List of Ph.D. (Mechanical) Paper II

Select any one subject

1. Advances in Mechanical Engineering (CAD/ CAM/CAE- I)
2. Advances in Mechanical Engineering (CAD/CAM/CAE-II)
3. Advances in Mechanical Engineering (Design-I)
4. Advances in Mechanical Engineering (Design-II)
5. Advances in Mechanical Engineering (Heat Power-I)
6. Advances in Mechanical Engineering (Heat Power-II)
7. Advances in Mechanical Engineering (Production-I)
8. Advances in Mechanical Engineering (Production-II)
9. Advances In Mechanical Engineering (Production Engineering)
10. Advances In Mechanical Engineering (Cad/Cam/Cae)
11. Advances In Mechanical Engineering (Industrial Engineering)

Ph.D. (Mechanical) Paper –II

ADVANCES IN MECHANICAL ENGINEERING (CAD/CAM/CAE-I)

Teaching Scheme: **Examination Scheme:**

Theory: 4 hrs/week Theory Examination: 100 Marks

Unit 1

1: Reverse Engineering:

Reverse engineering – Methodologies and Techniques, Hardware and software, Rapid prototyping –Relationship with reverse engineering

2: Manufacturing Systems:

Manufacturing Systems: Different 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, Lean Production, Agile Manufacturing

Unit 2

3: Computer Aided Manufacturing

Part programming on Lathe and machining centers 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

Unit 3

4: 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 4

5: 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.

Reference Books:

1. Vinesh Raja and Kiran J Fernandes, "Reverse Engineering – An Industrial perspective", Springer, London, 2008
2. Pham D and Dimov S, "Rapid manufacturing - The technologies and applications of rapid prototyping and rapid tooling. Springer-Verlag, London, 2001.
3. Katsudo Hitomi, (1998), "Manufacturing Systems Engineering", Viva Low Priced Student Edition, ISBN 81-85617-88-0
4. B. Wu, "Manufacturing Systems Design & Analysis: Context and Techniques" (2/e), Chapman & Hall, UK, ISBN 041258140X
5. Mikell P. Groover, (2002), "Automation, Production Systems and Computer Integrated Manufacturing", (2/e), Pearson Education, ISBN 81-7808-511-9
6. Radhakrishan P., Subramaniyan S. and Raju V., "CAD / CAM / CIM", (3/E), New Age International Publication
7. Jon Stenerson and Kelly Curran "Computer Numerical Control", Prentice-Hall of India Pvt. Ltd. New Delhi, 2008
8. P. N. Rao "CAD/CAM principles and operations", Tata McGraw Hill
9. Thomas M. Crandell "CNC Machining and Programming, Industrial Press ISBN-0-8311-3118-7
10. Ranky, Dr. Paul, (1984), "The Design & Operation of FMS",
11. Groover, Mikell P., 3/e, "Automation, Production Systems & Computer Integrated

Manufacturing", Pearson Education or PHI

12. Viswanadhan, N. & Narahari, Y., "Performance Modelling of Automated Manufacturing Systems" 2/e, PHI
13. Sewik, "Production Planning & Scheduling in Flexible Assembly Systems", Springer Verlag, ISBN 3-540-64998-0
14. Automation, Production Systems & C.I.M. – Groover, Michell P. 3/e, Pearson Education
15. Pneumatic Controls – Joji P. (2008), (Wiley India), (ISBN 978-81-265-1542-4)
16. Electropneumatics, Basic Level - G. Prede, D. Scholz, (FESTO Didactic), (2002), FESTO Controls Pvt. Ltd., Bengaluru.
17. Programmable Logic Controllers: Programming Methods & Applications – John R,
18. Hackworth & Frederick D. Hackworth, Jr. (PHI)
19. Programmable Logic Control: Principles & Applications – NIIT, (2008), (PHI)
20. SCADA, Stuart A. Boyer (ISA Publi.) ISBN 1-55617-660-0.
21. Practical SCADA for industry, David Bailey, (Elsevier Publi.) ISBN 0-7506-5805-3.

Ph.D. (Mechanical) Paper –II

ADVANCES IN MECHANICAL ENGINEERING (CAD/CAM/CAE-II)

Teaching Scheme: **Examination Scheme:**

Theory: 4 hrs/week Theory Examination: 100 Marks

Unit 1

1: Advanced Materials & Processing:

Composition of materials, properties and applications of: Inter-metallics, Ni and Ti aluminides, smart materials, shape memory alloys, Metallic glass- quassi crystals, Dielectrics, semi conductors, 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, ultrasonic machining, laser beam machining and electrochemical machining, abrasive floor machining, magnetic abrasive finishing, wire EDM, electrochemical grinding, physical vapor deposition, chemical vapor deposition, electro less coating and thermal metal spraying

Unit 2

2: Technology Management

Holistic Model of Management of Technology (MOT), Technology-strategy relationship, Elements of technology strategy and formulation of a technology strategy, Integration of technology strategy and business strategy for competitive success technology, Technology Transfer: Model of TT, System of TT with Public and Private Enterprises, Intellectual Property Rights: Patentable and non-patentable inventions, statutory exceptions, Persons entitled to apply for patents

3. Database Management

Data models, data base languages, data base administrator, design issues, mapping constraints, keys, entity relationship diagram, Structured query language: basic structure, set operations, aggregate functions, null values, nested sub-queries, views, modification of data base, File structures: file organization, organization of records in files, data dictionary storage, sequential files, data definition language, indexing: query optimization, transactions, transaction recovery, Conceptual DBMS, types of data structures and their applications in FMS, Integrated DBMS in FMS and its implementation

Unit 3

4: Work system design

Issues in Work system Design, Measuring Work by Physiological means, Work Posture, Fatigue Measurement and Evaluation, Environmental Factors and Work Systems

Unit 4

5: Precision Engineering:

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-workpiece 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, Chemical mechanical planarization

Reference Books:

1. 3. Katsudo Hitomi, (1998), "Manufacturing Systems Engineering", Viva Low Priced Student Edition, ISBN 81-85617-88-0
2. 4. B. Wu, "Manufacturing Systems Design & Analysis: Context and Techniques" (2/e), Chapman & Hall, UK, ISBN 041258140X
3. 5. Mikell P. Groover, (2002), "Automation, Production Systems and Computer Integrated Manufacturing", (2/e), Pearson Education, ISBN 81-7808-511-9
4. 6. Radhakrishan P., Subramaniyan S. and Raju V., "CAD / CAM / CIM", (3/E), New Age International Publication
5. 7. Jon Stenerson and Kelly Curran "Computer Numerical Control", Prentice-Hall of
6. India Pvt. Ltd. New Delhi, 2008
7. P. N. Rao "CAD/CAM principles and operations", Tata McGraw Hill
8. Thomas M. Crandell "CNC Machining and Programming, Industrial Press ISBN-
9. 0-8311-3118-7
10. Willer, "Non- traditional Machining Processes", SME publications.

11. G.F.Benidict, “Advanced Manufacturing Processes”, Marcel Dekker Publisher

12. E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, “Materials & Processes in Manufacturing”, (PHI)

13. 13.Geoff Eckold “Design & Manufacturing of Composite Structures”, (Jaico Publishing House)

14. S. Kalpaljian & Steven R. Schmidt, (Pearson Education) “Manufacturing Processe for Engineering Materials”,

15. 15 Krishnan K.Chawla, “Composite Material Science and Engineering”, Springer-Verlog, 1987

16. Hand Book of Technology Management, by Gerard H. Gaynor, McGraw Hill.

17. Strategic Management of Technological Innovation, 2/e (SIE)

    Authors: SCHILLING, MELISSA, Tata McGraw Hill Division: Higher Education ISBN-13: 978-0-07-066712-9 ISBN-10: 0070667128 ©2007 | 2nd Edition,

18. Strategic Management Tata McGraw Hill Authors: Pearce, John; ROVINSON, RICHARD Division: Higher Education ISBN-13: 978-0-07-060393-6 ISBN-10: 0070603936 ©2005 | 9th Edition

19. The Management Of Intellectual Property, by Satyawrat Ponkshe, Ponkshe & Bhate Publications, Pune.

20. Data Base System Concepts - Abraham Silberschatz, Henry F. Korth, S. Sudarshan,

21. 3/e, 1997, McGraw Hill International Edition.

22. . An Introduction to Data Base Systems - C. J. Date, 7/e (2003) (PearsonEducation)

23. Principles of Data Base Systems –Jeffery D. Ullman, 2/e (2000) Galgotia Publications.

24. Principles of Data Base Management – James Martin (10th Reprint, 1998) (EEE)(PHI).

25. Murty, R. L. (2009), - Precision Engineering in Manufacturing, (New Age International Publishers) ISBN: 81-224-0750-1

26. Venkatesh, V.C. & Izman, S. (2007), - Precision Engineering, (TMH), ISBN: 0-07-062090-3

27. Dornfeld, David & Lee, Dae-Eun, (2008), - Precision Manufacturing, (Springer Science + Business Media, LLC), ISBN: 978-0-387-32467-8

Ph.D. (Mechanical) Paper –II

ADVANCES IN MECHANICAL ENGINEERING (Design-I)

Teaching Scheme:

Theory: 4 hrs/week

Examination Scheme:

Theory Examination: 100 Marks

Unit 1

Advanced Theory of Elasticity (3-dimensional problems):

Theories of Stress and strain, Transformation of stress and strain, Linear stress-strain temperature relations, Applications of energy methods, Torsion, Bending, Plates

Unit 2

Fracture Mechanics

Linear Elastic Fracture Mechanics,Elastic Plastic Fracture Mechanics, Fracture Mechanisms in Metals

Unit 3

Tribology Friction and Wear: Theory of friction- sliding and rolling friction, Friction properties of metallic and non metallic materials, friction in extreme conditions, Wear, types of wear, mechanisms of wear, wear resistant materials, Lubrication: Hydrodynamic lubrication, Reynolds equation, Thermal, inertia and turbulent effects, Elasto, Plasto and magneto hydrodynamic lubrication, Hydrostatic, Gas lubrication, Surface Engineering: Diffusion Coatings, Electro and Electroless platings, Hot dip coating, Metal Spraying, Cladded coatings, Crystallizing coatings

Unit 4

Bio-medical device design: Applications, FDA approval procedures, A Certification

System Design: Systems design for Cooling of Electronic Equipments Enclosure design, power packing factors, electronic packing.

Reference Books:

1. Shiegly J.E., Machine design
2. Richard Fries and Paul King www.crcpress.com
3. Anatomy by Gray 1918
4. Pathology by Simpson
5. Principles of Orthopedic deformity correction - by Dror Paley www.springer.com
6. FDA procedures – Class notes
7. T L Anderson, Fracture Mechanics- Fundamentals and Applications, CRC Publishers, 2nd edition, 1995
8. Ashok Saxena, Nonlinear Fracture Mechanics for Engineers, CRC Publications
9. Hertzberg R.W., Deformation and Fracture Mechanics of Engineering Materials, Wiley, 4th edition, 1996.
10. Boresi A.D., Schmidt R.J, and Sidebottom O.M, "Advanced Mechanics of Materials", Wiley
11. Richard Budynas, "Advanced strength of applied stress analysis", McGraw Hill
12. Cook R.D., Young W.C., "Advanced Mechanics of Materials", Prentice Hall
13. Timoshenko and Goodier, "Theory of Elasticity", McGraw-Hill Publications
14. Ugural and Fenster, "Advanced Strength and Applied Elasticity", 4**th** Ed., Prentice Hall, PTR, 2003.
15. Srinath L.S, "Advanced Mechanics of Solids", Tata Mc-Graw Hill, New Delhi, 2003.
16. Balakumar Balachandran and Edward Magrab, "Vibrations", Thomson Brooks/Cole, 2004.
17. Kelly S.G., "Mechanical vibrations", McGraw-Hill, 2007
18. Hulling J. " Principles of Tribology" Mc Millan, 1984
19. Williams J.A. "Engineering Tribology" Oxford University press, 1994.
20. Davis J. "Surface Engineering for corrosion and Wear Resistance", Woodhead Publishing, 2001.
21. Tadausz Burakowski, "Surface Engineering of Metals: Principles, Equipments, Tehnologies" Taylor and Francis.

Ph.D. (Mechanical) Paper –II

ADVANCES IN MECHANICAL ENGINEERING (Design_II)

Teaching Scheme:
Theory: 4 hrs/week

Examination Scheme:
Theory Examination: 100 Marks

Unit 1

1: Vibrations

Multi-degree freedom systems, Approximate and numerical methods, Continuous systems, Nonlinear systems

2: **Acoustics**

Wave propagation, generation/transmission of sound, noise control

Unit 2

Micro Electro Mechanical Systems (MEMS)

From Microphysics to Macrophysics, Thermodynamics of Microstructures, Reliability of MEMS

Unit 3:

Mechatronics

Sensors: 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; Signal processing: 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; Programmable Logic Controller: Input/output processing, programming, functional block diagram (FBD), ladder diagram, logic functions, latching, sequencing, jumps, internal relays, counters, shift registers, master and jump control

Unit 4

Robotics: Kinematics, Dynamics, Trajectory, Control

Reference Books

1. John J Craig, “Introduction to Robotics – Mechanics and Control”, Prentice Hall, 3rd Edition, 2004.
2. Fu K.S., Gonzales R.C., and Lee C.S.G., “Robotics: Control, Sensing, Vision and Intelligence, Tata Mc-Graw Hill, 2008.
3. Kinsler, Frey and Coppens, “Fundamentals of Acoustics”, John Wiley & Sons
4. Allan D Pierce, “Acoustics: An Introduction to its Physical Principles and Applications”, Acoustical Society of Amer, 1989.
5. Balakumar Balachandran and Edward Magrab, “Vibrations”, Thomson Brooks/Cole, 2004.
6. Kelly S.G., “Mechanical vibrations”, McGraw-Hill, 2007
7. Balian Roger, “From Microphysics to Macrophysics”,1st edition, Springer, 2006.
8. Thermodynamics of Microstructures, ASM International, 2008
9. Younes Shabany, “Heat transfer Thermal Management of electronics”, CRC Press.
10. Electronics cooling magazine issues from 1997 -2010
11. Bharat Bhushan (Ed.), (2004), Handbook of Nanotechnology, Spinger-Verlag Berlin Heidelberg New York, ISBN 3-540-01218-4
12. Hsu, Tai-Ran, (2003), MEMS & MICROSYSTEMS: Design & Manufacture, TMH, ISBN:0-07-048709-X
13. Mahalik, N. P., (2007), MEMS, TMH, ISBN: 0-07-063445-9
14. Mechatronics, 3/e --- W. Bolton (Pearson Education)
15. Mechatronics: Principles, Concepts and Applications - N.P.Mahalik (TMH)
16. Process Control & Instrumentation Technology –Critis D. Johnson (Pearson Education)
17. Mechatronics System Design - Devdas Shetty, Richard A. Kolk (Thomson)
18. Programmable Logic Controllers” Programming Methods and Applications (with CD Rom) – Jack R. Hackworth & Fredrick D. Hackworth,Jr.(Pearson Education).
19. Faghri Amir, “Heat Pipe Science and Technology”, Taylor & Francis, 1995.
20. Dunn and Reay, “Heat Pipes”, Pergamon, 4th Edition,
21. Kaveh Azar, “Thermal Measurements in Electronic Cooling”, CRC Press, 1997.

Ph.D. (Mechanical) Paper –II

ADVANCES IN MECHANICAL ENGINEERING (Heat Power-I)

Teaching Scheme: **Examination Scheme:**

Theory: 4 hrs/week Theory Examination: 100 Marks

Unit 1

1: Convective Heat Transfer:

Fully developed flows, exact and similarity solutions, boiling and condensation, special topics

Turbulence**,** Governing equations, Free shear flows, Near wall behavior, Energy spectrum, Turbulence models

Boiling and condensation: Bubble dynamics, boiling and condensation enhancement techniques, recent advances in heat pipes.

Unit 2

Conduction and radiation , Transient heat conduction, Micro scale heat transfer, Radiation shape factor, Radiation from luminous fuel, oil, gas and flames, Radiation network, Radiation from gases and vapors

Unit 3

Advanced Trends in Heat Exchanger

Heat Exchanger design theory, recent trends in heat exchangers, advanced material in HE, Electronic cooling, Nanomaterial, micro channel heat exchangers.

Unit 4

Advanced Topics in I C Engines:

Engine Emissions & Control, Engine Electronics, Modeling Real Engine Flow and Combustion Process, Fuel/Air Mixture Requirements (Any two), , Premixed and Diffusion flames

Reference Books

1. Charles Fayette Taylor, “The Internal Combustion Engine in Theory and Practice”, Vol. I & II, The MIT Press.
2. John B Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill International Edition, 1998.

3. Makartchouk, A., “Diesel Engine Engineering: Thermodynamics, Dynamics, Design, and Control”. New York, and Basel: Marcel Dekker, Inc., 2002.
4. Blair, G., “The Basic Design of Two-Stroke Engines”, Warrendale, PA: Society of Automotive Engineers, 1990.
5. Owen, K., and Coley.T., “Automotive Fuels Handbook”. Warrendale, PA: Society of Automotive Engineers, 1990.
6. W.M Kays Combustion and M.E. Crawford, “Convective Heat and Mass Transfer”, McGraw Hill Intl.
7. D. Brian Spalding, “Combustion and mass Transfer’, 1st edition, Pergamon Press, 1979
8. T Cebeci, “Convective Heat Transfer”, Springer
9. Heat Exchanger Design methodology by R.K Shah
10. Compact Heat Exchanger by Kays and London
11. Heat Exchanger Design by Sadic and Kakac
12. Process heat transfer Holand and Frass
13. Process Heat Trasnfer by D.Q. Kern
14. Kenneth K.Kuo, “ Principles of Combustion”, John Wiley and sons. Inc, 2005
15. Irvin Glassman, “Combustion”, Academic Press, 1987
16. Turns,S.R., “An Introduction to Combustion, Concepts and Applications”, Mc-Graw Hill, 2000
17. Williams,F.A., “Combustion Theory” The Benjamin and Cummings Publishing Company Inc.,1985
18. Law,C.K., “Combustion Physics”, Cambridge University Press,2006

Ph.D. (Mechanical) Paper –II

ADVANCES IN MECHANICAL ENGINEERING (Heat Power-II)

Teaching Scheme:

Theory: 4 hrs/week

Examination Scheme:

Theory Examination: 100 Marks

Unit 1

1: Convective Heat Transfer:

Fully developed flows, exact and similarity solutions, boiling and condensation, special topics

Turbulence**,** Governing equations, Free shear flows, Near wall behavior, Energy spectrum, Turbulence models

Boiling and condensation: Bubble dynamics, boiling and condensation enhancement techniques, recent advances in heat pipes.

Unit 2

Conduction and radiation:

Transient heat conduction, Micro scale heat transfer, Radiation shape factor, Radiation from luminous fuel, oil, gas and flames, Radiation network, Radiation from gases and vapors

Unit 3

Advanced Trends in Heat Exchanger

Heat Exchanger design theory, recent trends in heat exchangers, advanced material in HE, Electronic cooling, Nanomaterial, micro channel heat exchangers.

Unit 4

Advanced Topics in Refrigeration and Cryogenics

Refrigeration applications in preservation of Food, transport by trucks and containers; Railway cars; Marine Refrigeration; Fans and Blowers, Sound Control. Construction of psychrometric charts, enthalpy deviation curves, advances in cryogenics, absorption system.

Reference Books

1. W.M Kays Combustion and M.E. Crawford, “Convective Heat and Mass Transfer”, McGraw Hill Intl.
1. T Cebeci, “Convective Heat Transfer”, Springer
2. Heat and Mass Transfer- Incropera, DeWitt
3. Heat and Mass Transfer – J.P Holman
4. Heat And Mass Transfer- Millls, Ganesan
5. Heat and Mass Transfer – P.K.Nag
6. Heat Exchanger Design methodology by R.K Shah
7. Compact Heat Exchanger by Kays and London
8. Heat Exchanger Design by Sadic and Kakac
9. Process heat transfer Holand and Frass
10. Process Heat Trasnfer by D.Q. Kern
11. Williams,F.A., “Combustion Theory” The Benjamin and Cummings Publishing Company Inc.,1985
12. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration
10. Threlkeld J.L., “Thermal Environmental Engineering”, Prentice Hall
13. Dossat R.J., Principles of Refrigeration, Pearson Education Asia
14. 12 Handbook of air-conditioning system design, Carrier Incorporation,McGraw Hill Book Co., U.S.A.
15. Hainer R.W. ‘Control Systems for Heating, Ventilation and Air – Conditioning’, Van Nastrand Reinhold Co., New York, 1984.

Ph.D. (Mechanical) Paper –II

ADVANCES IN MECHANICAL ENGINEERING (Production-I)

Teaching Scheme: **Examination Scheme:**

Theory: 4 hrs/week Theory Examination: 100 Marks

Unit 1:

Reliability Engineering:

Reliability evaluation of complex systems, Safeties and certifications, Terro technological Aspects

Modelling of Manufacturing Systems

Markov chains –Continuous and Discrete, Petri nets – Timed and Stochastic

Unit 2:

Metal Forming:

Yield criteria, Slip line field theory, Temperature Field in Material.- Plastic and Viscoplastic behaviour of material, Surfaces of Discontinuity, Numerical Models of Plasticity.

Advanced casting technology:

Casting Design & Pattern / Die Making, pattern and die design considerations, Computer aided casting component design, Computer aided design and manufacturing of patterns and dies. Sand Molding & Core Making Practices: High pressure molding technology, flaskless molding technology, magnetic molding, Core shooters used in shell core making and cold box process, Permanent Mold & Special Casting Techniques: Process parameters for Die casting- gravity, pressure and low pressure, Centrifugal casting, Vacuum casting, Investment casting, Squeeze casting, Casting defects and their classification, rejection analysis, remedial measures**,** High Integrity Die Casting, Vacuum die casting, Squeeze casting, Semi solid metal working, Design considerations for high integrity die Castings

Unit 3:

Computational Welding Mechanics:

Models for welding heat sources, Thermal analysis of welds, Fracture Mechanics of welded structures

Composite Materials:

Elastic behavior of unidirectional and multi directional composites, Laminated composite beams and plates (Any one)

Unit 4:

Material handling and plant layout

Evaluating and justifying material handling projects, location and layout analysis; group-of-items flow; space requirements; Unit material handling: unit load concepts, storage systems, positioning equipment, Bulk material handling, Excavators, Transportation interface, Safety and environment issues

Reference Books:

1. Materials handling handbook, Raymond Kulwiec, 2nd Ed., Wiley.
2. Plant Layout and Material Handling, Apple, James M., 3rd. ed. Wiley.
3. Goldak J.A., and Akhlaghi M., "Computational Welding Mechanics", Springer, New York, 2005.
4. Radaj D., "Heat Effects on Welding: Temperature field. Residual stress and Distortion", Springer, 1992.
5. Isaac and Daniel M., "Engineering Mechanics of Composite Materials", Oxford University Press, 1994.
6. Jones R.M., "Mechanics of Composite Materials", McGraw Hill, New York, 1975
7. Calcote L.R., "Analysis of Laminated Composite Structures", Van Nostrand Rainfold, New York, 1969
8. Kapur K.C., and Lamberson L.R., "Reliability in Engineering Design", Wiley India Pvt. Ltd., 2009.
9. Viswanadham, N and Narahari, Y. "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 2000

10. Hruz B. and Zhou M.C., “Modelling and Control of Discrete Event Dynamic Systems”, Springer, London, 2007.

11. Curry G., Feldman R.M., “Manufacturing Systems Modelling and Analysis”, Springer-Verlag, Heidelberg, 2009.

12. Sluzalec and Andrzej, “Theory of Metal Forming Plasticity - Classical and Advanced Topics” Springer Publications

13. Avitzur B., “Metal Forming - Process and analysis” Tata Mc-Graw Hill

14. Mielnik E.M., “Metal working science and Engineering”, Mc-Graw Hill. Inc

15. Principles of Metal Castings - Heine, Loper and Rosenthal (TMH)

16. Advanced Pattern Making – Cox I.L. (The Technical Press, London.

17. ASM Handbook – Vol. 15 Castings.

18. AFS and Control hand book – AFS.

19. Fundamentals of Metal Casting Technology - P.C. Mukherjee (Oxford, IBH)

20. Foundry Engineering – Taylor, Fleming & Wulff (John Wiley)

21. The Foseco Foundryman's Handbook, -Foseco, CBS Publishers & Distributors ISBN : 9780750619394

22. The New Metallurgy of Cast Metals Castings – Campbell, CBS Publishers & Distributors, ISBN- 9788131200919

23. Fundamentals of Metal Casting – Flinn, Addison Wesley

24. Principles of Metal Manufacturing Processes, J. Beddoes & M.J. Bibby (Elsevier, Butterworth, Heinemann) (2003)

25. Edward J Vinarcik, “High Integrity Die Casting Processes”, John Wiley & Sons Inc., New York, 2003.

26. Campbell John, “Castings”, Butterworth – Heinemann, 2000.

Ph.D. (Mechanical) Paper –II

ADVANCES IN MECHANICAL ENGINEERING (Production-II)

Teaching Scheme:
Theory: 4 hrs/week

Examination Scheme:
Theory Examination: 100 Marks

Unit 1: Reliability Engineering:

Reliability evaluation of complex systems, Safeties and certifications, Terro technological Aspects

Modelling of Manufacturing Systems

Markov chains –Continuous and Discrete, Petri nets – Timed and Stochastic

Unit 2: Advanced Machining Processes:

Hybrid electro-chemical processes, Hybrid thermal processes, Solid, liquid and powder based material addition processes (Analytical Study)

Composite Materials:

Elastic behavior of unidirectional and multi directional composites, Laminated composite beams and plates (Any one)

Unit 3: Jig & Fixture Design:

Fundamentals of jig-fixture design, Tolerance analysis, Modular fixtures, Computer aided fixture design, Expert systems in fixture design, fixture design optimization, estimating fixture rigidity, effect of contact stiffness in fixture assembly.

Advanced Tool & Die Design

Die Design for Deep Drawing and Stretch Drawing: design considerations, die materials, Die Design for Hydro Forming: Process Technology, Die design considerations, Extrusion Dies: Die Design for metal and plastic extrusion, die materials,

Unit 4: Material handling and plant layout

Evaluating and justifying material handling projects, location and layout analysis; group-of-items flow; space requirements; Unit material handling: unit load concepts, storage systems, positioning equipment, Bulk material handling, Excavators, Transportation interface, Safety and environment issues

Reference Books:

1. Materials handling handbook, Raymond Kulwiec, 2nd Ed., Wiley.
2. Plant Layout and Material Handling, Apple, James M., 3rd. ed. Wiley.
3. Metal Forming Handbook – Schuler, Springer- Verlag Berlin.
4. Dies for Plastic Extrusion – M.V. Joshi – Mc Millan.
5. Tool Design – C. Donaldson, LeCain & Goold (TMH)
6. Tool Design – H.W. Pollack (Taraporwalla)
7. ASM Handbook – Forming – ASME
8. Handbook of Die Design, 2/e – Suchy, I (McGraw Hill), 2006.
9. Tool Design, Donaldson, (TMH)
10. Tool Design, Pollock, Reston Pub. Co. Inc.
11. An Introduction to Jig & Tool Design, M.H.A. Kempster, (ELBS)
12. Fundamentals of Tool Design, Ed. Frank Wilson, ASTME (TMH)
13. Jigs and Fixture Design Manual, Henirkson (Industrial Press, NY)
14. A Text Book of Prod. Engineering, P. C. Sharma, S. Chand
15. Jigs and Fixture, P. H. Joshi, Tata Mc-Graw Hill Pub. Co
16. CMTI Machine Tool Design Handbook, (TMH)
17. Design Data Handbook –PSG College of Tech., Coimbtore
18. Jigs and Fixture Design 5e E.G. Hoffman CENGAGE Learning
19. Rong, Yeming; “Computer Aided Fixture Design”, Marcel Dekker, ISBN 0-8247-9961-5
20. M/c standard 8005

21. Kapur K.C., and Lamberson L.R., “Reliability in Engineering Design”, Wiley India Pvt. Ltd., 2009.

22. Isaac and Daniel M., “Engineering Mechanics of Composite Materials”, Oxford University Press, 1994.

23. Jones R.M., “Mechanics of Composite Materials”, McGraw Hill, New York, 1975

24. Calcote L.R., “Analysis of Laminated Composite Structures”, Van Nostrand Rainfold, New York, 1969

25. Hassan El-Hofy, “Advanced Machining Processes – Non Traditional and Hybrid Machining Processes”, Mc-Graw Hill, London, 2005

26. Brown J., “Advanced Machining Technology Handbook”, Mc-Graw Hill, New York, 1998

27. Viswanadham, N and Narahari, Y. “Performance Modelling of Automated Manufacturing Systems”, Prentice Hall of India, New Delhi, 2000

28. Hruz B. and Zhou M.C., “Modelling and Control of Discrete Event Dynamic Systems”, Springer, London, 2007.

29. Curry G., Feldman R.M., “Manufacturing Systems Modelling and Analysis”, Springer-Verlag, Heidelberg, 2009.

Ph.D. (Production) Paper –II

ADVANCES IN MECHANICAL ENGINEERING

(PRODUCTION ENGINEERING)

Teaching Scheme:

Theory: 4 hrs/week

Examination Scheme:

Theory Examination: 100 Marks

Unit 1: Quantitative techniques

Dual simplex method, integer programming, goal programming, branch-bound algorithm, dynamic programming, resource scheduling and leveling

Reference Books

1. Operations Research, H Taha, Prentice Hall
2. Operations Research, Hillier and Lieberman, McGraw Hill

Unit 2: Advanced Machining Processes:

Hybrid electro-chemical processes, Hybrid thermal processes, Solid, liquid and powder based material addition processes (Analytical Study)

Reference Books

1. Hassan El-Hofy, "Advanced Machining Processes – Non Traditional and Hybrid Machining Processes", Mc-Graw Hill, London, 2005

2. Brown J., "Advanced Machining Technology Handbook", Mc-Graw Hill, New York, 1998

Unit 3: Manufacturing Systems:

Machine tool design, control, automation and analysis, Computerized process planning

Reference Books

1. George Chryssolouris, "Manufacturing Systems: Theory and

2. Practice", 2nd Edition, Springer, New York, 2006.

3. Chang T.C., "Expert Process Planning for Manufacturing", Addison – Wesley, MA, 1990

4. Slocum A.H., "Precision Machine Design", SME, Prentice-Hall Inc, 1992.

Unit 4: Modeling of Production Systems

Markov chains –Continuous and Discrete, Petri nets – Timed and Stochastic

Reference Books

1. Viswanadham, N and Narahari, Y. "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 2000

2. Hruz B. and Zhou M.C., "Modelling and Control of Discrete Event Dynamic Systems", Springer, London, 2007.

3. Curry G., Feldman R.M., "Manufacturing Systems Modelling and Analysis", Springer-Verlag, Heidelberg, 2009.

ADVANCES IN MECHANICAL ENGINEERING

(CAD/CAM/CAE)

Teaching Scheme: **Examination Scheme:**

Theory: 4 hrs/week Theory Examination: 100 Marks

Unit 1: Quantitative techniques

Dual simplex method, integer programming, goal programming, branch-bound algorithm, dynamic programming, resource scheduling and leveling

Reference Books

1. Operations Research, H Taha, Prentice Hall
2. Operations Research, Hillier and Lieberman, McGraw Hill

Unit 2: Robotics

Robotic systems, trajectory, motion control, intelligence

Reference Books

1. John J Craig, "Introduction to Robotics – Mechanics and Control", Prentice Hall, 3rd Edition, 2004.

2. Fu K.S., Gonzales R.C., and Lee C.S.G., "Robotics: Control, Sensing, Vision and Intelligence, Tata Mc-Graw Hill, 2008.

Unit 3: Finite element analysis

Reference Books

Unit 4: Manufacturing Automation

Sensors, Signal processing, Programmable Logic Controller, ladder diagram, logic functions

Reference Books

1) Mechatronics, 3/e --- W. Bolton (Pearson Education)
2) Mechatronics: Principles, Concepts and Applications - N.P.Mahalik (TMH)
3) Process Control & Instrumentation Technology –Critis D. Johnson (Pearson Education)

4) Mechatronics System Design - Devdas Shetty, Richard A. Kolk (Thomson)

ADVANCES IN MECHANICAL ENGINEERING

(INDUSTRIAL ENGINEERING)

Teaching Scheme: **Examination Scheme:**

Theory: 4 hrs/week Theory Examination: 100 Marks

Unit 1: Quantitative techniques

Dual simplex method, integer programming, goal programming, branch-bound algorithm, dynamic programming, resource scheduling and leveling

Reference Books

1. Operations Research, H Taha, Prentice Hall
2. Operations Research, Hillier and Lieberman, McGraw Hill

Unit 2: Single and multi-variable optimization

Single variable methods: quadratic interpolation, cubic interpolation, Multi-variable methods: Evolutionary optimization, simplex search, conjugate direction, conjugate gradient method

Reference Books

1. Deb K (2004). Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India
2. Rao S (1996). Engineering optimization, Theory and Practice, New Age International Publishers

Unit 3: Worksystem design

Issues in Worksystem Design, Measuring Work by Physiological means, Work Posture, Fatigue Measurement and Evaluation, Environmental Factors and Work Systems

Reference Books

1. Introduction to ergonomics by R S Bridger, CRC Press
2. Human factors in engineering and design: Sanders and McCormick, McGraw Hill

Unit 4: Reliability Engineering:

Reliability evaluation of complex systems, Safeties and certifications, Terro technological Aspects

Reference Books

1. Reliability Engineering: Balgurusamy

2. Kapur K.C., and Lamberson L.R., "Reliability in Engineering Design", Wiley India Pvt. Ltd., 2009.

ADVANCES IN MECHANICAL ENGINEERING

(PRODUCTION ENGINEERING)

Teaching Scheme:

Theory: 4 hrs/week

Examination Scheme:

Theory Examination: 100 Marks

Unit 1: Quantitative techniques

Dual simplex method, integer programming, goal programming, branch-bound algorithm, dynamic programming, resource scheduling and leveling

Reference Books

1. Operations Research, H Taha, Prentice Hall
2. Operations Research, Hillier and Lieberman, McGraw Hill

Unit 2: Advanced Machining Processes:

Hybrid electro-chemical processes, Hybrid thermal processes, Solid, liquid and powder based material addition processes (Analytical Study)

Reference Books

1. Hassan El-Hofy, "Advanced Machining Processes – Non Traditional and Hybrid Machining Processes", Mc-Graw Hill, London, 2005

2. Brown J., “Advanced Machining Technology Handbook”, Mc-Graw Hill, New York, 1998

Unit 3: Manufacturing Systems:

Machine tool design, control, automation and analysis, Computerized process planning

Reference Books

1. George Chryssolouris, “Manufacturing Systems: Theory and

2. Practice”, 2nd Edition, Springer, New York, 2006.

3. Chang T.C., “Expert Process Planning for Manufacturing”, Addison – Wesley, MA, 1990

4. Slocum A.H., “Precision Machine Design”, SME, Prentice-Hall Inc, 1992.

Unit 4: Modeling of Production Systems

Markov chains –Continuous and Discrete, Petri nets – Timed and Stochastic

Reference Books

1. Viswanadham, N and Narahari, Y. “Performance Modelling of Automated Manufacturing Systems”, Prentice Hall of India, New Delhi, 2000

2. Hruz B. and Zhou M.C., “Modelling and Control of Discrete Event Dynamic Systems”, Springer, London, 2007.

3. Curry G., Feldman R.M., “Manufacturing Systems Modelling and Analysis”, Springer-Verlag, Heidelberg, 2009.

ADVANCES IN MECHANICAL ENGINEERING

(CAD/CAM/CAE)

Teaching Scheme: **Examination Scheme:**

Theory: 4 hrs/week Theory Examination: 100 Marks

Unit 1: Quantitative techniques

Dual simplex method, integer programming, goal programming, branch-bound algorithm, dynamic programming, resource scheduling and leveling

Reference Books

1. Operations Research, H Taha, Prentice Hall
2. Operations Research, Hillier and Lieberman, McGraw Hill

Unit 2: Robotics

Robotic systems, trajectory, motion control, intelligence

Reference Books

1. John J Craig, "Introduction to Robotics – Mechanics and Control", Prentice Hall, 3rd Edition, 2004.

2. Fu K.S., Gonzales R.C., and Lee C.S.G., "Robotics: Control, Sensing, Vision and Intelligence, Tata Mc-Graw Hill, 2008.

Unit 3: Finite element analysis

Reference Books

Unit 4: Manufacturing Automation

Sensors, Signal processing, Programmable Logic Controller, ladder diagram, logic functions

Reference Books

1) Mechatronics, 3/e --- W. Bolton (Pearson Education)
2) Mechatronics: Principles, Concepts and Applications - N.P.Mahalik (TMH)
3) Process Control & Instrumentation Technology –Critis D. Johnson (Pearson Education)
4) Mechatronics System Design - Devdas Shetty, Richard A. Kolk (Thomson)

ADVANCES IN MECHANICAL ENGINEERING

(INDUSTRIAL ENGINEERING)

Teaching Scheme: **Examination Scheme:**

Theory: 4 hrs/week Theory Examination: 100 Marks

Unit 1: Quantitative techniques

Dual simplex method, integer programming, goal programming, branch-bound algorithm, dynamic programming, resource scheduling and leveling

Reference Books

1. Operations Research, H Taha, Prentice Hall
2. Operations Research, Hillier and Lieberman, McGraw Hill

Unit 2: Single and multi-variable optimization

Single variable methods: quadratic interpolation, cubic interpolation, Multi-variable methods: Evolutionary optimization, simplex search, conjugate direction, conjugate gradient method

Reference Books

1. Deb K (2004). Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India
2. Rao S (1996). Engineering optimization, Theory and Practice, New Age International Publishers

Unit 3: Worksystem design

Issues in Worksystem Design, Measuring Work by Physiological means, Work Posture, Fatigue Measurement and Evaluation, Environmental Factors and Work Systems

Reference Books

1. Introduction to ergonomics by R S Bridger, CRC Press
2. Human factors in engineering and design: Sanders and McCormick, McGraw Hill

Unit 4: Reliability Engineering:

Reliability evaluation of complex systems, Safeties and certifications, Terro technological Aspects

Reference Books

1. Reliability Engineering: Balgurusamy

2. Kapur K.C., and Lamberson L.R., "Reliability in Engineering Design", Wiley India Pvt. Ltd., 2009.

List of Ph.D. (Mechanical) paper III (elective)

1. Numerical Computation of Fluid and Heat Flow.
2. Energy Analysis of Thermal Systems
3. Design of Heat Transfer Equipments
4. Mathematical Modeling and Design Optimization
5. Advanced theory of vibration
6. Analysis and Synthesis of Mechanisms
7. Advanced Finite Element Analysis
8. Noise and Vibration Harshness(NVH)
9. Optimization Techniques
10. Mechatronics system design
11. MEMS & Nanotechnology
12. Supply chain management & Logistics
13. Automatic Control Engineering
14. Decision Making in Manufacturing Environment
15. Metal Forming Technology
16. Mechatronics
17. Advanced casting technology
18. Manufacturing Systems
19. Precision Engineering
20. Computer Aided Manufacturing
21. Advanced Materials & Processing
22. Tribology
23. Technology Management
24. Database Management
25. Modern manufacturing systems
26. Low Cost Automation

Ph.D. (Mechanical) Paper –III (Elective)

1. Numerical Computation of Fluid and Heat Flow

Teaching Scheme:	Examination
Lecture: 3 hrs/week	Paper: 80 Marks
Tutorial: 1 hrs/week	Term Work: 20 Marks

Unit I

1. Introduction to CFD.
   Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations
2. Governing Equations.
   Review of Navier-stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy

Unit II

3. Finite Volume Method.
   Domain discretizations, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling,
4. Checkerboard pressure field and staggered grid approach
   Geometry Modeling and Grid Generation

Unit III

5. Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh Quality, Key parameters and their importance
   Methodology of CFDHT
6. Objective and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection- Diffusion Equation

Unit IV

7. Solution of N-S Equation for Incompressible Flows
8. Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered grid System of N-S Equations for Incompressible Flows.

Term Work:

Term paper based on literature survey on any advance topic in this subject.

Reference Books:

1. Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr., McGraw hill International editions, Mechanical Engineering series.
2. Numerical Methods in Fluid Flow & Heat Transfer by Dr.Suhas Patankar.
3. An Introduction to Computational Fluid Flow (Finite Volume Method) , by H.K.Versteeg, W, Malalasekera, Printice Hall.
4. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer publication.
5. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
6. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa publication.

Ph.D. (Mechanical) Paper –III (Elective)

2. Energy Analysis of Thermal Systems

Teaching Scheme:	Examination
Lecture: 3 hrs/week	Paper: 80 Marks
Tutorial: 1 hrs/week	Term Work: 20 Marks

Unit I

1. **Introduction to Thermal System Design:** Introduction; Workable, optimal and nearly optimal design; Thermal system design aspects; concept creation and assessment; Computer aided thermal system design.

2 **Thermodynamic modeling and design analysis:** First and second law of thermodynamics as applied to systems and control volumes, Entropy generation; Thermodynamic model – Cogeneration system.

Unit II

3 **Exergy Analysis :-** Exergy definition, dead state and exergy components ; Physical Exergy – Exergy balance ; Chemical Exergy ; Applications of exergy analysis; Guidelines for evaluating and improving thermodynamic effectiveness.

4 **Heat transfer modeling and design analysis:-** Objective of heat transfer processes; Review of heat transfer processes involving conduction, convection and radiation and the corresponding heat transfer equations used in the design.

Unit III

5 **Design of piping and pump systems:-** Head loss representation ;Piping networks ; Hardy – Cross method ; Generalized Hardy – Cross analysis ; Pump testing methods ; Cavitation considerations ;Dimensional analysis of pumps ; piping system design practice.

Unit IV

6 **Thermo-economic analysis and evaluation:-** Fundamentals of thermo-economics, Thermo-economic variables for component evaluation ; thermo-economic evaluation ; additional costing considerations.

7 **Thermo-economic optimization:-** Introduction ; optimization of heat exchanger networks ;analytical and numerical optimization techniques ; design optimization for the co-generation system- a case study ; thermo-economic optimization of complex systems.

Term Work:

Term paper based on literature survey on any advance topic in this subject

REFERENCE BOOKS:

1. **Thermal Design & Optimization -** Bejan, A., et al., John Wiley, 1996
2. **Analysis & Design of Thermal Systems -** Hodge, B.K., 2nd edition, Prentice Hall, 1990.
3. **Design of Thermal Systems -** Boehm, R.F., John Wiley, 1987
4. **Design of Thermal Systems -** Stoecker, W.F., McGraw-Hill

Ph.D. (Mechanical) Paper –III (Elective)

3. DESIGN OF HEAT TRANSFER EQUIPMENTS

Teaching Scheme:
Lecture: 3 hrs/week
Tutorial: 1 hrs/week

Examination
Paper: 80 Marks
Term Work: 20 Marks

Unit I

1. Different Classification of Heat Exchangers: Parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multipass; once through steam generators etc

2. Design of Shell and Tube Heat Exchanger: Thickness calculation, Tubesheet design using TEMA formula, concept of equivalent plate for analysing perforated analysis, flow induced vibration risks including acoustic issues and remedies, tube to tubesheet joint design, buckling of tubes, thermal stresses

Unit II

3: Boiler furnace design: Heat transfer in coal fired boiler furnace (gas side) – Estimation of furnace exit gas temperature, estimation of fin-tip temperature. Heat transfer in two phase flow- Estimation of inside heat transfer coefficient using Jens & Lottes equation and

Thom's correlation. Estimation of pressure drop in two phase flow using Thom's method.

4. Design of Steam Condenser and evaporative condensers: Effect of tube side velocity on surface area and pressure drop for various tube sizes (It involves estimation of tube side velocity, surface area

and pressure drop for various tube sizes & Plot the graph) and estimation of shell diameter of steam condenser.

Unit III

5. Design of Fuel Oil Suction Heater, Design of Fuel Oil Heater, Design of Recuperative Air Pre Heater, Design of Economizer: Design includes estimation of heat transfer area, pressure drop etc Superheater and Reheater Design, Design of heat pipe

Unit IV

6. Design of Cooling Tower : Design of surface and evaporative condensers ,cooling tower, performance characteristics

Term Work:

Term paper based on literature survey on any advance topic in this subject.

Reference Books:

1. **Process Heat Transfer** - D.Q. Kern, McGraw-Hill Publications
2. **Applied Heat Transfer** - V. Ganapathy, Penn Well Publishing Company, Tulsa, Oklahoma.
3. **Process Heat Transfer** - Sarit Kumar Das, A. R. Balakrishan, Alpha Science International, 2005.

Ph.D. (Mechanical) Paper –III (Elective)

4. Mathematical Modeling and Design Optimization

Teaching Scheme:
Lecture: 3 hrs/week
Tutorial: 1 hrs/week

Examination
Paper: 80 Marks
Term Work: 20 Marks

Unit I:

Research Modeling: The Reality, the experiment and the model, Concept of modeling, Models as Approximations ,Types of Modeling, Need and Classification of mathematical modeling, Use of Analogy, Data consideration and Testing of Models, Modeling 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:

2. 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 :

3. 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.

Text 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 Granovky, ”Optimization of Engineering Experiments”, Meer Publications

References:

1. Trochim, William M.K. (2003), 2/e, Research Methods, (Biztantra, Dreamtech Press, New Delhi), ISBN : 81-7722-372-0
2. Montgomery, Douglas C., & Tunger, George C. (2007). 3/e, Applied Statistics & Probability for Engineers, (Wiley India).
3. Ross P.J., "Taguchi Techniques for Quality Engineering", TMH, 2005.
4. Jeff Wu, "Experiments: Planning, Analysis and Parameter Design", John Wiley, 2000.
5. Fox R.L., "Optimization Methods for Engineering Design", Addison Wesley, 1971.

Ph.D. (Mechanical) Paper –III (Elective)

5. Advanced Theory of Vibrations

Teaching Scheme:	Examination
Lecture: 3 hrs/week	Paper: 80 Marks
Tutorial: 1 hrs/week	Term Work: 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:

3. **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.

4. **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:

5. **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.
6. **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.
7. **Validation of Analytical Models:** Preliminary check, correlation of analytical model with experimental model, model updating- fundamentals.

Unit IV :

8. **Non-Linear Vibrations**: Introduction, Sources of nonlinearity, Qualitative analysis of nonlinear systems. Phase plane, Conservative systems, Stability of equilibrium, Limit cycles-van der pol oscillator, Perturbation method, Chaos, Method of iteration, Self-excited oscillations, Lindstedt's Method.
9. **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:

Term paper based on literature survey on any advance topic in this subject.

References 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
8. Elements of Vibration Analysis, Lenord Meirovitch, Mc,Graw Hill Ltd, 2004
9. Vibration: Fundamental and Practice, Clarence W. de Silva, CRC Press LLC, 2000.
10. Fundamentals of Mechanical Vibration. - S. Graham Kelly. 2 nd edition McGraw Hill.

Ph.D. (Mechanical) Paper –III (Elective)
6. Analysis and Synthesis of Mechanisms

Teaching Scheme:	Examination
Lecture: 3 hrs/week	Paper: 80 Marks
Tutorial: 1 hrs/week	Term Work: 20 Marks

Unit I :

1. Basic Concepts:

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

2. Kinematic Analysis Of Complex Mechanisms: velocity-acceleration analysis of complex mechanisms by the normal acceleration and auxiliary point methods.

Unit II:

3. 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.

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

Unit III:

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

Unit IV:

6. **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

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

Term Work:

Term paper based on literature survey on any advance topic in this subject.

References 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.

Ph.D. (Mechanical) Paper –III (Elective)

7. Advanced Finite Element Analysis

Teaching Scheme: Examination

Lecture: 3 hrs/week Paper: 80 Marks

Tutorial: 1 hrs/week Term Work: 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 4), 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.

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, quadrilatateral 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:

Term paper based on literature survey on any advance topic in this subject

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 Finite Elements 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.

Ph.D. (Mechanical) Paper –III (Elective)

8. Noise and Vibration Harshness (NVH)

Teaching Scheme: Examination

Lecture: 3 hrs/week Paper: 80 Marks

Tutorial: 1 hrs/week Term Work: 20 Marks

Unit I :

1.Introduction to NVH:

Sources of noise and vibration. Design features, Common problems, Marque 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:

Term paper based on literature survey on any advance topic in this subject.

References 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.

Ph.D. (Mechanical) Paper –III (Elective)

9. Optimization Techniques

Teaching Load:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme

Examination

Paper: 80 Marks

Term Work: 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, algorithm

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:

Term paper based on literature survey on any advance topic in this subject.

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.

Ph.D. (Mechanical) Paper –III (Elective)

10. **Mechatronic System Design**

Teaching Scheme:
Lecture: 3 hrs/week
Tutorial: 1 hrs/week

Examination
Paper: 80 Marks
Term Work: 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 :

7. Advanced Applications in Mechatronics: Mechatronic control in automated manufacturing, Artificial Intelligence in mechatronics, Fuzzy Logic application in Mechatronics, Microsensors in Mechatronics, Case studies of Mechatronic systems.

Term Work:

Term paper based on literature survey on any advance topic in this subject.

Reference Books

5) Mechatronics, 3/e --- W. Bolton (Pearson Education)
6) Mechatronics -Dan Necsulescu (Pearson Education)
7) The 8051 Microcontroller: Architecture, Programming and Applications, 2/e—Kenneth J. Ayala (Penram International)
8) Mechatronics: Principles, Concepts and Applications - N.P.Mahalik (TMH)
9) Introduction to Mechatronics & Measurement Systems – David G. Alciatore & Michael B. Histand (TMH)
10) Process Control & Instrumentation Technology –Critis D. Johnson (Pearson Education)
11) Mechatronics System Design - Devdas Shetty, Richard A. Kolk (CENGAGE)
12) Computer Control of Manufacturing Systems - Yoram Koren (McGraw Hill)
13) Automated Manufacturing Systems: Sensors, Actuators - S. Brain Morriss (McGraw Hill)
14) Industrial Automation – David W. Pessen (John Wiley & Sons)
15) 99 Examples of Pneumatic Applications – FESTO Controls Pvt. Ltd. Bangalore.
16) Modular Pick and Place Device– FESTO Controls Pvt. Ltd. Bangalore.
17) Rationalization with Handling Technology– FESTO Controls Pvt. Ltd. Bangalore.
18) Rationalization with Small Workpiece Feeding- FESTO Controls Pvt. Ltd. Bangalore.
19) Sensors for Handling & Processing Technology- FESTO Controls Pvt. Ltd. Bangalore.
20) Sensors in Production Engg. - FESTO Controls Pvt. Ltd. Bangalore.
21) Handbook of Industrial Automation – Richard L. Shell & Ernest L. Hall (Marcel Decker Inc.)
22) Programmable Logic Controllers" Programming Methods and Applications (with CD Rom) – Jack R. Hackworth & Fredrick D. Hackworth,Jr.(Pearson Education)

23) Mechatronics – M. D. Singh & J.G. Joshi (Prentice Hall of India)

Ph.D. (Mechanical) Paper –III (Elective)

11. MEMS & NANOTECHNOLOGY

Teaching Scheme:

Teaching Scheme:
Lecture: 3 hrs/week
Tutorial: 1 hrs/week

Examination Scheme:

Examination
Paper: 80 Marks
Term Work: 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, nanoscale, consequences of the nanoscale 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 micromanufacturing, 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 :

Microsensors and actuators: Sensing and actuation, Chemical sensors, Optical sensors, Pressure sensors, Thermal sensors – thermopiles, thermistors, micromachined thermocouple probes, thermal flow sensors, MEMS magnetic sensor, Piezoelectric material as sensing and actuating elements – capacitance, piezomechanics, Piezoactuators as grippers, microgrippers, micromotors, microvalves, micropumps,

microaccelerometers, microfluidics, shape memory alloy based optical switch, thermally activated MEMS relay, microspring 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:

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

Unit IV :

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

Term Work: Term paper based on literature survey on any advance topic in this subject.

Reference books:

1. Bharat Bhushan (Ed.), (2004), Handbook of Nanotechnology, Spinger-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), Micromanufacturing & Nanotechnology, Springer India Pvt. Ltd., ISBN: 978-81-8128-505-8 (Distributed by New Age International, New Delhi)

5. Nanosystems: Molecular Machinery, Manufacturing & Computation, K E Drexler, (Wiley), (1992), ISBN 0471575186

6. P.Rai- Choudhury, Handbook of Microlithography, Micromachining & Microfabrication, 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

Ph.D. (Mechanical) Paper –III (Elective)

12. Supply Chain Management & Logistics

Teaching Scheme:

Teaching Scheme:
Lecture: 3 hrs/week
Tutorial: 1 hrs/week

Examination Scheme:

Examination
Paper: 80 Marks
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.5

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.

Term Work:

Term paper based on literature survey on any advance topic in this subject.

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.

Ph.D. (Mechanical) Paper –III (Elective)

13. AUTOMATIC CONTROL ENGINEERING

Teaching Scheme: **Examination Scheme:**

Teaching Scheme: Examination

Lecture: 3 hrs/week Paper: 80 Marks

Tutorial: 1 hrs/week Term Work: 20 Marks

Unit I:

1. Introduction to Automatic Control Systems:-Basic definition, Structure of a feedback systems, closed loop and open loop control systems. Laplace Transformation, Building blocks and transfer functions of mechanical, electrical, thermal and hydraulic systems. Mathematical models of physical systems, control systems components. Systems with dead time, control hardware and their models, Electro-hydraulic valves, hydraulic servomotors, synchros, LVDT, electro-pneumatic valves, pneumatic actuators.

Unit II:

2. Basic characteristic of feedback control systems:-Stability, steady state accuracy, transient accuracy, disturbance rejection, insensitive and robustness, Basic models of feedback control systems:- Proportional, integral, derivative and PID, feed forward and multi loop control configurations, stability, concept of relative stability.

Unit III:

3. Root locus and frequency response methods, stability in frequency domain, frequency domain methods of design, compensation and their realization in time and frequency domain, improving system performance.

4. Design of Lead lag compensators, OpAmp based and digital implementation of compensators, Tuning of process controllers.

Unit IV:

5. Introduction to design, sample data control systems, stable variable analysis and design, optimal control systems

6. Introduction to non linear control systems, discrete time systems and Z-Transformation methods, Microprocessor based digital control, State space analysis, Optimal and adaptive control systems.

Term Work:

Term paper based on literature survey on any advance topic in this subject.

Reference Books:

1. F.H.Raven,"Automatic Control Engineering", Third edition, McGraw Hill, 1983.
2. K.Ogata,"Modern Control Engineering", PHI, Estern Economy Edition, 1982.
3. I.J.Nagrath, M.Gopal,"Control Systems Engineering".
4. B.C.Kuo, "Automatic Control Systems".
5. Schaum Series," Theory and Problems of Feedback and Control Systems". (MGH)
6. Miller R.W.,"Servo Mechanism Devices and Fundamentals".
7. Dr.N.K.Jain,"Automatic Control Systems Engineering", Dhanpat Rai Publishing Company.
8. Jack Golten, Andy Verwer, "Control System Design and Simulation", McGraw Hill

Ph.D. (Mechanical) Paper –III (Elective)

14. Decision Making in Manufacturing Environment

Teaching Scheme: **Examination Scheme:**

Teaching Scheme: Examination

Lecture: 3 hrs/week Paper: 80 Marks

Tutorial: 1 hrs/week Term Work: 20 Marks

Unit I

1. **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

2. **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

Unit III

3. **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

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

Ph.D. (Mechanical) Paper –III (Elective)

15. Metal Forming Technology

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:

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

Unit 2:

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

Unit 3:

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

Unit 4:

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, McGrew 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

Ph.D. (Mechanical) Paper –III (Elective)

16. Mechatronics

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:
Sensors: 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;

Unit 2:
Signal processing: Transducer signal conditioning process, principals of analogue and digital signal conditioning, protection, filtering, operational and instrumentation amplifiers and their gains,

Unit 3:
Analogue to digital and digital to analogue conversion, multiplexers, pulse modulation;

Unit 4:
Programmable Logic Controller: Input/output processing, programming, functional block diagram (FBD),
ladder diagram, logic functions, latching, sequencing, jumps, internal relays, counters, shift registers, master and jump control

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

24) Mechatronics, 3/e --- W. Bolton (Pearson Education)
25) Mechatronics: Principles, Concepts and Applications - N.P.Mahalik (TMH)
26) Process Control & Instrumentation Technology –Critis D. Johnson (Pearson Education)
27) Mechatronics System Design - Devdas Shetty, Richard A. Kolk (Thomson)
28) Programmable Logic Controllers" Programming Methods and Applications (with CD Rom) – Jack R. Hackworth & Fredrick D. Hackworth,Jr.(Pearson Education).

Ph.D. (Mechanical) Paper –III (Elective)

17. Advanced casting technology

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:
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 2:
Sand Molding & Core Making Practices: High pressure molding technology, flaskless molding technology, magnetic molding, Core shooters used in shell core making and cold box process,

Unit 3:
Permanent Mold & Special Casting Techniques: Process parameters for Die casting-gravity, pressure and low pressure, Centrifugal casting, Vacuum casting, Investment casting, Squeeze casting,

Unit 4:
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.
9) Fundamentals of Metal Casting Technology - P.C. Mukherjee (Oxford, IBH)
5) Foundry Engineering – Taylor, Fleming & Wulff (John Wiley)
6) The Foseco Foundryman's Handbook, -Foseco, CBS Publishers & Distributors, ISBN: 9780750619394
7) The New Metallurgy of Cast Metals Castings – Campbell, CBS Publishers & Distributors, ISBN- 9788131200919
8) Fundamentals of Metal Casting – Flinn, Addison Wesley

9)Principles of Metal Manufacturing Processes, J. Beddoes & M.J. Bibby (Elsevier, Butterworth, Heinemann) (2003)

Ph.D. (Mechanical) Paper –III (Elective)

18. Manufacturing Systems

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:
Manufacturing Systems: Structural aspects, transformational aspects, procedural aspects, integrated manufacturing systems, Mass Customization, Multi-Product Small Batch Production- Economies of Scope with Diversification;

Unit 2:
Logistic Systems- Material flow: conversion / transportation / storage

Unit 3:
Manufacturing Optimization: Criteria for Evaluation, Optimization of single stage manufacturing- Unit production time and cost; Optimization of multistage manufacturing system

Unit 4:
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
2. B. Wu, "Manufacturing Systems Design & Analysis: Context and Techniques" (2/e), Chapman & Hall, UK, ISBN 041258140X
3. Mikell P. Groover, (2002), "Automation, Production Systems and Computer Integrated Manufacturing", (2/e), Pearson Education, ISBN 81-7808-511-9
4. Radhakrishan P., Subramaniyan S. and Raju V., "CAD / CAM / CIM", (3/E), New Age International Publication

Ph.D. (Mechanical) Paper –III (Elective)

19 Precision Engineering

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:

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 2:

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

Unit 3:

Diamond turning and milling – machines, tool design and alignment

Unit 4:

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 Engineering 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

Ph.D. (Mechanical) Paper –III (Elective)

20 Computer Aided Manufacturing

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:
Part programming on Lathe and machining centers using G & M codes

Unit 2:
Different types of tools and tool holders used on CNC Machines, parameters for selection of configuration of cutting tools

Unit 3:
Modular tools and fixtures, use of pallets for work holding, palletizing of fixtures

Unit 4:
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. Jon Stenerson and Kelly Curran "Computer Numerical Control", Prentice-Hall of India Pvt. Ltd. New Delhi, 2008
2. P. N. Rao "CAD/CAM principles and operations", Tata McGraw Hill
3. Thomas M. Crandell "CNC Machining and Programming, Industrial Press ISBN-0-8311-3118-7

Ph.D. (Mechanical) Paper –III (Elective)

21 Advanced Materials & Processing

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:

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

Unit 2:

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

Unit 3:

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

Unit 4:

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

Ph.D. (Mechanical) Paper –III (Elective)

22 Tribology

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:

Friction: Theory of friction- sliding and rolling friction, Friction properties of metallic and non metallic materials, friction in extreme conditions,

Unit 2:

Wear, types of wear, mechanisms of wear, wear resistant materials,

Unit 3:

Lubrication: Hydrodynamic lubrication, Reynolds equation, Thermal, inertia and turbulent effects, Elasto, Plasto and magneto hydrodynamic lubrication, Hydrostatic, Gas lubrication,

Unit 4:

Surface Engineering: Diffusion Coatings, Electro and Electroless platings, Hot dip coating, Metal Spraying, Cladded coatings, Crystallizing coatings

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. Hulling J. " Principles of Tribology" Mc Millan, 1984
2. Williams J.A. "Engineering Tribology" Oxford University press, 1994.
3. Davis J. "Surface Engineering for corrosion and Wear Resistance", Woodhead Publishing, 2001.
4. Tadausz Burakowski, "Surface Engineering of Metals: Principles, Equipments, Tehnologies" Taylor and Francis.

Ph.D. (Mechanical) Paper –III (Elective)

23 Technology Management

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:
Holistic Model of Management of Technology (MOT), Technology-strategy relationship

Unit 2:
Elements of technology strategy and formulation of a technology strategy, Integration of technology strategy and business strategy for competitive success technology

Unit 3:
Technology Transfer: Model of TT, System of TT with Public and Private Enterprises

Unit 4:
Intellectual Property Rights: Patentable and non-patentable inventions, statutory exceptions, Persons entitled to apply for patents

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. Hand Book of Technology Management, by Gerard H. Gaynor, McGraw Hill.
2.Strategic Management of Technological Innovation, 2/e (SIE)
Authors: SCHILLING, MELISSA, Tata McGraw Hill Division: Higher Education
ISBN-13: 978-0-07-066712-9 ISBN-10: 0070667128 ©2007 | 2nd Edition,
3.Strategic Management Tata McGraw Hill Authors: Pearce, John; ROVINSON, RICHARD Division: Higher Education ISBN-13: 978-0-07-060393-6 ISBN-10: 0070603936 ©2005 | 9th Edition
4.The Management Of Intellectual Property, by Satyawrat Ponkshe, Ponkshe & Bhate Publications, Pune.

Ph.D. (Mechanical) Paper –III (Elective)

24 Database Management

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:

Data models, data base languages, data base administrator, design issues, mapping constraints, keys, entity relationship diagram

Unit 2:

Structured query language: basic structure, set operations, aggregate functions, null values, nested sub-queries, views, modification of data base

Unit 3:

File structures: file organization, organization of records in files, data dictionary storage, sequential files, data definition language, indexing: query optimization, transactions, transaction recovery

Unit 4:

Conceptual DBMS, types of data structures and their applications in FMS, Integrated DBMS in FMS and its implementation

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. Data Base System Concepts - Abraham Silberschatz, Henry F. Korth, S. Sudarshan, 3/e, 1997, McGraw Hill International Edition.
2. An Introduction to Data Base Systems - C. J. Date, 7/e (2003) (PearsonEducation)
3. Principles of Data Base Systems –Jeffery D. Ullman, 2/e (2000) Galgotia Publications.
4. Principles of Data Base Management – James Martin (10th Reprint, 1998) (EEE) (PHI).
5. CAD/CAM/CIM, 3/e – Radhakrishnan, Subramanayam & Raju (New Age International)

Ph.D. (Mechanical) Paper –III (Elective)

25 Modern manufacturing systems

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:
Concept of F.M. Cell and F.M.System, Functions of a manufacturing cell, Types and components of FMS,

Unit 2:
Tests of flexibility, Group Technology and FMS, Architecture of typical FMS, Shop Floor Control system, dynamic scheduling in FMS,

Unit 3:
Flexible Assembly Systems: Basic concepts, classification, planning and scheduling in FAS,

Unit 4:
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)

Ph.D. (Mechanical) Paper –III (Elective)

26 Low Cost Automation

Teaching Scheme:

Teaching Scheme:

Lecture: 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Examination

Paper: 80 Marks

Term Work: 20 Marks

Unit 1:

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

Unit 2:

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

Unit 3:

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

Unit 4:

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.