VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

University Science Instrumentation Centre (USIC)

Course Curriculum of Post Graduate Diploma In Instrumentation

(PGDI)

(One year self finance)

INDEX

1. INTRODUCTION :

Instrumentation is an interdisciplinary area which is very important in the academic, and industrial spheres in the context of national development.The UGC along with many other organizations of Government of India have recognized this and launched comprehensive instrumentation programmes.

There are many industries like Fertilizers, Power production, O.N.G.C., Steel processing plants, Sugar industries, paper plants. Textiles, Pharmaceuticals ate located in Gujarat and particularly in South Gujarat.Also in medical sophisticated instrumentation is involved in diagnosis, treatment, surgery and clinical and analytical laboratories. Therefore, it is a felt need to introduce an interdisciplinary course in instrumentation at P.G. level in our University.

2. OBJECTIVES:

The objectives for the proposed programme are as the following :

2.1 To build up the knowledge and intellectual ability of the students by instruction in fundamental concepts and principles of various area of the instrumentation.

2.2 To cultivate the decision making capability by giving them opportunities to learn, to solve open ended problems and to acquaint them with the problems of the concern industries.

2.3 To promote and create the interest in propagating instrumentation culture among the students and teachers working in other disciplines of Science.

2.4 To promote the interaction between the institution and industries.

3. ELIGIBILITY :

T.Y.B.Sc. Pass (Physics/ Electronics/Instrumentation/ Chemistry)

4. DURATION :

One year course (Daily 6.00 P.M. to 10.00 P.M., 6 days /week)

5. SELECTION :

Selection should be done by merit prepared as following :

50	Marks of Written Test
50	Marks of the percentage of T.Y.B.Sc.
100	Total Marks

6. COURSE STRUCTURE :

PGDI **Appendix - A**

7. SCHEME FOR TEACHING AND EXAMINATION :

PGDI **Appendix - B**

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PAPER- I

Instruments Mechanism and Metrology

Materials for Instruments, bearings, machine bearing; Use of instruments bearings, different types of bearing and guides. Brief introduction to steps, couplings, clutches, joining and functional mechanisms.

Elements of workshop technology covering fundamentals of simple manufacturing processes machine tools like lathes. drilling machines. milling machines. shapping machines. Measuring systems and precision instruments. Measuring with rules. Mathematical concepts. Limiting means, range, variance. Standard deviation, normal distribution. continence intervals. Principals of sampling.

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

Comparison measurements: Comparators, pneumatic. electric and electronic comparators. Limits. Fits and Tolerances.Interchangeability. types of fits geometric dimensioning and tolerance. Interference.Surface characteristics, Evaluation and symbology. Surface roughness measurements, profilometers.

Alignment testing. Machine tools alignment, machine beds. Alignment of axis (spindle axis and bed. spindle axis and line of centers), axial slip and calibration of lead screw, alignment telescopes. Interferometers. Elerosonic pulse-Echo and resonance gauging. optical alignment. Equipment and methods.

Surface texture measurements and gauging.

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

RECOMMENDED BOOKS

1. **Elements of Precision Engineering R. Raman Oxford & IBM Pushlishing 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.**

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PAPER- II

General Electronics and Microprocessor

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. 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

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.

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

K-Map and its application, binary adders,full adders, full adder as a subs tractor, arithmetic functions. decoder demultiplexer. date selector multiplexer, encoder, ROM , applications of ROM, 1 bit memory, Jlip-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**

MICROPROCESSOR

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

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

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, mdexing, sub-routines, parameter passing and software time delays.

Data transfer Techniques Synchronous and asynchronous data transfer, polling, incrrupt 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.

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

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.**

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PAPER- III

MEASUREMENT INSTRUMENTATION, CONTROL

Experimental design, transducers, classification of transducers transducer, characteristics, selection of instrumentation transducer transducers as an electrical element, meaurment methods, temperature transducers, variable-resister transducer, differential transformer LVDT, Capacitive, piezo electric and photoconductive transducer, photoemissive detectors, photodiode, phototransistor, ionization transducer magnetic search coil, Hall transducer, digital displacement transducer, strain gages, different type of strain gages , theory and applications of strain gages.

Signal to noise consideration, noise in frequency domain, sources of noise, signed 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.

Functional Elements of instruments, performance characteristics, statistical analysis.

Fundamental concept of an instrument, input and output, configuration of measuring instruments and instrument systems, methods of correction for Interfacing and modifying inputs, Instrumentation amplifier, basic characteristics, isolation amplifiers.

Electrical measuring instruments, essential of indication instruments, types of electrical instrument. moving coil. Hot-wire and induction instruments electrostatic instruments. watt and energy meters insulation testing magger.

Measurement of displacement force torque and speed.

Methods of pressure measurement . measurement of vacuum , electrical pressure transducers pressure switches. calibration, maintenance and repair of pressure measuring instruments liquid, level measurements. electrical methods, capacitance level. indicator radiation level indicator, servicing of level measuring instruments.

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

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 telemetering systems. Digital Voltmeter and multimeters polarography, photovoltaic cell, light emitting diodes .**

RECOMMEDED 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.

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PAPER- IV

Optical, Analytical, Biomedical, Environmental Instrumentation

Laser Instrumentation, principals of laser types of lasers construction of laser, application of laser in distance measurement communication holography etc.

Fiber Optics, principles of optical fibers, materials for optical fibers, production of optical fibbers, sources,detectors,couplings, application of fiber optics, illuminators, endoscopy, communication etc.

Analytical Instrumentation :
Introduction to instrumentation system, need for an integrated approach

Analytical Instruments :

Working principles, operation and data analysis of the following instruments Spectrophotometers, Atomic AAS, Electron Microscopes.

Nuclear Magnetic Resonance Spectrometer.

Principal of operation, sample preparation and data analysis, stability of magnetic fields and electronics.

Mass Spectrometer :
Application Area, Working Principles of static and dynamic instruments, analysis of data.

X-ray techniques and their application to radiography fluorescence and differactometry Interpretation of data.

Moss Bauer spectrometers :
Principles of operation, measurement of radioactivity and analysis of data.

Biomedical Instrumentation :

Introduction to transducer and their application, recording electrodes.

EEG,ECG and other potentials :
Working principles and precautation.

Blood pressure instruments, introduction to homodynamic.
Introduction to ultra sound and topographic techniques.
Introduction of data and precaution for measurements.

Introduction to working principles and operation of pacemakers.

defibrillators heart-lung and other ICU instrumentation.

Enviromental Instrumentation:

1. **General introduction to physical enviroment :**
   Physical aspects like pressure, temperature, humidity, noise, visibility, air quality and water quality.
2. **Humid atmosphere, Hygrometers and dew point instruments, controlled humidity environment.**
3. **Thermal comfort meter, beat stress monitor and temperature monitors.**
4. **Air Velocity and effect on dispersion of pollutants.**
   Hot-wire anemometer, radar
5. **Sound level meters, type recorders, noise dosimeters, sound level monitors and acoustical calibrators.**
6. **Solar flux, Pyrometers and pyrheliometers.**
7. **Water quality by turbidity meter, calorimeter, PH meter. microscopes, atomic absorption spectroscopy.**
8. **Air quality measurement using gas chromatography, high-pressure liquid chromatography, gas chromatography, mass spectrometry, conductivity meter.**
9. **Particulate matter in air, soiling index and visibility.**
10. **Congenial environment for work, artificial lighting acoustic consideration and air conditioning.**

RECOMMENDED BOOKS :

1. **Air pollution-physical and chemical fundamentals. J.H.Seinfield. Mc Graw Hill NY 1975.**
2. **Meteorological instruments, W.E.Knowles Middleton and A.S.Spilhans, University Toronto Press 1953.**
3. **H.Willard, L.L. Merrit, J.A.Dean, F.A. Settle. Instrumental methods of analysis VI Edn.**
4. **Environmental instrumentation Frichtschen, L.J.and Gay, L.W.**
5. **Thermal comfor Fanger, P.O. 1982.**
   Robert E. Krieger Publishing Company, Malbar, FL.

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LABORATORY WORK

(09 Hours / week)

Group - A : 3 Hours / week

1. **Experiments to familiaries the use of instruments and techniques for measurement, double ended plug gauge. plain ring gauge, plug gauge in a**
2. **Experiments to familiarise the use of instruments and techniques for measurement of temperature, pressure etc.**
3. **Workshop practice. Simple exercises in workshop practice in sheet metal work, lathe jobs, shaping machine, milling machine, and grinding machine jobs.**

Group – B : 3 Hours / week

1. **Familiarization with various active and passive components.**
2. **Development of soldering skill and making of PCB.**
3. **To design, build and test two stages R C Coupled amplifier.**
4. **To design, build and test astable multivibrator.**
5. **To design, build and test Colpitt's oscillator.**
6. **Operational amplifier I**
7. **Operational amplifier II**
8. **To design, build and test adder, subtractor.**
9. **To design, build and test A to D converter**
10. **To design, build and test D to A converter**
11. **To design build and test (i) a 4 bit up counter using JK flip-flops (ii) a Modula N counter using JK flip flips and other gates.**
12. **Writing and testing different assembly language programmes.**

Group – C : 3 Hours / week

1. **Experiments with laser kit**
2. **Experiments with fibre optics kit.**
3. **Experiments with analytical and environmental instruments.**
4. **Experiments on vacuum system; case study of design of a High vacuum system, vacuum evaporation and preparation of Mirror conductance and speed of rotatory pump at the vessel measurement of vacuum.**
5. **Experiments with transducers, L.V.D.T. strain gauge etc.**
6. **P.I.D. Controller, P.I.D. simulator.**

Group – D Project work

APPENDIX - B

A SCHEME FOR TEACHING AND EXAMINATION AT POST GRADUATE DIPLOMA IN INSTRUMENTATION

PGDI

Course	Course No.	Teaching Scheme		Examination scheme				Total
		L	T	University Exam		Internal Exam		
				Theory Exam Hrs.	Marks	Theory Exam Hrs.	Marks	
Instruments Mechanism and metrology	PGI-101	3	1	3	53	3	22	75
General Electronics and Microprocessors	PGI-102	3	1	3	53	3	22	75
Measurement ,Instrumentation and control	PGI-103	3	1	3	53	3	22	75
Optical Analytical Biomedical Environmental Instrumentation	PGI-104	3	0	3	53	3	22	75
		Total of Theory Exam			212		88	300
Laboratory including workshop practice & project	PGI-105	9		9	140	9	60	200
						TOTAL MARKS		500