Semester 5

Theory

S.no.	Subject name	L	P	M
01	CNC Technology	4	0	100
02	Computer aided design	4	0	100
03	Engineering Metrology	4	0	100
04	Modeling and Simulation	4	0	100
05	Robotics and Vision System	4	0	100
06	Sensor and Signal Processing	4	0	100

Practical

S.no	Subject name	L	P	M
07	CNC Machine Tools Lab	0	3	100
08	Sensor and Signal Processing Lab	0	3	100

Semester V

Sensor and Signal Processing

4 0 100

UNIT I: (9)

General Concept of Measurement: Basic block diagram stages of generalised measurement system state characteristics; accuracy precision resolution reproductability sensitivity zero drift linearity Dynamic characteristics zero order instrument first order instrument time delay

UNIT II (9)

Sensors and Principles: Resistive sensors Potentiometer and strain gauges Inductive sensors: Self inductance type, mutual inductance type, LVDT Capacitive sensors- piezoelectric sensors thermocouples thermistors radiation pyrometry - Fibre optic temperature sensor photo electric sensors pressure and flow sensors.

UNIT III (9)

Signal conditioning: Amplification Filtering Level conversion Linearisation Buffering sample and hold circuit quantisation multiplexer/ demultiplexer analog to digital converters digital to analog converters.

UNIT IV (9)

Data acquisition and conversion: General configuration single channel and multichannel data acquisition system Digital Filtering data logging data conversion introduction to digital transmission systems PC based data acquisition system.

UNIT V (9)

Interface systems and standards: Block diagram of a typical interface IEE 488 standard bus British Standard interface (BS 4421) CAMAC Interface MEDIA interface RS232C standard.

TOTAL HOURS:45

TEXT BOOKS:

1. RANGAM C.S., SARMA, G.R. MANI, V.S.V.,"Instrumentation - devices and Systems", Tata Mcgraw Hill publishing Company Ltd., 1997.
2. SAWHNEY, A.K.," A Course in Electrical and Electronic Measurements and instrumentation," Dhanpat Rai & Sons, 1995.
3. DOEBLIN, E.O. Measurement Systems, McGraw Hill, 1995.

Semester V

Modeling and Simulation

4 0 100

UNIT I: (9)

System and System Environment: Component of a system Continuous and discrete systems Models of a system modeling.

UNIT II: (9)

Random Number Generation: Midsquare The midproduct method Constant multiplier method Additive congruential method Test for random numbers: the Chi-square test the Koimogrov Smimov test Runs test Gap test

UNIT III: (9)

Random Variable Generation: Inverse transform technique Exponential distribution Poission distribution Uniform distribution Weibull distribution Empirical distribution Normal distribution Building and empirical distribution The Rejection method.

UNIT IV: (9)

Simulation of Systems: Simulation of continuous system Simulation of discrete system Simulation of an event occurrence using random number table. Simulation of component failures using Exponential and weibull models.

UNIT V: (9)

Simulation of single server queue and a two server queue. Simulation of inventory system Simulation of a network problem Simulation using Simulation languages/ packages.

TOTAL HOURS:45

TEXT BOOKS:

1) Bankds J., Carson. J.S., and Nelson B.L., Discrete Event System Simulation, Prentice Hall of India, New Delhi, 1996.
2) Gottfried B.S., Elements of Stochastic Process Simulation¿, Prentice Hall, London , 1984.

REFERENCES:

1) Geoffrey Gordon., System Simulation, Prentice Hall of India, 1984.
2) Narsingh Deo., System simulation with Digital Computer, Prentice Hall of India, 1979

Semester V

Robotics and Vision System

4 0 100

UNIT I: (9)

Robotics: Introduction- Robotic Mechanism - Classification of Robots - Drive Systems Robots - Co-ordinate system - Degrees of Freedom Spatial Descriptions -Transformations Position and orientation - Description of Frames - Mapping involving frames - Transform equations.

UNIT II (9)

Kinematics of Manipulators Link parameters Link frame assignment and forward kinematics Inverse manipulator kinematics Velocities and static forces Velocity transformation Force control system Interfacing computers to Robots RS 232 Interface Hardware Handshaking Software Handshaking RS 232 communication.

UNIT III (9)

Machine Vision: Introduction Image Geometry Co ordinate Systems Sampling and Quantization Image Definitions Levels of Computation Point Level Local Level Global level Object Level, Binary Image Processing Thresholding , Geometric properties Size Position Orientation Projections Binary Algorithms Morphological Operators Basic Lighting Techniques.

UNIT IV (9)

Optics - Lens Equation Image Resolution Depth of Field View Volume Exposure Shading Image radiance Surface orientation Reflectance Map Shape from Processing Color constancy : Statistical methods of Texture analysis- Structural analysis of Ordered Texture Model based methods for Texture analysis Shape from Texture Depth stereo imaging Stereo matching Shape from X-Range Imaging Active Vision.

UNIT V (9)

Dynamic Vision Change Detection Segmentation using motion Motion Correspondence Image flow Segmentation using a moving camera Tracking Shape from motion Object recognition System components Complexity of Object Recognition Object Representation Feature Detection Recognition Strategies Verification.

TOTAL HOURS:45

TEXT BOOKS:

1. P.A.Jananki Raman, " Robotics and Image Processing " , Tata McGraw Hill 1991.
2. Ramesh Jain, Rangachar Kasturi, Brian G.Schunck, Machine Vision, Mc Graw Hill International Edition, 1995.

REFERENCE BOOKS:

1. K.S.Fu, R.C. Gonzalez, C.S.G.Lee," Robotics Control, Sensing, Vision, and Intelligence, McGraw-Hill Incs., 1987.
2. Michael C.Fairhurst, " Computer Vision for Robotic Systems- An Introduction , Prentice Hall Inc., 1988.
3. Rembold and others, " Computer Integrated Manufacturing,
4. Mikell P. Groover, Mitchell Weiss, Roger N.Nagel, Nicholas G.Odrey Industrial Robotics Technology, Programming and Applications, McGraw- Hill International Editions, 1986.
5. Awcock and R.Thomas, "Applied Image Processing ", McGraw Hill, Inc, 1996.
6. Rembold, " Microsystem Technology and Micro Robotics " Springer Ferlog, Publishers, 1998.

Semester V

Computer Aided Design

4 0 100

THE DESIGN PROCESS: (9)

The design process Morphology of design - Product cycle - Sequential and concurrent engineering - Role of computers - Computer Aided Engineering - Computer Aided Design - Design for Manufacturability – Computer Aided Manufacturing - Benefits of CAD.

INTERACTIVE COMPUTER GRAPHICS: (9)

Creation of Graphic Primitives - Graphical input techniques - Display transformation in 2-D and 3-D – Viewing transformation - Clipping - hidden line elimination - Mathematical formulation for graphics - Curve generation techniques - Model storages and Data structure - Data structure organisation - creation of data files – Accessing data files - Concepts of data processing and information system. Data Bank Concepts - Data bank information storage and retrieval - Data life cycle - Integrated data processing - Information system. Engineering Data Management System. Hierarchical data structure. Network data structure - Relational data structure. Data storage and search methods.

SOLID MODELING: (9)

Geometric Modeling - Wireframe, Surface and Solid models - CSG and B-REP Techniques - Features of Soild Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis.

FINITE ELEMENT ANALYSIS (9)

Introduction - Procedures - Element types - Nodal approximation - Element matrices, vectors and equations -Global connectivity - Assembly - Boundary conditions - Solution techniques - Interfaces to CAD – Introduction packages - Software development for design of mechanical components.

PRACTICAL: (9)

TOTAL HOURS:45

Text Book:

1. Sadhu Singh, " Computer Aided Design and Manufacturing ", Khanna Publishers, New Delhi, 1998.

References:

1. D.F. Rogers and J.A.Adams, " Mathematical Elements in Computer Graphics ", McGraw-Hill Book Company, New York, 1976.
2. P.Radhakrishnan and C.P.Kothandaraman, " Computer Graphics and Design ", Dhanpat Rai and Sons, New Delhi, 1991.
3. E.Dieter George, " Engineering Design ", McGraw-Hill International Edition, 1991.
4. P.Radhakrishnan and S.Subramanyan, " CAD / CAM / CIM ", Wiley Eastern Ltd., New Age International Ltd., 1994.

5. Groover and Zimmers, " CAD / CAM : Computer Aided Design and Manufacturing ", Prentice Hall of India, New Delhi, 1994.
6. V.Ramamurthi, " Computer Aided Mechanical Design and Analysis ", Tata McGraw Hill Publishing Co Ltd., 1998.
7. Ibrahim Zeid, " CAD - CAM Theory and Practice ", Tata McGraw Hill Publishing Co. Ltd., 1991.

Semester V

Engineering Metrology

4 0 100

Need for measurement: **(9)**

Precision and Accuracy - Reliability - Errors in Measurements - Causes - Types.

LINEAR AND ANGULAR MEASUREMENTS **(9)**

Measurement of Engineering Components - Comparators, Slip gauges, Rollers, Limit gauges - Design and Applications - Auto collimator - Angle dekkor - Alignment telescope - Sine bar - Bevel protractors - Types - Principle - Applications.

FORM MEASUREMENTS **(9)**

Measurement of Screw thread and gears - Radius measurement - Surface finish measurement - Straightness, Flatness and roundness measurements - Principles - Application.

LASER METROLOGY **(9)**

Precision instrument based on Laser - Use of Lasers - Principle - Laser Interferometer - Application in Linear and Angular measurements - Testing of machine tools using Laser Interferometer.

ADVANCES IN METROLOGY **(9)**

Co-ordinate measuring machine - Constructional features - Types - Applications of CMM - CNC CMM applications - Computer Aided Inspection - Machine Vision - Applications in Metrology.

LABORATORY EXERCISE

i) Straightness measurement using Autocollimator.
ii) Measurement of Taper angle using Tool Makers Microscope.
iii) Measurement of various elements of screw thread using Tools Makers Microscope.
iv) Measurement of composite error using gear tester.
v) Calibration of optical comparator and measurement of dimension
vi) Determining the accuracy of electrical and optical comparator.
vii) Measurement of taper angle using sine bar.
viii) Measurement of various angles using Bevel Protractor.
ix) Measurement of dimensions using Vernier Height Gauge.

TOTAL HOURS:45

Text Book:

1. R.K.Jain, " Engineering Metrology ", Khanna Publishers, 1994.

References:

1. Gaylor, Shotbolt and Sharp, " Metrology for Engineers ", O.R.Cassel, London, 1993.
2. Thomas, " Engineering Metrology ", Butthinson & Co., 1984.
3. Books an Workshop Technology and Manufacturing Processes.

Semester V

CNC Technology

4 0 100

INTRODUCTION (9)

Evolution of Computer Numerical Control - Components - Co-ordinate system - Working principle of CNC Lathe, Turning Centers, Milling Machine, Machining Center, Drilling Machine, Boring Machine, Punching and Nibbling Maching, Pipe-Bending Machine, Spot Welding Machine, Electro Discharge Machine, Grinding Machine, Laser and Electron Beam Machining Equipment - DNC and adaptive control

CONSTRUCTIONAL FEATURES OF CNC MACHINES (9)

Machine structure - Slide ways - Ball screws-Accessories-Spindle drives-Axes feed drives - Open and closed loop control - Types of positional control-Machine Tool control-Control of Spindle speed-Control of slide movement and velocity.

CNC PART PROGRAMMING (9)

Part Program Terminology-G and M Codes -Types of interpolation-Methods of CNC part programming-Manual part programming-Computer Assisted part programming-APT language - CNC part programming usingCAD/CAM-Introduction to Computer Automated Part Programming.

TOOLING AND WORK HOLDING DEVICES (9)

Cutting tool materials - Hard metal insert tooling - Choosing Hard Metal tooling-ISO specification-Chip breakers-Non insert tooling - Qualified and pre-set tooling-Tooling System- Turning center-Maching center. Principles of location-Principes of clamping-Work holding devices for rotating work pieces-Chucks. Collets- Centers and Face Drivers - Mandrels-Workholding devices for fixed workpieces, Machine Vice, Clamping set, Angle plate, V block, Step block.

ECONOMICS AND MAINTENANCE (9)

Factors influencing selection of CNC Machines-Cost of operation of CNC Machines-Cost of Operatin of CNC Machines-Practical aspects of introduction of CNC-Maintenanace features of CNC Machines-Preventive Maintenance.

TOTAL HOURS:45

References:

1. BERRY LEATHAM-JONES, Computer Numerical Control, Pitman, London, 1987.
2. STEAVE KRAR and ARTHUR GILL, CNC Technology and Programming, McGraw-Hill PublishingCompany, 1990.
3. RADHAKRISHNAN,P., Computer Numerical Control (CNC) Machines, New Central Book Agency, 1992.
4. HANS B.KIEF and T.FREDERICK WATERS, Computer Numerical Control Macmillan/McGraw-Hill,1992.

5. G.E.THYER, Comuter Numerical Control of Machine Tools. Second Edition, B/H NEWNES, 1993.
6. BERNARD HODGES, CNC Part Programming Work Book, City and Guilds/Macmillan, 1994.
7. DAVID GIBBS, An Introduction to CNC Machining, Cassell, 1987.
8. GROOVER, M.P., Automation, Production Systems and Computer Integrated Manufacturing, PrenticeHall 1998

Semester V

Sensor and Signal Processing Lab

0 3 100

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1. Wave shaping circuit
2. Analog to Digital Converters
3. Digital Comparator
4. Speed measurement using Inductive pickup/Proximity sensor
5. Voltage to frequency converter
6. Frequency to Voltage Converter
7. Measurement to temperature using thermocouple, thermistor and RTD
8. Measurement of displacement using LVDT & Capacitive transducer
9. Position and velocity measurement using encoders
10. Position measurement using linear scales
11. Absolute encoders

TOTAL HOURS:45

Semester V

CNC Machine Tools Lab

0 3 100

Study of specifications of CNC Milling Machines and Lathes.
Study of ISO G&M Codes
Study of CNC Control Systems such as Fanuc, Heidenhein, Denford, Sinumeric CNC MILLING.
Programming, simulation of machining using the following features.

1. Linear and Circular interpolation
2. Pocker milling, slotting, peck drilling and other fixed cycles.

CNC LATHE:

Programming, simulation and machining using the following features:

1. Straight and step turning
2. Taper turining and thread cutting
3. Machining and internal surfaces.

TOTAL HOURS:45