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IV Year B.Tech. ME(NT)-I Sem	L	T/P/D	C
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(A70352) OPERATIONS RESEARCH

UNIT – I

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method.

UNIT – II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.

UNIT – III

Sequencing – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT – IV

Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

Inventory: Introduction – Single item, Deterministic models – Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

UNIT – V

Waiting Lines: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

Dynamic Programming:

Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming

problem.

Simulation: Introduction, Definition, types of simulation models, Steps involved in the simulation process- Advantages and disadvantages- applications of simulation to queuing and inventory.

TEXT BOOKS :

1. Operations Research /J.K.Sharma 4e. /MacMilan
2. Introduction to O.R/Hillier & Libermann/TMH

REFERENCE BOOKS :

1. Introduction to O.R /Taha/PHI
2. Operations Research/ NVS Raju/ SMS Education/3rd Revised Edition
3. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
4. Operations Research / Wagner/ PHI Publications.
5. Operations Research/M.V. Durga Prasad, K. Vijaya Kumar Reddy, J. Suresh Kumar/ Cengage Learning.
6. Introduction to O.R/Hillier & Liberman / TMH.

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(A72905) CARBON NANO TUBES AND THEIR APPLICATIONS

AIM

To provide the structural and electronic properties of carbon nanotubes, as well as the device structures and operation. It also deals with the applications of carbon nanotubes like electrodes,sensors and fuel cells.

OBJECTIVES

1. To investigate the use of carbon nanotubes as active components
2. To explore the method of synthesis and its role in obtaining SWNT / MWNT with desired characteristics
3. To investigate several applications of carbon nanotubes

Unit I:

Introduction to CNT : Introduction, History, Discovery, Carbon Nano tubes Carbon clusters and Fullerenes. Structures and types of Carbon Nano tubes: arm chair, zig-zag and chiral, structure of graphene, Defects in carbon Nanostructures.

Unit II:

Synthesis : Synthesis of CNTs by Flame, CVD, Laser & Arc process, growth of CNTs: Growth Mechanisms involved in growth of CNTs, tip growth, basal growth.

Unit III:

Characterization of CNTs: Characterization of Carbon Nanotubes by Raman Spectroscopy and Transmission Electron Microscopy.

Unit IV:

Properties of CNTs: Electrical: Electron transport in CNT, field emission, Optical properties Vibrational, Mechanical Properties of CNTs. Mechanical reinforcements and their application in modern day: Polymer Nano composite an Metal Nano composite.

Unit V:

Energy storage and Sensor applications : Application of CNTs: as an electrode material for Lithium batteries & Hydrogen & storage, Fuel cell applications and energy storage.Chemical Sensors applications of CNTs, and Glucose sensors based on CNT.

TEXT BOOKS:

1. Carbon Nanotubes by P.M.Ajayan, John Wiley Edition.

2. Science of Engineering Materials and Carbon Nanotubes: C.M. Srivastava and C. Srinivasan New Age Publishers.
3. Introduction to Nanotechnology by Charles P. Poole Jr and Frank J.Owens Wiley India Pvt. Ltd.
4. Nanotechnology, A gentle introduction to the next big idea by Mark Ranter, Daniel Ranter Pearson education.

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(A70328) CAD / CAM

UNIT – I

Fundamentals of CAD/CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD ,Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

Geometric Modeling: 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT-II

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions,parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III

NC Control Production Systems : Numerical control, Elements of NC system, NC part programming : Methods of NC part programming, Manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning.

UNIT – V

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM, Benefits of CIM

TEXT BOOKS:

1. CAD/CAM /Groover M.P./ Pearson education
2. CAD/CAM Concepts and Applications/ Alavala/ PHI

REFERENCE BOOKS :

1. CAD/CAM Principles and Applications/P.N.Rao/ TMH
2. CAD / CAM Theory and Practice/ Ibrahim Zeid/TMH
3. CAD / CAM / CIM/Radhakrishnan and Subramanian/ New Age
4. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
5. Computer Numerical Control Concepts and programming/Warren S Seames/ Thomson.

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(A70351) METROLOGY, INSTRUMENTATION AND CONTROL SYSTEMS

UNIT – I

Fundamentals and characteristics of measuring systems – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics – sources of error, Classification and elimination of error.

UNIT – II

Measurement Of Temperature: Various Principles of measurement – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators.

Measurement Of Pressure: Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

Measurement Of Humidity: Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter

UNIT – III

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

Stress Strain Measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes.

Measurement of Level: Direct method – Indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – Bubbler level indicators.

UNIT – IV

Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA) .

Measurement Of Speed: Mechanical Tachometers – Electrical tachometers – Stroboscope, Non- contact type of tachometer.

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle.

Measurement Of Force,Torque And Power: Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT – V

Elements Of Control Systems: Introduction, Importance – Classification – Open and closed systems Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems.

Pre-Requisite:

Objective: This subject provides insight into the different mechanical measurement systems and working and testing procedures

TEXT BOOKS:

1. Measurement Systems: Applications & Design by D.S Kumar, Anuradha Agencies
2. Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH

REFERENCE BOOKS:

1. Instrumentation and Control systems/ S.Bhaskar/ Anuradha Agencies
2. Experimental Methods for Engineers / Holman
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Mechanical Measurements / Sirohi and Radhakrishna / New Age
5. Instrumentation &mech. Measurements by A.K. Tayal ,Galgotia Publications.

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(A70355) ROBOTICS

(Elective – I)

UNIT – I

Introduction, Automation and Robotics – An over view of Robotics – classification by coordinate system and control systems - **Components of the Industrial Robotics:** Degrees of freedom – End effectors: Mechanical gripper – Magnetic – Vacuum cup and other types of grippers – General consideration on gripper selection and design, Robot actuator and sensors.

UNIT – II

Motion Analysis: Basic rotation matrices – Composite rotation matrices – Euler Angles – Equivalent Angle and Axis – Homogeneous transformation – Problems.

Manipulator Kinematics: D-H notations - Joint coordinates and world coordinates - Forward and inverse kinematics – problems.

UNIT – III

Differential Kinematics: Differential Kinematics of planar and spherical manipulators - Jacobians – problems.

Robot Dynamics: Lagrange – Euler formulations – Newton-Euler formulations – Problems on planar two link manipulators.

UNIT IV

Trajectory Planning: Joint space scheme – cubic polynomial fit – Avoidance of obstacles – **Types of motion:** Slew motion - joint interpolated motion – straight line motion – problems.

Robot actuators and Feed back components: Actuators: Pneumatic.

UNIT V

Robot Application in Manufacturing: Material handling - Assembly and Inspection – Work cell design, work volume, Robot screan.

TEXT BOOKS :

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control / JJ Craig/ Pearson/ 3rd edition.

REFERENCES :

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klaftez/ Prentice Hall

3. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
4. Robot Dynamics & Control/Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pvt. Ltd.
5. Robotics and Control / Mittal R K & Nagrath I J / TMH

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(A70346) MECHANICAL VIBRATIONS

(Elective-I)

UNIT- I:

Single Degree of Freedom Systems : Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility- Response to Non Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT- II:

Two Degree Freedom Systems: Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers;

UNIT-III:

Multi Degree Freedom Systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time systems.

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

UNIT- IV:

Frequency Domain Vibration Analysis: Over view, machine-train monitoring parameters-Data base development-vibration data acquisition-trending analysis-failure- node analysis-signature analysis-root cause analysis.

UNIT V:

Numerical Methods: Raleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

TEXT BOOKS:

1. Mechanical Vibrations/Groover/Nem Chand and Bros
2. Elements of Vibration Analysis / Meirovitch/ TMH, 2001

REFERENCE BOOKS:

1. Mechanical Vibrations/VP Singh/Danapathi Rai & Sons
2. Mechanical Vibrations/ SS Rao/ Pearson, 2009/4th Edition,

3. Mechanical Vibrations/Debabrata Nag/Wiley
4. Vibration problems in Engineering / S.P. Timoshenko.
5. Mechanical Vibrations and sound engineering/ A.G.Ambekar/ PHI
6. Theory and Practice of Mechanical Vibrations/JS Rao & K. Gupta/ New Age Intl. Publishers/Revised 2nd Edition

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(A70337) CNC TECHNOLOGIES
(ELECTIVE – I)

Objectives:

1. Understand basic features of NC and CNC Machines and their Design Considerations.
2. To study various system devices hardware and software interpolations.
3. To know various tooling systems used in CNC Machines.
4. Understand both Manual and Computer Aided Programming for Generating Various Contours.
5. To study about the DNC systems and Adaptive Control used for various machining process.

UNIT I:

Features of NC Machines, Fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, Features of NC Machine Tools, design consideration of NC machine tool, methods of improving machine accuracy.

UNIT II:

CNC Machines Elements: Machine Structure- Guideways - feed drives-spindles - spindle bearings.

System Devices: Drives, feedback devices, counting devices.

Interpolators for manufacturing systems: DDA integrator, DDA hardware interpolators, CNC software interpolators.

UNIT III:

Tooling for CNC Machines: Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers.

UNIT IV:

NC Part Programming: Manual programming-Basic concepts, Point-to-Point contour programming, canned cycles, parametric programming.

Computer-Aided Programming: General information, APT programming, Examples APT programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path

generation.

UNIT V:

DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, grinding.

TEXT BOOKS:

1. Computer Control of Manufacturing Systems - Yoram Koren, Tata Mc Graw Hill, 2009.
2. Computer Aided Manufacturing - Elanchezhian, Sunder Selvan and Shanmuga Sunder, University Science Press, Second edition.

REFERENCE BOOKS:

1. Machining Tools Hand Book Vol 3, (Automation & Control)/ Manfred Weck / John Wiley and Sons, 1984.
2. Mechatronics – HMT, TMH.
3. Computer Numerical Control-Operations and Programming – Jon Stenerson and Kelly Curron Pul, 3rd Edition.

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	4	**-/-/-**	**4**

(A70347) MECHANICS OF COMPOSITE MATERIALS (ELECTIVE-I)

UNIT-I

Introduction to Composite Materials: Introduction ,Classification Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications .

UNIT-II

Reinforcements: Fibers- Glass, Silica, Kevlar, carbon, boron ,silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT-III

Macro Mechanical Analysis of a Lamina: Introduction, Definitions Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

UNIT-IV

Macro Mechanical Analysis of Laminates: Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus.

UNIT-V

Failure Analysis of Laminates: Introduction, Special Cases of Laminates, Applications, Failure Criterion for a Laminate.

TEXT BOOKS:

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials/Isaac and M Daniel/ Oxford University Press, 1994.

REFERENCES:

1. Analysis and performance of fibre Composites/ B. D. Agarwal and L. J. Broutman/ Wiley- Inter science, New York, 1980.
2. Mechanics of Composite Materials/ Second Edition (Mechanical

Engineering)/ Autar K. Kaw/Publisher: CRC

3. Analysis of Laminated Composite Structures/ L. R. Calcote/ Van Nostrand Rainfold, New York, 1969.

4. Advanced Mechanics of Composite Materials/ Vasiliev &Morozov/ Elsevier/Second Edition

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(A72405) AUTOMOBILE ENGINEERING

(ELECTIVE-I)

UNIT – I

Introduction : Layout of automobile – introduction chassis and body components . tyopes of Automobile engines. – power unit – Introduction to engins lubrication – engine servicing

Fuel System :S.I. Engine : Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction MPFI and GDI Systems.

C.I. Engines : Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction CRDI and TDI Systems.

UNIT – II

Cooling System : Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporating cooling – pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

Electrical System : Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT – III

Transmission System : Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box , over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

Suspension System : Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

UNIT – IV

Braking System : Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

Steering System : Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT – V

Emission from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG,CNG, liquid Fuels and gaseous fuels, Hydrogen as a fuel for IC Engines. - their merits and demerits.

Standard Vehicle maintenance practice.

TEXT BOOKS:

1. Automobile Engineering (Vol. I and II) / Kirpal Singh/ Standard Publishers
2. A Text Book Automobile Engineering/P.S. Gill/ Katson Books

REFERENCES:

1. Automotive Mechanics / Joseph Heitner/Van nostrand Reinhold
2. Automotive Engineering / Newton Steeds & Garrett
3. Automotive Engines / S. Srinivasan/TMH
4. Automobile Engineering/R.K. Singhal/Katson Books
5. Automobile Engineering/Arora and Domkonduwar/Dhapatrai Publishers
6. Automobile Engineering/Kamaraju Rama Krishna/TMH

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(A72906) MECHANICAL BEHAVIOUR OF NANO MATERIALS (ELECTIVE-II)

Objective:

To familiarize students how the material strength changes when things goes from macro level to nanometer level.

Unit-I:

Nanomaterials: Origin and their classification, Processing methods (Top-Down and Bottom-Up), Processing of bulk nanomaterials by various severe plastic deformation methods (ECAP, HPT, ballmilling, ARB, RCS etc.,) Processing by plastic deformation.

Unit-II:

Mechanical properties of coarse grained materials and nanocrystalline materials, Yield strength, Ductility, Hall-Petch effect, Strain Hardening,Strain rate sensitivity, Deformation mechanisms in nanocrystalline materials, Dislocation pile-up break down, Grain boundary dislocation sources and sinks, Grain boundary sliding, rotation and coalescence, Shear bands.

Unit-III:

Strengthening methods in coarse grained materials,Grain refinement, Strain hardening, Dispersion strengthening, Precipitation hardening, Composite strengthening.

Unit-IV:

Fatigue behavior and Creep behavior of nanocrystalline materials, Wear characterstics of nano materials,

Unit-V:

Tools to probe the nano-mechanical behavior and the associated mechanics (for bulk materials and thin films)

TEXT BOOKS:

1. Nanostructured materials: Processing, Properties and Potential Applications, edited by C.C.Koch, Noyes Publications (2002).
2. Structural nanocrystalline Materials: Fundamentals & Applications, by C.C.Koch, I.A.Ovidko, S.Seal, and S.Veprek, Cambridge University Press (2011).

Outcomes:

- To learn about the mechanical properties of nano-materials such as

yield strength, strain hardening, strain rate, grain boundary dislocation, grain boundary sliding, rotation and coalescence and shear bands etc.,

- To know the importance of strengthening of materials using coarse grained, dispersion hardening, precipitation hardening and composite strengthening.
- To know the fatigue behavior and creep behavior of nanocrystalline materials and also wear characteristics of nano-materials

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(A72908) NANO SENSORS AND ACTUATORS
(ELECTIVE-II)

Aim

To have deeper understanding in fabrication of micro/nano devices and their architectures of sensor and actuator applications.

Objectives

- Demonstrate proficiency in the basic subfields of Engineering Physics as well as other areas of recent applications
- Through critical thinking, problem solving in device designs of Micro-/Nano instruments
- Construct and assemble experimental ideas, analyze available measurements of physical phenomena and their related things

Unit I:

Introduction to Micro- and Nanotechnology: Introduction, Physics of Scaling – General Mechanisms for Electromechanical transduction – Sensor and Actuator Transduction Characteristics

Unit II:

Introduction to Sensors : Sensors – Classification, Principle of operation – Linear and rotational sensors, Acceleration sensors, Force, torque and pressure sensors, Flow sensors, Temperature sensors, Proximity sensors, Light sensors, Smart material sensors, Micro and nano-sensors, Capacitive and Inductive sensors, Selection criteria of sensors – Signal conditioning and calibration.

Unit III:

Introduction to Actuators: Classification – Principle of operation – Electrical, Electromechanical, Electromagnetic, Hydraulic and pneumatic and smart material Actuators, Micro and Nano-actuators, Selection criteria

Unit IV:

Sensor and Actuator Characteristics : Range, Resolution, Sensitivity, Error, Repeatability, Linearity and Accuracy, Impedance, Nonlinearities, Static and Coulomb Friction, Eccentricity, Backlash, Saturation, Dead-band, System Response, First-Order System Response, Under-damped Second Order System Response, Frequency Response.

Unit V:

Nanotechnology enabled sensors: Electromagnetic sensors, Optical

Sensors, Magnetic Sensors, Physical Sensors, Chemical Sensors and biological sensors, Possibilities, Realities and applications

TEXT BOOKS:

1. Mechatronics – An introduction by Robert H Bishop, Taylor & Francis
2. Sensor Technology Handbook edited by Jon Wilson – Elsevier & Newnes
3. Nanotechnology – Basic Science and Emerging Technologies, Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Chapman & Hall CRC
4. Nanotechnology – A gentle Introduction to the next big idea by Mark Ratner and Daniel Ratner
5. Nano the essentials – Understanding Nanoscience and Technology by T Pradeep

REFERENCES:

1. Introduction to Nanotechnology – Charles P Poole Jr, Frank J Owens, Wiley Interscience – John Wiley & sons
2. Nanotechnology for Dummies – Richard Booker, Earl Boysen, Wiley Publishing Inc.
3. Nanotechnology demystified by Linda Williams, Dr Wade Adams, Tata Mc Grawhill
4. Bionanotechnology by David Goodsell
5. Biosensing using nanomaterials edited by Arben Mercoci, Wiley Publishing Inc.
6. Engines of Creation by K Eric Drexler

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(A72907) MEMS /NEMS DESIGN AND APPLICATIONS (ELECTIVE-II)

AIM

The course is intended to cover deep understanding of micro and nano electromechanical systems their design and various applications as well as micro and nano fabrication techniques

Objectives

- To provide understanding of MEMS/NEMS applications specially sensors,Micro machining tools etc.,
- To provide silicon micro fabrication techniques etc.,
- To bring out scaling and packaging issues of physical system

Unit I:

Overview and Introduction: New Trends in Engineering and Science: Micro and Nanoscale Systems: Introduction to Design of MEMS and NEMS. Biological and Biosystems Analogies. Overview of Nano and Microelectromechanical Systems. Micro and Nanoelectromechanical Systems. Synergetic Paradigms in MEMS. MEMS and NEMS Architectures

Unit II:

Fundamentals of MEMS Fabrication: Introduction and Description of Basic Processes. Microfabrication and Micromachining of ICs, Microstructures and Microdevices. MEMS Fabrication Technologies. Bulk Micromachining, Surface Micromachining. High Aspect Ratio Technology

Unit III:

Devising and Synthesis of MEMS and NEMS: MEMS Motion Microdevices Classifier and Synthesis. Microelectromechanical Microdevices. Synthesis and Classification Solver. Nanoelectromechanical Systems.

Unit IV:

Modeling of Micro Electromechanical Systems, Devices, and Structures: Introduction to Modeling, Analysis and Simulation. Electromagnetics and its Application for MEMS and NEMS. Basic Foundations in Model Developments of Micro and Nanoactuators in Electromagnetic Fields. Lumped-Parameter Mathematical Models of MEMS. Direct-Current Microtransducers. Induction Micromachines: Two Phase and Three Phase. Synchronous Microtransducers: Single-Phase Reluctance Micromotors. Permanent-Magnet Synchronous Microtransducers. Microscale Permanent-Magnet

Stepper Micromotors: Mathematical Model in the Machine Variables, Permanent-Magnet Stepper Micromotors in the rotor and synchronous reference frames. Piezotransducers: Steady-State Models and Characteristics, Mathematical Models of Piezoactuators: Dynamics and Nonlinear Equations of Motion. Fundamentals of Modeling of Electromagnetic Radiating Energy.

Unit V:

Modeling of Nanoscale Electromechanical Systems, Devices and Structures: Classical Mechanics and Its Application: Newtonian Mechanics, Lagrange Equation, Hamilton Equations of Motion. Thermolysis and Heat Equation. Atomic Structures and Quantum Mechanics, Molecular and Nanostructures Dynamics: Schrodinger Equation and Wavefunction Theory. Density Functional Theory. Nanostructures and Molecular Dynamics. Electromagnetic Fields and their Quantization. Molecular Wires and Molecular Circuits.

TEXT BOOKS

1. "MEMS and NEMS: Systems, Devices and Structures" by Sergey Edward Lyshevski, CRC press,2002 edition.
2. An introduction to Micro electro mechanical systems Engineering" by Nadim Malut and Kirt Williams – Second edition – Artech House, Inc, Boston.
3. "Micro electro mechanical systems Design"./ by James J Allen- CRC Press – Taylor and Francis Group.

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(A72910) SURFACE ENGINEERING
(ELECTIVE-II)

Unit I:

Introduction; Definition of surface engineering, Real surface topography of a metal Application Examples of surface engineering; **Surface Degradation**: Physical (Wear, Fracture & Fatigue, Creep) phenomenon, chemical (aqueous corrosion, solvation by liquid metals, reaction with organic solvents) phenomenon, biological phenomenon; repairing the surface.

Unit II:

Hard Thin Films: Definitions of thin film; hardness, toughness and elastic modulus of thin films; deposition of Hard thin films (Ex: diamond, c-BN, WC, SiC, nanocomposite) by physical vapor deposition and chemical vapor deposition; applications of hard thin films.

Unit III:

Chemical conversion coatings: Definition of chemical conversion coating; Chromating; Phosphating; Electrochemical (like anodizing); Applications of chemical conversion coatings.

Unit IV:

Lubrication coatings: Need for lubricating surfaces; Electroless deposition and Electroplating processes; Examples. Aluminizing, Boronizing; Hard-facing & Cladding; Thermal Spray Processes;

Unit V:

Characterization and Performance Evaluation of Coatings: Thickness measurement; Measurement of Hardness (micro and nano hardness) and elastic modulus of thin and thick coatings; Friction co-efficient measurement; Adhesion measurement of coatings/thin films to the substrates; Contact angle measurement and its relevance; Corrosion testing of the surfaces; Wear measurement;

TEXT BOOKS:

1. MEMS and NEMS (Systems, Devices and Structures) by Sergey Edward Lyshevski by CRC press
2. M. Ohring, "The Materials science of thin films", Academic Press, 1992.
3. S. Grainger and J. Blunt, "Engineering Coatings", Woodhead Publishing, 1998.
4. H. Dimigen, "Surface Engineering", Wiley-VCH, 2000.

5. J. B. Hudson, "Surface Engineeing": An Introduction", Butterworth Heinemann, 2000.
6. D. L. Smith, "Thin Film Deposition, Principles and Practice", McGraw-Hill, 2000.
7. S. Zhang and Nasar Ali, "Nanocomposite Thin Films and Coatings: Processing, Properties and Performance", Imperial College Press, 2007.

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IV Year B.Tech. ME(NT)-I Sem	L	T/P/D	C
	-	-/3/-	2

(A70390) COMPUTER AIDED DESIGN AND MANUFACTURING LAB

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling: Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Study state heat transfer analysis of plane and axi-symmetric components.
8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.
10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM software.
13. Quality Control and inspection.

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	-	-/3/-	2

(A72982) CHARACTERIZATION OF NANO MATERIALS LAB

List of experiments

1. Particle size determination of Ag nanoparticles using DLS technique
2. Zeta potential measurement of Ag nanoparticles using Zeta Potential Analyzer
3. Colloidal Cu sol – Optical absorption spectra using UV-Vis absorption Spectroscopy
4. CdS nanoparticle- Optical absorption spectra; Band gap estimation from the band edge using UV-Visible absorption Spectroscopy
5. Crystallite size determination of ZnO by scherrer formula using X-ray Diffraction
6. Crystallite size determination of Fe_2O_3 by scherrer formula using X-ray Diffraction
7. TG/DTA analysis
8. Atomic Force Microscope