacturing", (PHI)
4. Murty, R. L. (2009), - Precision Engineering in Manufacturing, (New Age International Publishers) ISBN: 81-224-0750-1
5. Venkatesh, V.C. & Izman, S. (2007), - Precision Engineering, (TMH), ISBN: 0-07-062090-3
6. Dornfeld, David & Lee, Dae-Eun, (2008), - Precision Manufacturing, (Springer Science Business Media, LLC), ISBN: 978-0-387-32467-8
7. Introduction to Work Study: International Labor Office (ILO), Geneva.
8. Motion and Time Study Design and Measurement of Work: Ralph M. Barnes, Wiley, The University of California.
9. Industrial Engineering and Production Management: M. Telsang, S. Chand and Company Ltd.

36. Advances in Computer Aided Planning

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT- I

CAD Tools: Definition of CAD Tools, Graphics standards, Graphics software: requirements of graphics software, Functional areas of CAD, Efficient use of CAD software. Basics of Geometric Modelling: Requirement of geometric 3D Modelling, Geometric models, Geometric construction methods, Modelling facilities desired.

Geometric Modelling: Classification of wireframe entities, Curve representation methods, And Parametric representation of analytic curves: line, circle, arc, conics And Parametric representation of synthetic curves: Hermit cubic curve, Bezier curve, B-Spline curve wire, NURBS, Curve manipulations.

UNIT- II:

1. Surface Modeling

Classification of surface entities, Surface representation methods, Parametric representation of analytic surfaces: plane surface, ruled surface, surface of revolution, tabulated cylinder, Parametric representation of synthetic curves: Hermite cubic surface, Bezier surface, B-Spline surface, Blending surface, Surface manipulations.

2. Solid Modelling

Geometry and topology, Boundary representation, The Euler-Poincare formula, Euler operators, Constructive solid geometry: CSG primitives, Boolean operators, CSG expressions, Interior, Exterior, closure, Sweeping: linear and non-linear, Solid manipulations, feature modelling.

UNIT-III:

Transformations: 2-D and 3-D transformations: translation, scaling, rotation, reflection, concatenation, homogeneous coordinates, Perspective projection, orthotropic projection,

isometric projection, Hidden surface removal, shading, rendering. Evaluation Criteria: Evaluation criteria of CAD software, Data exchange formats: GKS, IGES, PHIGS, CGM, STEP Dimensioning and tolerances: Linear, angular, angular dimensions, maximum material condition (MMC), Least material condition (LMC), Regardless of feature size (RFS). R22M.Tech. CAD/CAM JNTUH

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. CAD/CAM Concepts and Applications/ Alavala/PHI.
2. Mastering CAD/CAM/ Ibrhim Zeid/ McGraw Hill International.
3. CAD/CAM Principal and Applications/ P. N. Rao/ TMH/3rd Edition
4. CAD/CAM /Groover M.P./ Pearson education
5. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
6. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
7. Computer Numerical Control Concepts and programming/ Warren S Seames/ Thomson.

37. Advances in Additive Manufacturing

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT-I

Introduction: Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies Liquid-based AM Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Poly jet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Micro fabrication. Solid-based AM Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

UNIT-II

Powder Based AM Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Electron Beam Melting (EBM): Models and specifications,

Process, working principle, Applications, Advantages and Disadvantages, Case studies R22M.Tech. CAD/CAM JNTUH Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT-III

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques. AM Software's: Need for AM software, Features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab. UNIT-V: AM Applications: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web Based Rapid Prototyping Systems

Term Work

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books :

1. Rapid prototyping: Principles and Applications by Chua C.K., Leong K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.
2. Rapid Manufacturing by D. T. Pham and S. S. Dimov, Springer, 2001.
2. Wholers Report 2000 by Terry Wohlers, Wohlers Associates, 2000.
3. Rapid Prototyping & Engineering Applications by Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

38. Advances in Green Manufacturing

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT-I

Concepts of sustainability and sustainable development – Need for sustainable development -Components of sustainability- Social, Economic, Environmental dimensions - Linkages between technology and sustainability - Sustainable Manufacturing –Scope, Need and Benefits

UNIT-II

Tools and Techniques of Sustainable Manufacturing – Environmental Conscious Quality Function Deployment, Life cycle assessment, Design for Environment, R3 and R6 cycles, Design for Disassembly -Sustainable Product Development – Various Phases. EIA Methods –CML, EI 95 and 99, ISO 14001 EMS and PAS 2050 standards, Environmental Impact parameters - Interactions between energy and technology and their implications for environment and sustainable development. Design for recycling – Eco friendly product design methods – Methods to infuse sustainability in early product design phases – Multi-Criteria Decision Making in Sustainability.

UNIT-III

Frameworks for measuring sustainability- Indicators of sustainability – Environmental, Economic, Societal and Business indicators - Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment– Corporate Social Responsibility

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. G. Atkinson, S. Dietz, E. Neumayer, — "Handbook of Sustainable Manufacturing". Edward Elgar Publishing Limited, 2007.
2. D. Rodick, "Industrial Development for the 21st Century: Sustainable Development Perspectives", UN New York, 2007

39. Advances in Automation in Manufacturing

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT- I:

1. Introduction to Automation

Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

2. Introduction to Material Handling

Overview of Material Handling Equipment, Considerations in Material Handling System Design, the 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies

UNIT - II:

1. Manual Assembly Lines

Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

2. Transfer lines

Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

UNIT- III:

Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation. R22M.Tech. CAD/CAM JNTUH

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Automation, Production systems and computer integrated manufacturing by Mikel P. Groover, Pearson Education.
2. CAD CAM: Principles, Practice and Manufacturing Management by Chris Mc Mohan, Jimmie Browne, Pearson Edu. (LPE)
3. Automation by Buckingham W, Haper & Row Publishers, New York, 1961 3. Automation for Productivity by Luke H.D, John Wiley & Sons, New York, 1972.

40. Advances in Computer Aided Process Planning

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

UNIT- I

Introduction: The Place of Process Planning in the Manufacturing Cycle-Process planning and production Planning-Process planning and Concurrent Engineering, CAPP, Group Technology.

UNIT- II:

1. Part Design Representation

Design Drafting-Dimensioning-Conventional Tolerance- Geometric Tolerance-CAD-input/output devices -Topology - Geometric Transformation – Perspective Transformation-Data Structure-Geometric modelling for process planning--GT Coding-The OPITZ system-The MICLASS System.

2. Process Engineering and Process Planning

Experience based planning-Decision table and Decision Trees-Process capability analysis-Process Planning-Variant process planning-Generative Approach-Forward and backward planning, Input format, AI.

UNIT- III:

Computer Aided Process Planning Systems: Logical Design of process planning-Implementation Considerations-Manufacturing system components, Production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

UNIT-V: An Integrated Process Planning Systems: Totally integrated process planning systems-An Overview- Modulus Structure-Data Structure-Operation-Report Generation, Expert process planning

Term Work:

The student will write a term paper in a specific area from the above syllabus describing the present status of research in that area, based on at least 20 papers published in journals of repute.

Reference Books:

1. Gideon Halevi and Roland D. Weill, "Principle of process planning- A Logical Approach ", Chapman & Hall, 1995
2. Chang T. C. & Richard A. Wysk, "An Introduction to automated process planning systems ", Prentice Hall 1985.
3. Chang, T.C., "An Expert Process Planning System", Prentice Hall,1985
4. Nanua Singh, & " Systems Approach to Computer Integrated Design and Manufacturing ", John Wiley & Sons,1996 3. Rao P.N., & " Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co.,2000