## Advances in Production & Industrial Engineering

1. **Quantitative techniques:**
   - Optimization techniques, Simulation Using Software, Non-linear Programming, Goal Programming, Inventory Management , Supply Chain Management, Project Management, Resource Optimization.
   - **Books**
     1. Gupta P. K. and Hira D. S. : Operations Research, S Chand & Company Ltd.
     2. Sharma J. K. : Mathematical Models in Operations Research, Tata McGraw – Hill Publishing Company Limited.
     3. Sharma S. D., Kedar Nath : Operations Research, Ram Nath & Co.
     4. R. Panneerselvam : Operations Research, Prentice Hall of India Pvt. Ltd

2. **Robotics And Automation:**
   - CAD / CAM, Rapid Prototyping, Flexible Manufacturing Systems And Group Technology ( MICLASS, OPTIZ ), Cell Formation in GT.
     Analysis of Vision System, online Inspection through Vision System, Design of Grippers, various sensors in robotics, Robot kinematics and dynamics, Trajectory Planning in robotics, Avoiding obstacles by robot.
   - **Books**
     1. Robotics Technology and Flexible Automation – S.R. Deb Tata McGraw Hill.
     2. Robotics for Engineers – Yoram Koren, Tata McGraw Hill.
     3. Industrial Robotics – Groover, Weiss, Tata McGraw Hill.
     4. Robotics – Control, Sensing, Vision and Intelligence – K. S. Fu, R. C. Gonzalez, C. S. G. Lee, McGraw Hill Int.
        Robotics and Image Processing by P.A. Janakiraman, Tata McGraw Hill 1995
3. **Facility planning:**
   - Site selection theories, Physical facilities – Algorithm, Automated Guided Vehicles ( AGV's), Material handling systems – Conveyor design., Deterministic models - single and multi facility location models, Job Allocation problems - quadratic assignment problems, Warehouse layout models, plant location problems
   - **Books**
     1. Facilities Planning, Thompkins, J A and White, J. A.
     2. Facility layout and Location. Francies, R.L. and White, J. A
     3. Plant Layout and Material handling James M Apple,2"d Edition., John, Wiely and Sail.

4. **Production Systems:**
   - Markov chain analysis, Discrete Time Markov Chain, Assembly line balancing, Petri Nets, Generalized Stochastic PetriNets, Stochastic of manufacturing Systems, Economic analysis, Materials Management, Operations Management.
   - **Books**
     1. Production Flow Analysis for Planning Group Technology – John L. Burbridge
     2. Just in Time – David Hutchins-Gower Publishing ISBN-0566077981
     3. Handbook of MRP II and JIT-John Petroff-Prentice hall

5. **Reliability / Maintenance:**
   - Fault Tree Analysis & Event Tree Analysis, Accelerated reliability testing, Nonparametric reliability evaluation, Failure Modes Effects Analysis & Failure

Modes Effects and Criticality Analysis, HASS, HALT, reliability evaluation of complex system, Evaluation of system reliability, maintainability and availability, AGREE, ARINC, Mean & Median statistical methods, Fair & Kim's Algorithm.

- **Books**
  1. Concepts in Reliability in Engineering – L. S. Srinath, Affiliated East West Press.
  2. Reliability in Engineering Design – K. C. Kapur and L. R. Lumbersome, Willey.
  3. System reliability-Modelling and Evaluation – C. Singh and R. Billinton, Hutchinson.
  4. Terotechnology: Reliability Engineering and Maintenance Management - B Bhadury and S.K. Basu, Asian Books, New Delhi 2002.
  5. A.K. Gupta: Reliability Engineering & Terotechnology Mc Millan (I) Ltd.
  6. Terotechnology & Reliability Engineering: A. K. Gupta, McMillan Co.
  7. Maintenance, Replacement & Reliability: A. K. S. Jardine, HMSO, London.

**6. Work Study & Ergonomics:**

a. Time & Motion Study, PMTS, Anthropometry, Critical analysis of work design criteria, Man - machine learning phenomenon, Bio – dynamics analysis, Job evaluation and merit rating.

**b. Books**

1. Human Factors in Design and Manufacturing-Mark S.Sanders, Ernest. J. McCORMICK.
2. Works Organisation and Management: Basu S.K., Sahoo K.C., and Datta N.K., Oxford-IBH, 3rd Edn., 1997.
3. Human Engineering- Guide to Equipment design C.T.Morgan, J.S.Cook, A. Chapnis and M.W.Land: McGraw Hill, N.Y, 1963.
4. Barnes, "Motion and Time Study", Wiley International.

**7. Advanced Machine Tool Design**

a. Design of elements like Bed, Columns, Guideways, Design of Guides using FEA, Lumped parametric method, Design of spindles based on deformation and rigidity, Reliability based design, static and dynamic rigidity, stability analysis, Vibrational study - Microdisplacement and error analysis Modular Concept in Machine tool structure.

**b. Books**

1. Design of Machine Tools – Latest Edn. – S. K. Basu and D. K. Pal, Oxford – IBH.
2. Computer Numerical Control Machines – B. Leatham and Jones.
3. Computer Control in Manufacturing – Yoram Koren, Tata McGrew Hill.
4. Numerical Control and Computer Aided Manufacturing – Kundra, Rao and Tiwari, Tata McGraw Hill.
5. NC Machine tools – S.J. Martin, ELBS.
6. Principles of Machine Tools – A. Bhattacharya and G.C. Sen, New Central Book Agency, Calcutta.
7. Machine Tool Design – N. K. Mehta, Tata McGraw Hill.

**8. Advanced Machining / Non conventional Machining**

a. Theory and Numerical analysis of abrasive jet machine, Abrasive flow machining, Ultrasonic machining, Electrical Discharge Machining(EDM), Electro Chemical

Machining, Electro Chemical Discharge Machining(ECDM) , Vibro ECDM, Dry and Near dry EDM, thermal Energy Methods material pressing, LASER machining, Electron Beam Machining, Plasma arc machining, Physical vapour deposition and chemical vapour deposition, high energy rate forming and Electroforming.

**b. Books**

1. MEMS & Microsystem: Design & Manufacture by Tai ran Hsu, Tata McGraw Hill Publisher, 2002.
2. The MEMS handbook, CRC Press, 2001
3. Microsensors, MEMS and smart Devices by Julian W. Gardner & Vijay K. Varadan, John Wiley & Sons, 2001.
4. 'Nanotechnology' by Nario Taniguchi, , Oxford University Press, 1996.

**9. Metrology and Quality Control**

a. Error due to Numerical Interpolation, displacement measurement technique, Error types and their evaluation, Image processing and its applications in metrology, Laser trackers, micro and nanometrology, Process capability- Process Capability Index. Advanced dimensional chain and tolerance stacking , Global management or six sigma management, methods of improving accuracy and surface finish. Quality Control, Statistical Quality Control, Quality assurance systems

**b. Books**

1. Precision Engineering in Manufacturing , R.L. Murthy
2. Metrology, R.K. Jain
3. Engineering Metrology, I.C. Gupta

10. **Theory of plasticity, Metal forming**

a. Analysis in drawing and extrusion of metals, theory and practice of Bulk forming processes, Plastic deformation in forging, rolling, Extrusion and Drawing process, Sheet metal forming. Theory of plastic deformation – Yield criteria - Work of plastic deformation

- Analysis of forming processes - Energy slab method- open die forging, plate drawing, Flat rolling ,- Other methods of analysis like FEM, Upper and lower bound solution methods – slip line field.
- Review of stress –strain relations, Yield criteria, plastic anisotropy, forming limits and material models , Viscoplasticity, Solutions to metal forming problems.

- **Books**

1. Theory of Metal Forming Plasticity - Classical and Advanced Topics by Sluzalec, Andrzej , Springer Publications
2. Metal Forming - Process and analysis – by B. Avitzur, Tata Mcgraw Hill
3. Metal working science and Engineering by E.M. Mielnik , McGraw Hill. Inc.
4. Theory of plasticity "-Chakrabarthy J.,- McGraw Hill Co, 1987.
5. Metal forming Mechanics and Metallurgy – Hofsord W.F. and Caddell R.M. – Prentice Hall, Eaglewood, cliffs, 1993
6. Theory of Metal Forming Plasticity - Classical and Advanced Topics by Sluzalec, Andrzej , Springer Publications

**11. Tribology**

a. Triboenvironment, contact theory of surface, Ergodicity and Stationarity of surface, Contact phenomenon & contact deformation of the surface, Parameters affecting friction and wear, Adhesive, Abrasive, Erosive wear, Dry friction,

boundary friction, semi liquid and liquid friction under lubrication, Use of solid lubricants in extrusion and metal cutting, method of testing and Characterization of lubrication.

**b. Books**


1. Fundamentals of Tribology – S.K.Basu, B.B. Ahuja and S.N. Sengupta, PHI
2. Friction, lubrication, wear- vol I,II and III-Kragelsky.
3. Tribology of bearings – B.C. Mujumdar.
4. Tribology – A System Approach – H.Czichos and Elsevies.
5. Friction and Wear of Materials –E. Rabinowics, Wiley N.Y.


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