METROLOGY AND COMPUTER AIDED INSPECTION

Metrology concepts- Abbe's principle-need for high precision measurements- problems associated with high precision measurements.

Standards for length measurement- Shop floor standards and their classification- Light interference- Method of coincidence- Slip gauge calibration-measurement errors.

Various tolerances and their specifications, gauging principles, selective assembly, comparators. Angular measurements - principles and Instruments, Gear and Thread measurements.

Surface and form metrology- Flatness, roughness, waviness, roundness, cylindricity, etc. Computer Aided Metrology- principles and interfacing, software metrology.

Laser metrology- Applications of lasers in precision measurements- Laser interferometer, speckle measurements, laser scanners.

Coordinate Measuring Machine- Non contact CMM Electro optical sensors for dimensional metrology- Non contact sensors for surface finish measurements

Image processing and its application in metrology.

Recommended Book:

Shotbolt, C.S. and Galyer. J. Metrology for Engineers, Cassell Publ., Fifth Edition, 1990.

MANUFACTURING ENGINEERING

Theory of metal cutting- mechanics of cutting- shear angle theories- cutting tool materials, tool geometry- tool wear and tool life- cutting fluids-dynamic stability of metal cutting systems.

Non-traditional machining process such as EDM, USM, AJM, WJM, AWJM, LBM,EBM, plasma machining etc.-mechanism of metal removal characteristic features and applications in each case.

High speed machining- abrasive processes, machining of polymers, ceramics, glasses and composites.

Recommended Book:

1. Serope Kalpakjian and Steven R Schmid, Manufacturing processes for engineering materials, 5th Edition, Pearson (Chapters 1, 8, 9)

2. Ghosh and Mallik, Manufacturing Science.

ADVANCED MATERIALS AND PROCESSING

Atoms- molecules-bonds in solids- crystallinity- defects in metallic structure- Dislocations and plastic deformations-fracture-iron carbon equilibrium diagrams-steels and cast irons-transformation hardening in steels-TTT diagrams- other heat treatment processes-formation of alloys in steel and cast irons- non ferrous alloys and their applications- special alloys.

Polymers and polymerization- structure and properties of thermoplastics and thermosets-engineering applications-property modifications-mechanical, thermal behavior- composites with polymer matrix-ceramics- glasses-glass ceramics-fabrication methods- metal matrix and ceramic matrix composites.

Processing of polymers-fabrication of composites-processing of ceramics-thermal spraying-ion beam machining-laser and electron beam processing-superplastic forming-thin films and their deposition-diamond coating techniques-tribological applications.

Recommended Book:

1. William D. Callister, Materials Science and Engineering: An Introduction, 7th Edition, Wiley India (Chapters 1, 2, 3, 4, 6, 9-11, 14-16)

AUTOMATION AND SENSORS

Automation concepts: Definitions, types, automation achievements, Hard and soft automation, Line balancing and techniques, Automation tools, Role of CIM, Group technology, FMS

Sensors for intelligent manufacturing and condition monitoring- force, temperature, vibration, pressure, flow, optical, electrical, acoustic, pneumatics, magnetic, electro-optical and vision sensors, Sensors for CNC machine tools - linear and angular position and velocity sensors, Acoustic emission - principles and applications - concepts of pattern recognition.

Robotics: Definitions, work envelops robotic layout and its components, Laws, applications, forward and inverse kinematics, sensors-internal sensors and external sensors, selection criteria.

Recommended Book:

1. Serope Kalpakjian and Steven R Schmid, Manufacturing processes for engineering materials, 5th Edition, Pearson (Chapter 14, 15)

2. Tonshoff and Inasaki, Sensors in Manufacturing.

3. William Bolton, Instrumentation and control systems, 1st or 2nd Edition, Newness

DRIVES AND CONTROLS

Drives – Actuators: Electrical Actuator, Hydraulic Actuators, Pneumatic Actuators, electro-magnetic, electro-pneumatics, servo actuators, Shape memory alloys, piezoelectric, magnetostrictive actuators and their relative merits

Controls - Role of control systems in Manufacturing- Classifications, Properties and applications of open and closed loop process control system, Laplace transform, Block diagram representation and reduction, stability criteria, microprocessor in automation-data communication and network, Data acquisition and processing, filters, ADC and DAC, PLCs and PID controllers, Mechatronics, system simulation and modeling.

Recommended Book:

1 William Bolton, Instrumentation and control systems, 1st or 2nd Edition, Newness

FLUID POWER SYSTEMS

Physical properties of hydraulic fluids; energy and power in hydraulic systems; frictional losses in hydraulic pipelines; hydraulic pumps; hydraulic cylinders and cushioing devices; hydraulic motors; hydraulic valves; hydraulic circuit design and analysis; hydraulic conductors and fittings; ancillary hydraulic devices; maintenance of hydraulic systems; pneumatics: air preparation and components; circuits and applications; basic electrical controls for fluid power circuits; fluid logic control systems.

Recommended Book:

1 Anthony Esposito, Fluid Power with Applications, 7th Edition, 2009, Pearson

ENGINEERING MATHEMATICS

Ordinary Differential Equations (ODEs)
Laplace Transforms
Linear Algebra
Fourier Analysis
Partial Differential Equations (PDEs)
Power and Taylor Series
Numerical Analysis
Optimization
Data Analysis
Statistics

Recommended Books:
Erwin Kreyszig, Advanced Engineering Mathematics (2002), 8th Edition, John Wiley & Sons Inc. (See relevant chapters 1, 2, 5, 6, 7, 10, 11, 18, 20, 22, 23)