

**Veer Narmad South Gujarat University,USIC**  
**SURAT – 395007 (GUJARAT)**  
 Revised Syllabus(Effective from June-2010)  
**M.Sc(Tech) in Instrumentation**  
 (Structure of the 1<sup>st</sup> and 2<sup>nd</sup> Semester)  
 And  
**Post Graduate Diploma in Instrumentation**  
 (Structure of the 1<sup>st</sup> and 2<sup>nd</sup> Semester)

**FIRST SEMESTER**

Course No.	Title	Theory/Lab Hours per week			Marks		
		Theory	Tutorial	Total Hours	External Exam.	Internal	Total
INS -11	Workshop technology & Mechanism	04	01	05	70	30	100
INS -12	General electronics	04	01	05	70	30	100
INS -13	Measurement techniques	04	01	05	70	30	100
INS -14	Optical and Analytical instrumentation	04	01	05	70	30	100
INS -15	Practicals W – 1, E - 2	09	01	10	140	60	200

**SECOND SEMESTER**

Course No.	Title	Theory/Lab Hours per week			Marks		
		Theory	Tutorial	Total Hours	External Exam.	Internal	Total
INS -21	Metrology	04	01	05	70	30	100
INS -22	Microprocessors	04	01	05	70	30	100
INS -23	Measurement systems	04	01	05	70	30	100
INS -24	Biomedical and Environmental Instrumentation	04	01	05	70	30	100
INS -25	Laboratory work W – 1.E – 1 Transducer & Sensor Lab	09	01	10	140	60	200

**DISTRIBUTION OF INTERNAL MARKS :**

For each Theory Papers	Marks
1. One Test per Semester	15
2. One Tutorial per Paper Semester	10
3. One Assignment per Semester	05
Total	30

For laboratory Course per semester	Marks
1. One Test	40
2. journal/report writing	20
Total	60

**Semester-I**  
**PAPER – INS - 11**  
**Workshop technology & Mechanism**

**Unit - 1**

Materials for Instruments, bearings, machine bearing; Use of instruments bearings, different types of bearing and guides.

**Unit - 2**

Brief introduction to steps, couplings, clutches, joining and functional mechanisms.

**Unit - 3**

Elements of workshop technology covering fundamentals of simple manufacturing processes

**Unit - 4**

Machine tools like lathe, drilling, milling and shaping machines. Measuring systems and precision instruments. Measuring with scales, Mathematical concepts, Limiting means, range, variance, Standard deviation, normal distribution, confidence intervals. Principles of sampling.

**Unit - 5**

Alignment testing. Machine tools alignment, machine beds. Alignment of axis (spindle axis and bed, spindle axis and line of centers).

**Unit - 6**

Axial slip and calibration of lead screw, alignment telescopes. Interferometers. Ultrasonic pulse-Echo and resonance gauging. optical alignment. Equipment and methods.

**RECOMMENDED BOOKS**

1. Elements of Precision Engineering :R. Raman Oxford & IBM Publishing Co.,New Delhi - Bombay - Calcutta.
2. The Design and use of Instrument and Accurate Mechanism :White head, T.N. Dawn Publication Inc.
3. Engineering Metrology : R.K.Jain,Khanna Pub.Delhi 1973

**Semester-I**  
**PAPER - INS-12**  
**General Electronics**

**UNIT-1**

Typical electronic systems, classification of electronic systems and devices. junction diode, zener diode, voltage regulator, special purpose diode rectifiers, filters, JFET, MOSFET, BJT integrated devices and circuit manufacture, transistor and intergrated circuit biasing, basic design. AC gain, input output impedances, some special circuit.

**UNIT- 2**

Darlington pair, feedback, single and multi stage amplifiers. cascade amplifier, frequency response, amplifier classes, complementary symmetry circuits. new power transistor type of feed back circuits, effects of feedback on impedance, negative feedback circuits, stability in feedback amplifies, oscillation operation, UJT oscillator, PLL

**UNIT- 3**

Basic operational amplifier OPAMP circuits, applications of OPAMPS linear and non-linear applications of OPAMP system of numbers, binary. octal, hexadecimal, BCD, Gray code, ASCII code conversion pvm one system to another.

**UNIT- 4**

Positive and negative logic, different logic gates, their symbols and truth tables, introduction to different logic families, TTL, ECL, CMOS, I C. merits and demerits.

**UNIT-5**

K-Map and its application, binary adders, full adders, full adder as a subs tractor, arithmetic functions. decoder demultiplexer. data selector multiplexer, encoder, ROM , applications of ROM .

**UNIT- 6**

1 bit memory, flip-flops, shift resistors, synchronous counter, asynchronous counter, applications of counter. RAM tristate buffer and multiplexed display system, A to D, D to A converters.

**RECOMMENDED BOOKS**

1. Nagraths : Electronics, Analog and Digital
2. Millman and Halkias, Integrated Electronics, McGraw Hill
3. Millman and Grabel, Microelectronics, McGraw Hill

**Semester-I**  
**PAPER - INS-13**  
**MEASUREMENT TECHNIQUES**

**UNIT-1**

Generalized measurement system, Basic Concepts in dynamic measurements, System response Impedance matching.

**UNIT- 2**

Causes & types of experimental errors, Uncertainty analysis, Evaluation of uncertainties for complicated data reduction, Statistical analysis of experimental data, Probability distributions, Gaussian error distribution, Chi-Square test of Goodness of fit, Method of least Squares, Correlation coefficient.

**UNIT- 3**

Transducer, Transducer characteristics, Selection of an instrumentation transducer, Transducer as an electrical element, Modelling external circuit components, circuit calculations, Measurement methods.

**UNIT- 4**

Variable – resistance transducer, Differential transformer (LVDT), Capacitive transducer, Piezoelectric transducer, Photoconductive transducer, Photovoltaic cell, Ionization transducer, Hall effect transducer, Magnetometer search coil, Digital displacement transducer.

**UNIT-5**

Temperature transducers, stress & strain, strain measurements, Electrical – Resistance strain gages, Measurement of Resistance strain - gage outputs, Temperature Compensation, Strain-gage Rosettes, unbonded Resistance strain gage.

**UNIT- 6**

Signal to noise Consideration, Noise in the frequency domain, Sources of noise, Signal to noise & experimental design, Frequency & bandwidth considerations, Bandwidth control, Signal – to – noise enhancement, Digital correlation & autocorrelation methods.

**RECOMMENDED BOOK**

(1) M.Sayer & A Mansingh

Measurement, Instrumentation and Experiment Design in Physics and Engineering, PHI 2000

(2) J.P.Holman

Experimental Method for Engineers, 7<sup>th</sup> Edition, McGraw Hill, 1990

(3) E.O.Deoblin

Measurement systems, Applications & Design, McGraw Hill, 1990

(4) C.S.Rangan, G.R.Sarma, V.S.V.Mani

Instrumentation Devices and systems, McGraw Hill, 1983

(5) A.K.Sawhney

A course in electrical and electronics measurements and instrumentation, Dhanpat Rai & sons, 1998

**Semester-I**  
**PAPER - INS-14**  
**Optical & Analytical Instrumentation**

**UNIT-1**

Laser, Introduction, Absorption, of Light, Spontaneous & stimulated emission, Einsteins coffecient population inversion, Pumping processes, Light amplification, threshold conditions, Laser rate equations for three level & four level systems, properties of laser light: coherence, Directionality.

**UNIT- 2**

Types of lasers : Ruby laser, Neodymium lasers, ( Nd : YAG, Nd : Glass), He – Ne laser, Argon – ion laser, CO<sub>2</sub> laser, Dye laser, Semiconductor lasers, Applications of lasers in Material processing, Laser tracking, Lidar, Length measurement, velocity measurement & holography.

**UNIT- 3**

Fiber optics, Comparison with conventional metallic fibers, Step index & Graded index fibers, Introduction to fiber propagation using ray model, material dispersion, Combined effect of multipath dispersion & material dispersion, Fiber materials, Fiber fabrication process.

**UNIT- 4**

Optical Sources : Laser diodes, Light source linearity, Source – to – fiber power launching, Fiber – to- fiber joints, Splicing techniques, Optical fiber connectors, Photodetectors : Physical principles of photodiodes, Applications of Fiber optics: Medical application, Lightwave communication

**UNIT-5**

Electron structure of atoms, X – ray fluorescence line spectra, Fine structure, Absorption & emission processes, Production of X – rays, X –ray diffraction & crystallography, Neutron diffraction, Transmission electron microscopy, Surface analytical methods, Nuclear techniques, Atomic force & tunneling Scanning microscopes.

**UNIT- 6**

Spin resonance spectroscopy : Nature of spinning particles, interaction between nuclear spin & a magnetic field, Larmor precession, Nuclear magnetic resonance, Chemical shift, Relaxation mechanisms, Experimental study of NMR, Electron spin resonance, Hyperfine structure of ESR absorptions, Fine structure in ESR spectra, Double resonance in ESR, Mossbauer spectroscopy, Applications of Mossbauer spectroscopy.

**RECOMMENDED BOOKS**

- (1) A.K.Ghatak & K. Thyagarajan, Optical Electrinocs, Cambridge University press, 1990
- (2) K. Thyagarajan & A.K.Ghatak  
LASERS, Theory & Applications, Macmillan ( India), 1984
- (3) G. Keiser  
Optical fiber communications, McGraw – Hill, 1983
- (4) J. Gowar  
Optical communication systems, PHI, 1987
- (5) M. Sayer & A. Mansingh  
Measurement, Instrumentation and Experiment Design in Physics and Engineering, PHI , 2000

**Semester - I**  
**PAPER – INS - 15**  
**Workshop technology & Mechanism**

**Lab: 1** **(03 hours/week)**  
**Group: B** **MECHANICALS LAB**

- (1) Filing practice
- (2) Turning practice - I
- (3) Turning practice – II
- (4) Shaping practice
- (5) Grinding practice
- (6) Milling practice – I
- (7) Milling practice – II
- (8) Gear cutting practice
- (9) Alignment with maintenance

**PAPER – INS -15**

**ELECTRONIC LAB**

**Lab : 2** **ELECTRONIC LAB** **( 06 hours/week )**  
**Group : A**

- (1) Familiarization with various active & passive components
- (2) Development of soldering skill & making of PCB
- (3) To design, build & test Half adder & Half subtractor
- (4) To design, build & test UJT Oscillator
- (5) To design, build & test inverting & non – inverting amplifier using IC 741
- (6) To design, build & test Full Adder & Full subtractor
- (7) To design, build & test integrator & differentiator circuit using IC 741
- (8) To design, build & test stable multivibrator
- (9) To design, build & test colpitt's oscillator
- (10) To design, build & test a 4 – bit binary up counter using J – K flip flops
- (11) To design, build & test digital to analog converter
- (12) To design, build & test a single stage RC coupled amplifier

**Semester-II**  
**PAPER – INS-21**  
**Metrology**

**Unit - 1**

Standards of measurements, standards of length, end standards, Vernier callipers, fixed gauges, inside, depth and height gauges, Gauge blocks surface plates. micrometers. Angular measurement sine bars, angle gauges, levels, clinometers, auto collimators, taper gauge.

**Unit - 2**

direct measuring tools and instruments, Optical projectors and microscopes, Horizontal vertical and cabiner profile projector, Toolmakers and workshop microscopes, End standards, end bars, slip gauges.

**Unit - 3**

Comparison measurements: Comparators, pneumatic, electric and electronic comparators. Limits, Fits and Tolerances. Interchangeability, types of fits geometric dimensioning and tolerance. Interference.

**Unit - 4**

Surface characteristics, Evaluation and symbology, Surface roughness measurements, profilometers.

**Unit - 5**

Surface texture measurements and gauging.

**Unit - 6**

Management of inspection and quality control, Automatic dimensional controls manufacturing processes.

**RECOMMENDED BOOKS**

1. Elements of Precision Engineering : R. Raman, Oxford & IBM Publishing Co., New Delhi - Bombay - Calcutta.
2. The Design and use of Instrument and Accurate Mechanism : White head, T.N. Dawn Publication Inc.
3. Engineering Metrology : R.K.Jain, Khanna Pub.Delhi 1973.

**Semester-II**  
**PAPER - INS-22**  
**MICROPROCESSORS**

**UNIT-1**

What is microprocessor, need for microprocessor in instrumentation advantage of microprocessor in instrumentation.

**UNIT-2**

Microprocessor Architecture, Introduction, Registers, concept of data, address and data buses, memory (RAM, ROM and EPROM ) input output devices, Microcomputer systems.

**UNIT-3**

Instructions, Timing and Programming Methods, Instruction set and classifications, timing diagrams, fetch and execute cycles, addressing modes, assembly language programs, single stepping and single cycle utility routines in microprocessors kits, simple programming techniques like looping, counting, indexing, sub-routines, parameter passing and software time delays.

**UNIT-4**

Data transfer Techniques, Synchronous and asynchronous data transfer, polling, interrupt driven data transfer, masking of interrupts, serial data transfer, direct memory access, data transfer, timing cycles, op-code, fetch cycle, memory and I/O read and write cycles.

**UNIT-5**

Parallel input/output and interfacing applications, Basic interfacing concepts, Interfacing of memory chips, Interfacing with seven segment display and keyboard.

**UNIT-6**

General purpose peripheral devices block diagram, pin configuration and operating modes of 8251, 8254, 8255, 8259, 8279 (or their currently available functionally equivalent/upgrade ) and DMA controller asynchronous receiver / transmitter (UART) etc. interfacing these chips to 8085

DAC & ADC : DAC & ADC chips and their interfacing.

Higher bit chips, brief description of 6800/ 68000 series, 8086, 8088, 80286, 80386, 80486 Pentium and other higher bit chips.

**RECOMMENDED BOOKS**

1. R.S. Gaonkar, Microprocessor, architecture, programming and Applications, Penran International 1997.
2. Mathur, Introduction to Microprocessors,
3. B.B. Bray, Microprocessors Architecture programming and PHL 1997.
4. B. Ram, Fundamentals of microprocessors 2000.

**Semester-II**  
**PAPER – INS - 23**  
**MEASUREMENT SYSTEMS**

**UNIT-I**

Measurement of Displacement force torque and speed.

**UNIT-II**

Methods of pressure measurement. Measurement of vacuum , electrical pressure transducers pressure switches.

**UNIT-III**

Calibration, maintenance and repair of pressure measuring instruments liquid, level measurements. Electrical methods, capacitance level, Indicator radiation level indicator, servicing of level measuring instruments.

**UNIT-IV**

Temperature measurement methods of temperature measurement, Expansion and filled system thermometers electrical temperature instruments, parameters.

**UNIT-V**

Characteristics of vacuum. Vacuum system vacuum pumps gauges. Pumping speed for a vacuum system, thin film techniques, film thickness measurements and monitors.

1. IEF 488 interfaces bus instrumentation software.
2. Recorders, Automatic controllers and tele-metering systems. Digital Voltmeter and multi-meters polarography, photovoltaic cell, light emitting diodes.

**UNIT-VI**

Signal to noise consideration, noise in frequency domain, sources of noise, signal to noise in experimental design, frequency and bandwidth consideration, bandwidth control, signal to noise enhancement, digital correlation and auto correlation methods, signal recovery, signal filtering, signal averaging, signal coding.

**RECOMMENDED BOOKS**

1. M.Sayer and A.Mansingh, Measurement, Instrumentation and experimental design for physics and engineering PHI, 2000.
2. B.E.Jones, Instrumentation. Measurement and control. TMH 1981.
3. A.K. Sawhney, A Course in electrical and electronics measurements and instrumentation. Dhentat Rai and Sons. 1998.
4. C.S. Rangan G.S. Sharma, V.S.Mani. Instrumentation Devices Systems, TMH,1983, (1998)
5. J.P. Holman, Experimental Systems, applications and Design, M.C. Grow Hill 1990.
6. F.O.Deoblin Measurement Systems, applications and design, Mc Gro Hill , 1990
7. A.J.Difender, Principles of electronic instrumentation. W.B. Saunders (toppan) 1972.
8. S.K.Singh, Industrial Instrumentation and Contrl, TMH 1990.
9. D.Patranabis, Principals of Industrial Instrumentation, TMH 1996
10. J.Jha, M.Puri, R.S.Kanav, M.Kasav.  
Elements of Electronic Instrumentation, Narosa. !996.

**Semester-II**  
**PAPER - INS-24**  
**Biomedical and Environmental Instrumentation**

**UNIT-1**

Electrodes, Sensors & Transducers:

Sensor error sources, Tactics & signals processing for improved sensing, Electrodes for biophysical sensing, Medical surface electrodes, Microelectrodes, Inductive transducers, Temperature transducers.

**UNIT- 2**

Electrocardiographs

ECG waveform, other ECG signals, ECG preamplifier, ECG readout devices, ECG machine, ECG machine maintenance, ECG faults & troubleshooting.

**UNIT- 3**

Electroencephalography

EEG Electrodes, EEG amplitude & frequency bands EEG diagnostic uses and sleep patterns, EEG system : simplified block diagram, preamplifiers & EEG system specifications, Typical EEG system artifacts, faults, troubleshooting and maintenance.

**UNIT- 4**

Blood pressure measurements, Oscillometric and ultrasonic noninvasive pressure measurements

Direct methods : H<sub>2</sub>O manometers, pressure amplifier designs, systolic, diastolic and mean detector circuits.

**UNIT-5**

Defibrillators, Defibrillator circuits, Cardioversion, Pacemakers, Heart – lung machines, ICU equipment, Bedside monitor circuits, Central monitoring consoles.

**UNIT- 6**

Environmental Instrumentation

Air – pollution standards, General air – sampling train, Gas sampling techniques, Particulate sampling techniques, SO<sub>2</sub> measurements, Combustion products measurements, Opacity measurements : Odor measurements, Water quality by turbidity meter, Calorimeter, PH meter.

**RECOMMENDED BOOKS**

- (1) Joseph J. Carr, John M. Brown

Introduction to Biomedical equipment Technology Fourth Edition, Pearson Education,2001

- (2) J.P.Holman

Experimental Methods for Engineers : 7<sup>th</sup> Edition , THM, 2001

- (3) L. crimwell, F.J.Weibell, E.R.Pfeifter

Biomedical Instrumentation and Measurements, PHI,1980

**Semester-II  
PAPER – INS-25  
PRACTICLES**

**Lab : 2**

**( 03 hours/week )**

**ELECTRONIC LAB**

- (1) To design, build & test Wein bridge oscillator using IC 741
- (2) To design, build & test 4 – bit binary down counter using J.K.Flip flops
- (3) To design, build & test A to D converter
- (4) To design, build & test Voltage regulator using IC 741
- (5) To design, build & test (i) 4 X 1 multiplexer (ii) 1X 4 demultiplexer
- (6) Writing & testing the following assembly language programmes :
  - (i) Arrange the data stored in some location in ascending / descending order
  - (ii) Multiple precision addition & subtraction
- (7) To design, build & test (i) BCD to Excess – 3 code converter (ii) Excess -3 to BCD code converter.

**Lab : 3**

**( 03 hours/week )**

**TRANSDUCER & SENSORS LAB**

- (1) Study of LVDT & Strain gauge
- (2) Study of Speed measurement
- (3) Study of R.T.D. Characteristics
- (4) Study of Thermistor and Thermocouple
- (5) Study of inductive pickup and capacitive pickup
- (6) Study of Piezoelectric transducer
- (7) Study of LDR

