IE 851: INDUSTRIAL INSTRUMENTATION

L T P

(3 1 0)

Theory Marks=100
Sessional Marks=75

1. Measurement of mass and weight- Analytical Balance, Spring Balance, Pendulum Scale, Industrial Weighers.

2. Density/ Specific gravity- Density of solids, liquids and gases. Online Measurement Techniques. Float type, Liquid Level Method, Displacement Meter, Hydrometer Specific Gravity Meter, Radioactive Method.

3. **Measurement of displacement, force, torque, velocity and acceleration**.

4. **Temperature Measurement-** (i) Resistive Thermometers- resistance of metals, Platinum RTD's, construction and calibration. (ii) Bimetallic Thermometers- industrial applications. (iii) Thermistor Thermometers- linearization and signal conditioning techniques. (iv)Thermocouple Thermometers- Functional models of thermoelectric circuits. Calibration, Thermocouple Failure and Validation, Applications. (v) Semiconductor Junction Thermometers- Transistor as temperature sensor, integrated temperature sensors (LM 75, LM 135/235/335, AD 590). (vi) Pyrometers. IR thermometers. Manometric thermometers, Fiber-Optic temperature Sensors.

5. **Measurement of Pressure**- (i) Manometers, Elastic Transducers, Electric Pressure Transducers (capacitive, inductive, resistive). Other Transducers (force balance, piezo electric). (ii) Vacuum Measurement- Mc Lead Gauge, Knudsen Gauge, Ionization Gauge, and Pirani Gauge. Pressure Switches and transmitters.

6. Measurement of Flow- (i) Variable Head Flow Meter (ii) Variable Area Flow Meter – Rotameters. Ultrasonic, electromagnetic flow meters , hot-wire anemometer, laser Doppler anemometer. Open channel flow metering. Flow meters for solid materials.

7. Measurement of level- Float gauge, float-tape, float-shaft methods, bubbler system, etc. Electrical transducers – resistive, inductive, capacitive.

BOOKS:

1. Principles of Industrial Instrumentation- Patranabis, TMH.
2. Measurement Systems – Application & Design: Doeblin, MGH.
3. Industrial Instrumentation-Principles & Design: Padmanabhan T R, SPRINGER.
4. Principles of Measurement & Instrumentation – Morris A S, PHI.
5. Mechanical Measurements- Jain.
6. Industrial Instrumentation Fundamentals- Fribance, McGraw Hill.
7. Transducers & Instrumentation- Murthy D V S, PHI

IE 853: Optical Instrumentation

L T P
(3 1 0)
Theory Marks=100
Sessional Marks=75
Time: 3 hours

Characteristics of charged coupled devices. Opto-couplers and their applications in analog and digital devices. Optical fiber fundamentals , modes in optical fibers, step index and graded index fiber, green lenses , fiber coupling, fiber optic sensors for industrial applications –displacement ,pressure, acceleration ,force ,velocity and flow sensors , fiber optic current and voltage sensors . Ch. Of laser radiation, structure of gas and solid state lasers, pulse mode laser, Q-switched laser, semiconductor laser. Holographic data systems. Memories and read out. Optical data processing fundamentals. Instruments – microscopes ,binocular ,stereoscope, polarization and phase contact microscope , photographic systems ,telephoto lens ,Fizean interferometer , Twyman Green interferometer ,Mach–Zehnder interferometer . Laser modes – Q-switching, frequency doubling, laser application – distance measurement , laser Doppler velocity-metery ,welding ,cutting , machining , holography , holographic inferometry.

Books/References:

1. Optics: Ghatak, TMH
2. Opto-electronics: An Introduction – Wolf and Smith, PHL
3. An Introduction to Fibre Optics – Shotwell; PHI (EEE)

IE 856: Project-II (0-6-0)
Max Marks: 150

This subject has two components. The first is sessional, under which a project work has to be taken up on a relevant topic to be decided by the student in consultation with the supervisor. The project is to be done in a group, which may consist of two, three or four students. The project may be a software, a hardware or a study type project.

The students have to submit a project proposal and/or justify the relevance of the topic in a project proposal seminar at the beginning of the semester, after approval of which only a student can take up that project. The students also have to give a presentation of their progress in a seminar. At the end, the students have to submit a report and present their works in a seminar.

The second component of the subject is the End Semester Examination for which a seminar and viva-voce examination will be held at the end of the semester after the satisfactory completion of the project work. .

L T P

IE 852: Telemetry and Tele-control (3-1-0)

Theory Marks=100
Sessional=75

Introduction. Telemetry links, Telemetry errors caused by noise, interference and distortion, signal characterization in time and frequency domain, analog and digital signals, landline telemetry, mechanical , pneumatic and electrical systems, Industrial telemetry and carrier communication systems, modulation techniques: AM and FM, demodulation, sensitivity of wire & wireless transmission, PLCC, sampling theorem, Nyquist frequency sampling techniques and signal reconstruction, pulse modulation- PAM,PWM,PPM signals, pulse code modulation, coding formats, Digital data communication techniques- multiplexing, FDM & TDM systems, their relative merits, ASK,FSK,PSK and higher order modulation, local area and public data networks, modems and coders, IRIG and CCITT standards, Fiber and satellite communication, remote control, mechanical , electrical and electronic methods, special considerations, typical Telemetry and Tele-control schemes related to industry and space applications.

Books/References:

1. Information Transmission etc.: Schwartz, M.
2. Tele-control Methods etc.: Swaboda, Van Norstad.

IE 857: Viva-Voce

Max Marks : 75

The viva-voce examination will be held at the end of the semester. Those students who have successfully completed their project works can only appear in this examination. The viva voce examination will cover the entire syllabus of Electrical engineering of B.E. course.

EE 844/IE 854: Digital Image Processing (Elective)

L	T	P
4	1	0

Max Marks: 100
Sessional: 75
Time: 3 hours

Human Visual System and Image perception; Monochrome and colour vision models; Image acquisition and display; Video I/O devices; Standard video formats; Image digitization; display and storage; 2D signals and systems;

Image Transforms: 2D, DFT, DCT, Harr transform;

Image enhancement: Some simple intensity transformations, Histogram processing; Image subtraction; Image averaging.

Spatial filtering: Background; Smoothing filters; Sharpening filters.

Image Restoration: Degradation Model; Inverse filtering; Least mean square (Wiener) Filter.

Image Compression: Lossy Compression; Lossless Compression.

Image Segmentation: Detection of discontinuities; Edge linking and Boundary Detection; Thresholding;

Representation and Description: Representation schemes; Boundary descriptors; Regional descriptors; Morphology.

Applications of Digital Image Processing

Books:

1) Funndamentals of Digital Image Processing, A.K.Jain, Pearson Education.
2) Digital Image Processing, R.C.Gonzalez & R.E.Woods, Perason Education.
3) Digital Image Processing with MATLAB, R.C.Gonzalez & R.E.Woods, S.L.Eddins, Pearson Education.

EE 844/IE854: Expert Systems (Elective) (4-1-0)

Theory: 100 Marks
Sessional: 75 Marks

Theory of Expert Systems:, Rule Based Systems, Forward & Backward Chaining, Matching, Partial Fuzzy Matching, Rate Algorithm, Handling Uncertainty, Uncertainty Factor, Bayesian Methods, Dempster –Shafer Theory, Fuzzy Logic, Model & Temporal Logic, Truth Maintenance, Default Reasoning, Structural Representation Systems_Frames, Semantic Nets, Object Based, Scripts, Indexing, Retrieval Technique, Learning, Expert System Shells, Expert System Development Cycle, Debugging Knowledge Bases, Expert System Tools.

Books:

1) P. Jakson- Introduction to Expert Systems, Addison Wesley.
2) D.W. Ralston- Principles of Artificial Intelligence& Expert Systems, McGraw Hill.
3) B. Buchanaen & E. Shorteiffe—Rule Based Expert Systems.
4) L. Brownston__Programming Expert Systems in OPSS, Addison Wesley.

EE 844/IE 854: RELIABILITY ENGINEERING (Elective)

Theory Marks: 100
Sessional Marks: 75

L	T	P
4	0	0

1. **Introduction to Reliability Engineering**: Definition of reliability, reasons for reliability engineering programmes, applications and benefits, reliability and cost, reliability and quality, definition of availability and maintainability.

2. **Reliability Mathematics**: Basic probability theorems, rules for combining probabilities-independent events, mutually exclusive events, complementary events, conditional events, simultaneous occurrence of events; Random variables-discrete and continuous, their properties; Data reduction to frequency histograms and polygons, frequency distribution and probability density function, failure probability density function and its estimate, cumulative frequency and cumulative distribution, data and distribution descriptive values-central tendencies (mean, mode and median), distribution moments, variance and standard deviation, coefficient of variation, skewness, kurtosis, fractiles, percentiles and quantiles, distribution parameters-location, shape and scale parameters; Standard distributions-discrete and continuous, discrete-Binomial and Poisson distributions, continuous-exponential, normal, log-normal, Rayleigh, Weibull, Gamma and extreme-value distribution.

3. **Concepts of Reliability**: Definition of reliability; Failure- causes of failures, modes of failures, life characteristics pattern (Bath-tub curve); Measures of reliability-failure rate, mean time between failure (MTBF), mean time to failure (MTTF), derivation of reliability function and its properties, relationship between density function, distribution function, reliability and failure rate; Hazard rate function-constant hazard model, linear hazard model; Reliability evaluation at component level; Probability plotting.

4. **System Reliability Evaluation**: Reliability block diagram; Systems-series, parallel, series-parallel, parallel-series, k-out-of-m system, standby system; Complex system- decomposition technique, tie set and cut set method, Boolean truth table method; Fault tree and Event tree method; Redundancy technique in system design-component versus unit redundancy, weakest link technique, mixed redundancy, standby redundancy.

5. **Availability Analysis**: Markov process and general concept of modeling; Instantaneous and Steady-state availabilities; State-space diagram; Markov model for-two repairable components, three repairable components, standby redundant system, non-repairable system; Stochastic transitional probability matrix; Steady-state availability calculation of systems.

6. **Maintained Systems**: Maintenance, objectives of maintenance, forms of maintenance, types of maintenance; Preventive maintenance-idealized maintenance, effect of preventive maintenance on reliability; Corrective maintenance; Definition and derivation of Maintainability function.

7. **Economics of Reliability Engineering**: Economic issues, manufacturer's cost, customer's cost, reliability achievement cost models, reliability utility cost models, depreciation-cost models; availability-cost model for parallel systems.

References:

1. Reliability Engineering - E. Balagurusamy, Tata McGraw Hill Publishing Comp. Ltd., 1984.
2. Reliability Engineering – A. K. Govil, Tata McGraw Hill Publishing Comp. Ltd., 1983.
3. Introduction to Reliability Engineering- E. E. Lewis, John Wiley and Sons, 1996.
4. Reliability Engineering Handbook (Vol 1) – Dimitri Kececioglu, Prentice Hall PTR, 1991.
5. Reliability Evaluation of Engineering Systems-concepts and techniques-Roy Billinton and Ronald N. Allan (2^{nd} Edition), Plenum Press, 1992.
6. Probabilistic Reliability- an engineering approach- M. L. Shooman, McGraw Hill Book Company, 1968.

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IE 855: Biomedical Instrumentation (Elective) (4-1-0)

Theory :100
Sessional : 75

Introduction to the physiology of cardiac, nervous and muscular and respiratory systems.
Transducers and Electrodes: Different types of transducers and their selection for Bio medical applications, Electro theory, Different type of Electrodes – Hydrogen Calomel, Ag-AgCl, pH, P_{o2}, Pco2 electrodes, selection criteria electrodes.

Cardio vascular measurements: The heart and other cardio vascular systems, Measurement of blood pressure, blood flo cardiac output and Cardiac rate, Electro cardiography, Phonocardiography, Ballistocardiography, Plethysmograph Magnet- Cardiography, Cardiac Pace maker, Computer applications.
Measurement of Electrical Activities and muscles and brain: Electromyography, Electroencephalography and the interpretation, Respiratory system Measurement: Respiratory mechanism, Measurement of gas volume, flow rate carbo dioxide and oxygen concentration in inhaled air, respiratory controller. Instrumentation For clinical Laborator Measurement of pH value of blood, ESR measurements.

Hemoglobin measurement, oxygen and carbon dioxide concentration in blood, GSR Measurement, polarograph measurements, computer applications.

Medical Imaging: Ultrasound imaging, Radiography, MRI, Electrical Tomography and application.
Biotelemetry: Transmission and Reception aspects of Biological signals via long distances.

Aspect of patient care monitoring.

Books: 1. Webster JS – Medical Instrumentation – Application & Design.
2. Cromwell L- Biomedical Instrumentation, PHI.
3. Khandpur RS- Handbook of Biomedical Instrumentation, TMH, New Delhi,1991.
4. Astor BR – Introduction to Biomedical Instrumentation and Measurement, McMillan.

EE 845/IE 856: Digital System Design (4-0-0)

Max Marks: 100
Sessional: 75
Time: 3 hours

1. Counter Design: Changing the counter modulus; Decade counters; Pre-settable counters; Counter design as a synthesis problem.

2. Design of Sequential circuits: State machine design using Moore and Mealy model; State transition diagram and preparation of state synthesis table. Derivation of design equation from state synthesis table using Karnaugh map.
   Circuit implementation: flip-flop based approach and ROM based approach.
   State reduction techniques, Analysis of asynchronous Sequential circuits, Problems specific to asynchronous sequential circuits, Design issues related to asynchronous Sequential circuits.

3. D/A conversion and A/D conversion, Variable, Resistor Networks.
   Binary ladders. D/A converters, D/A accuracy and resolution. A/D converter – simultaneous Conversion. A/D converter – Counter method. Continuous A/D conversion. Dual- slope A/D conversion. A/D Accuracy and Resolution.

4. A simple Computer Design
   Building blocks, Register Transfer language, Macro and micro operations, Design of control unit, programming computer.

Books:

1) Digital Logic & Computer Design, M.Morris Mano.

IE 855: Fluidic Power & Control (Elective) (4-1-0)

Max Marks: 100
Sessional marks: 75
Time: 3 hours

Scope & potential of application of pneumatics, hydraulics in instrumentation and control, fundamentals of fluid flow through orifices, restrictions, linearization of fluid flow equations. Pneumatic system elements and devices and their linearized modeling , e.g.- sources, regulated sources, valve actuators etc…Hydraulic system elements & devices & their linearized modeling. Feedback & its applications to development of hydraulic controllers. Pneumatic controllers, control schemes & control circuits, pneumatic telemetering, hydraulic power transmission. Hydraulic pumps & motors, hydraulic and pneumatic valves Fluidic elements, characteristics, logic devices. Analysis & synthesis of fluid logic systems with applications.

Books:

1) Control system components, Gibson & Tutor, McGraw hill.
2) Analysis & design of pneumatic Systems, Anderson & Blaine,.
3) Fluidic power systems, Morse, AC
4) Fluid Power & applications, Espisito