STUDY & EVALUATION SCHEME

THREE YEAR DIPLOMA COURSE IN
INSTRUMENTATION AND CONTROL ENGINEERING

(2014 Scheme)

SEMESTER - IV

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Written Paper		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
1	Applied Mechanical Engineering	4	-	3	50	50	100	3	100	3	300
2	*Introduction to Microprocessor	4	-	3	50	50	100	3	100	3	300
3	Measurement System	4	-	3	50	50	100	3	100	3	300
4	*Electronics Instruments and Measurements	4	-	3	50	50	100	3	100	3	300
5	*Electronic Devices and Circuits-II	4	-	3	50	50	100	3	100	3	300
6	Industrial Training and Report Presentation	-	-	3	-	50	-	-	100	3	150
**	Student Centered activities	-	-	2							
	TOTAL	20	-	20							1650

**Student centered activities will include: extension lectures, field visits, Soft Skills, seminars, debates, hobby clubs, library studies, awareness regarding ecology and environment, conservation of energy (Petroleum products, electricity etc), social service camps and other co-curricular activities including games. Advanced planning for each semester has got to be made

*Common with Digital/Medical Electronics

NOTE- Students to undergo Industrial Training of 3 to 4 weeks duration in reputed organization during winter vacation before the start of the semester and evaluation will be done in even semester. The students have to submit a report related to Instrumentation Industry.

APPLIED MECHANICAL ENGINEERING

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RATIONALE

Instrument Technology is integration of different branches of science which are put together to achieve required functional goal. The students are therefore required to know the basics of the relevant engineering branches so as to have a clear undertaking about the process equipment and controls. The syllabus of Mechanical Engineering has been prepared with a view to acquaint them with the basics of mechanical engineering.

DETAILED CONTENTS

1. Simple stress and strain **10%**

Hooke's Law, Young's modulus, rigidity modulus, bulk modulus , Poisson's ratio. Properties of materials. stress – strain diagram for a ductile metal, working stress, ultimate stress factor of safety resilience – strain energy. temperature stress , stress in composite bars

2. Springs **5%**

Construction and application of : Helical springs, deflection under tension , deflection under compression and torque closed helical springs, spiral springs, taut bands, helical spiral springs and leaf springs.

3. Instrument Compound **5%**

Construction, working and application of diaphragm, capsule, Bourdon elements, bellows

4. Sample Mechanisms **10%**

Definition of a link, kinematic pair, kinematic chain mechanism, inversions machines, simple mechanisms with lower pairs, four bar chain, slider crank chain, double slider crank chain, higher pairs.

5. Static Pressure of Fluids **10%**

Properties of fluid (viscosity, specific weight, specific volume and specific gravity Pascal's law concept of static pressure. intensity of pressure and total pressure head, total pressure on a plain surface and centre of pressure (without proof).

1. Flow of Liquids **12%**

Types of flow (laminar and turbulent). Reynold number, rate of discharge, law of continuity potential pressure and kinetic energy.Bernoulli's Throem (without proof) Concept of atmospheric pressure, gauge pressure, absolute pressure , vacuum and differential pressure.

Concept of water turbines and pumps

7. Principles of fluidics **8%**

8. Gas Laws **10%**

Boyle's law, charle's law, Joule's law, characteristic equation, gas constant, universal gas constant

9. Laws of thermodynamics **10%**

Zeroth law, first law of thermodynamics, equation of first law. Second law of thermodynamics concept of entropy

10. Processes **10%**

Constant volume constant pressure isothermal adiabatic and polytropic processes, Throttling and free expansion. Work done under these processes

11. Principle of working of a steam power plant and a gas power plant. 10%

LIST OF PRACTICALS

1. To prove the relationship, p=wh for various fluids
2. To measure the pressure head of water in a pipe line by
   a) Piezometer tube
   b) U-tube or double column manometer
   c) Inverted U-tube and compare it with the measurement made by means of a pressure gauge.
3. To verify the Bernoulli's theorem

   Visit: To visit a hydro-electric power plant and note the position of its each equipment/component and instrument. Draw a scheme diagram and give function of its each part/component briefly.
4. To study functional features of a steam power plant through visit and through models
5. To study the constructional and functional features of a steam turbine.

INTRODUCTION TO MICROPROCESSORS

L	T	P
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RATIONALE:

The study of microprocessors in terms of architecture, software and interfacing techniques leads to the understanding of working of CPU in a microcomputer. The development in microprocessors of 32 bit architecture brings them face with mainframe systems. Thus the study of microprocessors is relevant in finding employment in R&D, assembly, repair and maintenance of hardware of microprocessors and computers. Microprocessors find application in process control industry. They are also a part of the electronic switching system between source and destination in long distance telecommunications. Thus the microprocessors are an area of specialization. Students of electronics engineering often use microprocessors to introduce programmable control in their projects, in industrial training.

DETAILED CONTENTS

1. Introduction (5%)

(a) Typical organization of a microcomputer system and functions of its various blocks.

(b) Microprocessors, its evolution, function and impact on modern society.

2. Architecture of microprocessor (with reference to 8085 microprocessor) (10%)

(a) Concept of bus, bus organization of 8085.

(b) Functional block diagram of 8085 and function of each block.

(c) Pin details of 8085 and related signals.

(d) Demultiplexing of address/data bus (AD0-AD7), generation of read, writes control signals.

3. Instruction timing and Cycles (10%)

(a) Instruction cycle, machine cycle and T states.

(b) How a stored programme is executed-Fetch and Execute cycles.

4. Programming (with respect to 8085 microprocessor) (15%)

(a) Brief idea of machine and assembly languages, machine and mnemonic codes

(b) Instruction format and addressing mode, identification of instructions as to which addressing mode they belong.

(c) Concept of instruction set, explanation of the instructions of the following groups of instruction set of 8085. Data transfer group, Arithmetic group, Logic group, Stack, I/O and machine Control Group.

(d) Programming exercises in assembly language (Examples can be taken from the list of experiments)

5. Memories and I/O interfacing (10%)

(a) Memory organization, memory map, partitioning of total memory space, address decoding, concept of mapped I/O and memory mapped I/O. Interfacing of memory and I/O devices

(b) Concept of memory mapping, concept of stack and its function.

6. Interrupts (10%)

(a) Concept of interrupt, maskable and non-maskable, edge triggered interrupts, software interrupts, restart instruction and its use.

(b) Various hardware interrupts of 8085, servicing interrupts, extending interrupt system.

7. Data Transfer Techniques (10%)

(c) Concept of programmed I/O operations, sync data transfer, async data transfers (handshaking), Interrupt driven data transfer, DMA, serial output data, serial input data.

8. Brief idea and programming of interfacing chip 8255. (10%)

9. Microcontrollers (10%)

(a) Introduction, architecture of 8051 only applications of microcontrollers.

10. Comparison (10%)

(a) 8085, Z80, 6800 (8 bit microprocessors)

LIST OF PRACTICALS (INTRODUCTION TO MICROPROCESSORS)

1. Addition of two 8 bit numbers

2. (a) To obtain 2's complement of 8 bit number

(b) To subtract a 8 bit number from another 8 bit number using 2's Complement

3. Extract fifth bit of a number in A and store it in another register.

4. Count the number of bits in high state in accumulator

5. Check even parity and odd parity of a binary number

6. Addition of two sixteen bit numbers

7. Subtraction of a sixteen bit number from another sixteen bit number

8. Multiplication of two 8 bit numbers by repetitive subtraction

9. Divide two 8-bit numbers by repetitive subtraction

10. (a) Smallest number of three numbers.

(b) Largest number of three numbers

11. To sort an array of unsigned binary numbers in decreasing/increasing order

12. Generate timing delay through software

MEASUREMENT SYSTEMS

L	T	P
4	-	3

RATIONALE

This syllabus has been designed to make a base for understanding of instrumentation technology. The basic principles involved in instrumentation, displays etc. are included in the syllabus. The students will be able to identify different types of instruments, sensors and transducers used in the field of instrumentation. The students will also be able to select appropriate transducers relating to a process. They will also know about the conditioning of a signal from a transducer(s) for the purpose of indication/control. Faculty is advised to show them and make them familiar with transducers while covering the topic.

DETAILED CONTENTS

1. Performance Characteristics of Instruments. 10%

(i) Concept of time constant, response time, natural frequency, damping coefficient.
(ii) Order of instruments.
(iii) Step response of different orders of instrument systems.

2. Display Means. 10%

(i) Various indicating, integrating and recording methods and their combinations.
(ii) Merits and demerits of circular chart and strip chart recorders.
(iii) Basics of printing devices.
(iv) Scanning and data logging.

3. Basic Definition. 5%

Classification – definition of terms used – accuracy, precision, sensitivity, linearity, hysteresis etc. Selection criteria of transducers.

4. Variable Resistance Transducers. 10%

(i) Basic principles; Potentiometers, strain gauges – load cells – temperature compensation – applications.
(ii) Hot wire anemometers; photo resistors, Humidity sensor.
(iii) Resistive temperature transducers.
(iv) Thermister and their circuits; carbon microphones.

5. Variable Inductance Transducers. 10%

Basic principles, El pick ups induction potentiometers LVDT (Linear Variable Differential Transformer) variable reluctance accelerometers, capacitance pickups, condenser microphones, differential capacitance pick ups – signal conditioning circuits. Measurement of pressure, liquid level moisture etc.

6. Piezo Electric Transducers. 10%

Piezoelectric crystals and their properties, general forms of piezoelectric transducers, accelerometers, pick ups.

7. Magneto astrictive transducers. 10%

Magneto elastic property of nickel and perm alloy. Measurement of force, acceleration, torque.

8. Other Transducers. 15%

(i) Based on Hall Effect, eddy current, ionization.

(ii) Optical transducers.
(iii) Digital transducers, single shaft encoders.
(iv) Thermocouple sensor, photo voltaic cell.
(v) Tachogenerator.
(vi) Synchros
(vii) Selection of sensors for measurement of following parameters: Temperature, pressure, flow and level, vibration, displacement, speed.

9. Principle of operation, construction details and transfer functions of: **10%**

Electrical components like limit switches potentiometer, synchros, auto transformer, servomotors (DC & AC), stepper motor, magnetic amplifiers, operational amplifiers, application to typical servo system.

10. Pneumatic components; flapper nozzle system, bellows & relays lock up relays: 10%

Hydraulic components: principle of operation of hydraulic amplifier, electro pneumatics relays; construction and application, control valves and actuators concept and type of control valves and their characteristics. Principle of operation and constructional details of solenoid valves motor operated valves, diaphragm operated valves, power cylinders, piston operated valves. Hand wheel actuators, control valves and its application selection of valves CV CB factors.

LIST OF PRACTICALS (MEASUREMENT SYSTEMS)

1. Study of strain gauge and measurement of strain in given sample.
2. Study of synchro transmitter and receiver.
3. Study of piezoelectric pressure transducer.
4. Study and calibration of L.V.D.T.
5. Study of variable capacitive transducer.
6. Study of variable inductive transducer.
7. Study of servomotor.
8. Study of pneumatic control valve.
9. Study of solenoid valve and motor operated valve.
10. Study of optical transducer.

ELECTRONICS INSTRUMENTS & MEASUREMENTS

L	T	P
4	-	3

RATIONALE

The study of this subject will help a student to gain the knowledge of the working principles and operation of different electronic instruments (Analog as well as digital). The practical work done in this subject will help to acquire skill in operation and testing of the instruments as per their specifications will also be imparted.

DETAILED CONTENTS

1. Basics of Measurement (5%)

(i) Review of performance, specifications of instruments, accuracy, precision, sensitivity, resolution range etc. Errors in measurement and loading effects.

2. Multi-meter: (10%)

(i) Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance in a multi-meter

(ii) Specifications of a multi-meter and their significance

(iii) Limitations with regards to frequency and input impedance

3. Electronic Voltmeter (10%)

(i) Advantages over conventional multi-meter for voltage measurement with respect to input impedance and sensitivity.

(ii) Principles of voltage, current and resistance measurements (block diagrams only)

(iii) Specifications of an electronic Voltmeter/Multi-meter and their significance.

4. AC Milli-voltmeter (10%)

(i) Types of AC millivoltmeters : Amplifier-rectifier and rectifier-Amplifier, Block diagram and explanation of the above types of ac millivoltmeters

(ii) Typical specifications and their significance

5. Cathode Ray Oscilloscope (20%)

(i) Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only – no mathematical treatment) Deflection sensitivity, brief mention of screen phosphor for CRT in relation to their visual persistence and chemical composition

(ii) Explanation of time base operation and need for blanking during fly back ; synchronization

(iii) Block diagram explanation of a basic CRO and a triggered sweep oscilloscope, front panel controls

(iv) Specifications of a CRO and their significance

(v) Use of CRO for the measurement of voltage (dc and ac) frequency, time period and phase angles

(vi) Special features of dual treace, delayed sweep and storage CROs (brief mention only); introduction to digital CROs

(vii) CRO probes, including current probes.

(viii) Digital storage Oscilloscope: Block diagram and principle of working.

6. Signal Generators and Analysis Instruments (15%)

(i) Block diagram, explanation and specifications of
(ii) laboratory type low frequency and RF signal generators
(iii) pulse generator and function generator
(iv) Brief idea for testing, specification for the above instruments
(v) Distortion factor meter, wave analysis and spectrum analysis

7. Impedance Bridges and Q-Meters (15%)

(i) Block diagram explanation of working principles of a laboratory type (balancing type) RLC bridge. Specifications of a RLC bridge.
(ii) Block diagram and working principles of a Q-meter

8. Digital Instruments: **(15%)**

(i) Comparison of analog and digital instruments, characteristics of a digital meter
(ii) digital voltmeter
(iii) Block diagram and working of a digital multi-meter
(iv) Working principle of time interval, frequency and period measurement using universal counter/frequency counter, time-base stability, accuracy and resolution.
(v) Principles of working and specifications of logic probes, signature analyzer and logic analyzer.
(vi) Digital, LCR bridges

LIST OF PRACTICALS (ELECTRONIC INSTRUMENTS & MEASUREMENTS)

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance
2. To observe the limitations of a multimeter for measuring high frequency voltages and currents
3. To measure Q of a coil and observe its dependence on frequency, using a Q-meter
4. Measurement of voltage, frequency, time period, and phase angle using CRO
5. Measurement of time period, frequency, average period using universal counter/frequency counter
6. Measurement of rise, fall and delay times using a CRO
7. Measurement of distortion of a LF signal generator using distortion factor meter
8. Measurement of R,L and C using a LCR bridge/universal bridge

ELECTRONIC DEVICES AND CIRCUITS – II

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RATIONALE:

The course provides the students with basic understanding of the principles of common electronic devices and circuits of importance, the knowledge regarding the application of various circuits and devices, practical experience in the design, fabrication and testing of circuits

DETAILED CONTENTS

1. Multistage Transistor Amplifier (15%)

Need of multistage amplifier, different coupling schemes and their working; brief mention of application of each of the types of coupling, working of R-C coupled and transformer coupled multistage amplifier, approximate calculation of voltage gain of two stage R-C coupled amplifier. Frequency response for R-C coupled and transformer coupled amplifiers and physical significance of the terms bandwidth, upper and lower cross over frequencies. Direct coupled amplifier and its limitation, difference amplifier typical diagram and working.

2. Audio Power Amplifiers (15%)

Difference between voltage and power amplifiers, importance of impedance match in power amplifier, collector efficiency of power amplifier. Typical single ended power amplifier and its working, graphical method of calculation of output power; heat dissipation curve and importance of heat sinks; class A, class B and Class C Amplifier; collector efficiency and distortion in class A,B and C amplifier (without derivations) working principles of push pull amplifier circuits, its advantages over single ended power amplifier, cross over distortion in Class B operation and its reduction. Different driver stages for push pull amplifier circuit. Working principles of complementary symmetry push pull circuit and its advantages. Transformer less audio power amplifiers and their typical applications.

3. Feedback in Amplifier (15%)

Basic principles and types of feedback Derivation of expression for the gain of an amplifier employing feedback Effect of negative feedback on gain, stability, distortion and bandwidth (only physical explanation), Typical feedback circuits RC coupled amplifiers with emitter by pass, capacitor removed Emitter follower and its application, simple mathematical analysis for voltage gain and input & output impedance of above circuits.

4. Operational Amplifier (15%)

Characteristics of ideal operational amplifier and its block diagram, definition of inverting and non-inverting inputs, differential voltage gain, input and output voltages, input offset current, input bias current, common mode rejection (CMRR), Power Supply Rejection Ratio (PSRR) and slew rate. Method of offset, Null Adjustment, use of Op-amp as an invertor, scale changer, Adder, Subtractor, Differentiator, Integrator. Schmitt trigger circuit, time base generator circuit, S/H switch circuit.

5. Sinusoidal Oscillators (15%)

Application of oscillators, Use of positive feedback, negative feedback & negative resistance for generation of oscillation, Barkhausen criterion for oscillations. Different

oscillator circuits tuned collector Hartley, colpitts, phase shifts, wiens bridge and crystal oscillators and their working principles (no mathematical derivation), Operational amplifier as Wein Bridge Oscillator and phase shift oscillator

6. Tuned Voltage Amplifiers (15%)

Classification of amplifiers on the basis of frequency. Series and parallel resonant circuits, expression for resonant frequency, expression for impedance at resonance; relationship between resonant frequency, Q and Band width (no derivation) Hybrid equivalent circuits of transistor and its parameters, h parameters model of single and double tuned amplifiers; their working principles and frequency response (no mathematical derivation) Concepts of neutralization. Staggered tuned amplifier and typical applications in brief.

7. Optical Electronics Devices and Their Applications (10%)

Working principles and characteristics of photo resistors, photo diodes, photo transistors, photo voltaic cells, LEDS, LCDs and optical couplers. Simple application of optical electronic devices (one example of each may be mentioned)

LIST OF PRACTICALS (ELECTRONIC DEVICES AND CIRCUITS – II)

1. Two stage R.C. Coupled Amplifier to measure the over all gain of two stages at 1 KHZ and compare it with the gain of 1st stage. Also to observe the loading effect of second stage on the first stage.

2. To plot the frequency response curve of two stage amplifier and compare it with that of the single stage amplifier

3. For a single ended power amplifier measurement of optimum load, maximum undistorted power (by giving maximum allowable signal), collector efficiency and percentage distortion factor.

4. For a push-pull amplifier measurement of optimum load, maximum undistorted power (by giving maximum allowable signal), collector efficiency and percentage distortion factor.

5. For a complementary symmetry amplifier measurement of optimum load, maximum undistorted power (by giving maximum allowable signal), collector efficiency and percentage distortion factor.

6. Feedback in Amplifier: Single stage amplifier with and without by pass capacitor measurement of voltage gain and plotting of frequency response in both cases (i.e. with and without by pass capacitor).

7. Feedback in Amplifier: Emitter follower circuit measurement of voltage gain and plotting of frequency response curve.

8. Sinusoidal oscillator (LC): Hartley/Colpittis oscillator circuit measurement of frequency and amplitude oscillations by plotting the wave shape from CRO

9. Sinusoidal oscillator (RC): Wein bridge oscillator circuit – measurement of resonant frequency and amplitude of oscillations by plotting the wave-shape from CRO

10. Tuned Voltage Amplifier Series and parallel resonant circuit – measurement of resonant frequency. Plotting of the resonance curve (i.e. graph between input frequency and impedance) and calculation of Q of the resonant circuit from this plot.

11. Plotting of the frequency response of single tuned voltage amplifier and calculate the Q of the tuned circuit load.

12. Use of op-amp (IC741) as inverting and non-inverting amplifier, adder, integrator, buffer, scale changer

13. To measure the output off ser voltage of an op-amp (741) and zero adjustment using nulling techniques.

Note : Use of simulation software such as OrCADPSpice MULTISIM, ELECTRONIC WORK BENCH etc. for performing some of the above on the computer also, which will enhance the understanding of the students beyond traditional laboratory experiments.

INDUSTRIAL TRAINING & REPORT PRESENTATION

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RATIONALE

Minor project work aims at exposing the student to the various industries. They are expected to learn about the construction, working principles of different electronic and Micro processors based instruments. It is expected from them get acquainted with industrial environment at the shop floor and acquire desired attitudes. For this purpose student during middle of course are required to be sent for a designated period in different industries where production/servicing/installation of microprocessor based systems is going on.

Depending on an interest of students they are sent to:

1. Chemical Industry
2. Power Plant
3. Sugar Factory
4. Paper Industry
5. Fertilizer Factory
6. Hospital
7. Automobile Industry
8. Petro Chemical Industry
9. Air Lines

As a minor project activity each student as supposes to study the operations at sight and prepare a detail project report of the observations/processes/activities by him/her. These students should be guided by respective subject teachers each teacher may guide a group of 4 to 5 students. The teachers along with field supervisor/engineers conduct performance assessment of students.