CURRICULUM

for

DIPLOMA PROGRAMME

in

INSTRUMENTATION ENGINEERING

2nd Year (3rd & 4th Semester)

FOR THE STATE OF HIMACHAL PRADESH

Prepared by

National Institute of Technical Teachers Training & Research, Sector-26, Chandigarh-160019, India.

June, 2018

General Guidelines for Curriculum Implementation

1. Weightage for the internal assessment in respect of theory subjects will be as follow:
   - House Test: 40 %
   - Class Test: 20%
   - Home Assignment: 20%
   - Attendance: 20%
2. There will be two class tests in every semester and the average of the two tests will be taken into account.
3. The syllabus for the class tests will be as under:
   - Class Test-I: 30 % of syllabus
   - Class Test-II: next 30 % of syllabus
4. Class Test-I should be conducted in first week of March/September.
5. Class Test-II should be conducted in the second week of April/October.
6. The 30%, 60% and 80% contents of the syllabus will be based on the number of hours allocated for the topics in the detailed curriculum of each subject.
7. The question paper for both the class tests will be of 30 marks each and of one-hour duration.
8. Improvement test can be conducted after every class test on the basis of some genuine reason to be judged by the Head of concerned Department.
9. There will be one house test in the First week of May/November and syllabus converge will be 80%.
10. The house test will be of total 60 marks and the duration of House Test should be two hours.
11. There will be minimum two home assignments per subject per semester.
12. Weightage for the internal assessment in respect of Practical subjects should be: Practical Performance: 60% and Viva Voce : 40%
13. Weightage for Internal Assessment in respect of Drawing subjects will be as under:
    i. House Test and Class Test = 40%
    ii a) Class performance/Drawing Sheets=40%
    ii b) Attendance/punctuality = 10%
    ii c) Viva = 10%

For iia), iib), iic) marks should be given in each drawing sheet by concerned teacher during evaluation.

14. It is suggested that students may be taken for industrial visits for industrial exposure in second year and third year.
15. **Student Centered Activities**: A provision has been made for organizing Student Centered Activities for overall personality development of students. SCA will comprise co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, cultural activities and participation in programs like technical and cultural events etc.

Distribution of marks for SCA will be as follows:

i. 20% marks shall be given for general behaviour

ii. 20% marks for attendance shall be based on the following distribution:

Attendance	Marks
Less than 65%	Nil
More than 65%	Proportionate

iii. 60% Marks shall be given for the Sports/NCC/Cultural and Co- curricular activities/other activities after due consideration to the following points:

1. For participation in sports/NCC/Cultural/ Co-curricular activities at National or above level, shall be rewarded with minimum of 40% marks
2. For participation in sports/NCC/Cultural/Co-curricular activities at Inter-polytechnic level, shall be rewarded with minimum of 30% marks
3. For participation in two or more of the listed activities, 20% extra marks should be rewarded

Note: These marks are to be sent to the H.P. Takniki Shiksha Board, Dharamsala at the end of semester along with internal assessment.

STUDY AND EVALUATION SCHEME

THIRD SEMESTER INSTRUMENTATION ENGINEERING

Sr. No.	Subject	Study Scheme Hrs./Week		Marks in Evaluation Scheme								Total Marks
				Internal Assessment			External Assessment					
		Th.	Pr.	Th.	Pr.	Total	Th.	Hrs.	Pr.	Hrs.	Total	
3.1	# Engineering Materials	5	-	50	-	50	100	3	-	-	100	150
3.2	Measuring Instruments	4	2	30	20	50	100	3	50	3	150	200
3.3	Transducers	5	2	30	20	50	100	3	50	3	150	200
3.4	**Digital Electronics	4	2	30	20	50	100	3	50	3	150	200
3.5	Opto-Electronics	4	2	30	20	50	100	3	50	3	150	200
3.6	Fundamentals of Electrical and Electronics Engineering	4	2	30	20	50	100	3	50	3	150	200
Student Centered Activities		-	4	-	25	25	_	_	_	_	_	25
Total		26	14	200	125	325	600	18	250	15	850	1175

*Common with Diploma in Mechanical Engineering
**common with Diploma in EE, ECE & EEE

STUDY AND EVALUATION SCHEME

FOURTH SEMESTER INSTRUMENTATION ENGINEERING

S. No.	Subject	Study Scheme Hrs./Week		Marks in Evaluation Scheme								Total Marks
				Internal			External Assessment					
		Theory	Pr.	Th.	Pr.	Total	Th.	Hrs.	Pr.	Hrs.	Total	
4.1	Basic Mechanical Engineering	4	2	30	20	50	100	3	50	3	150	200
4.2	Control Systems	5	2	30	20	50	100	3	50	3	150	200
4.3	Microprocessors & Microcontrollers Programming	4	2	30	20	50	100	3	50	3	150	200
4.4	Energy Management	5	2	30	20	50	100	3	50	3	150	200
4.5	Minor Project	-	6	-	50	50	-	-	50	3	50	100
4.6	Basics of Management & Entrepreneurship Development	3 + 1(T)	-	50	-	50	100	3	-	-	100	150
Student Centered Activities		-	4	-	25	25	-	-	-	-	-	25
Total		22	18	170	155	325	500	15	250	15	750	1075

* Common with other diploma Programmes

T = Tutorial

Industrial Training - After examination of 4th Semester, the students shall go for training in a relevant industry/field organisation for a minimum period of 4 weeks and shall prepare a diary. The students shall also prepare a report at the end of training and shall present it in a seminar, which will be evaluated during 5th semester.

3.1 ENGINEERING MATERIALS

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RATIONALE:

Due to advancement in technology new materials are being developed and it has become possible to change the properties of material to suit the requirements .The diploma holders are required to guide and solve problems faced at different stages of work regarding use of various materials. This syllabus has been designed to give the students knowledge of different type of materials which are generally used in the field of Instrumentation Engineering.

DETAILED CONTENTS

1. **GENERAL:** **(10Hrs)**

   Introduction to engineering materials, classification of materials, thermal chemical, electrical and mechanical properties of various materials

2. **FERROUS MATERIAL:** **(14Hrs)**

   2.1 Basic properties and classification of iron and steel.
   2.2 Cast iron, plain carbon steel, stainless steel, high strength low alloys steels.
   2.3 Use of ferrous metal alloys for components used in electric equipments.
   Magnetic properties of ferrous alloy and nickel alloys.

3. **CONDUCTINGMATERIAL:** **(14Hrs)**

   3.1 Conductivity, resistivity and super conductivity.
   3.2 Copper and copper Alloys-General properties as conductors, temperature co-efficient, density, mechanical properties, corrosion, contact resistance
   3.3 Aluminum and Aluminum Alloy-General properties of conductors, resistivity temperature co-efficient, density, mechanical properties, solder ability, contact resistance.
   3.4 Applications of copper and aluminum and their suitability.

4. **SEMI-CONDUCTING MATERIALS:** **(14Hrs)**

   Materials used for electronic components like resistors, capacitors, diodes and transistors etc.

5. **INSULATING MATERIALS** **(18Hrs)**

   General properties i.e. electrical properties physical properties, Thermal
   and chemical properties of insulating materials. Selection of Rubber and plastics. Plastic laminates. Thermo-setting materials, Thermoplastic materials, Bakelite and epoxy resins, Ceramics for applications, asbestos, mica, glass, bitumen etc. hard facing materials. Properties and applications of thermo coal, glass wood, fiberglass

6. **PROTECTIVE COATING** **(10Hrs)**

   Properties and applications of paints, varnishes, Lacquer sand Enamels.

REFERENCE BOOKS

1. Material Sciences by R.K Rajput
2. Advances in material sciences by R.K Dogra
3. Material sciences and metallurgy by D.S. Nat
4 Manufacturing Engineering and Technology by Kalpakjian Pearson and Co. Ltd.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted (%)
1	10	13
2	14	16
3	14	16
4	14	16
5	18	26
6	10	13
Total	80	100

3.2 MEASURING INSTRUMENTS

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4 - 2

RATIONALE:

To know the higher technologies involved in the field of Instrumentation Engineering, through knowledge of the techniques and use of basic instruments and gauges for the measurement of different parameters in the process control is required. The basic parameters involved are mass, length and time. The derived parameters such as speed, torque and volume etc. are used in the industries and are of greater importance.

DETAILED CONTENTS

1.Electrical Measuring Instruments (19hrs)

1.1 Concept of measurement and instruments.

1.2 Electrical quantities and instruments for their Measurements.

1.3 Types of electrical measuring instruments–indicating, integrating and recording instrument.

1.4 Essentials of indicating instruments-deflecting, controlling and damping torques.

1.5 Sources of error and application of Ammeters and Voltmeters (Moving coil and moving iron type): merits and demerits of dynamometer type wattmeter, sources of error.

1.6 Merits and demerits of single-phase and three-phase energy meters. (Induction Type), Errors and compensation, Simple problems. Construction and working principle of maximum demand indicators.

2. Digital Instruments (6 hrs)

2.1 Introduction to digital meters, DSO, MSO, DVM, DCM and DMM.

3. Miscellaneous Measuring Instruments (17hrs)

3.1 Construction, working principle and application of Meggar, Earth tester, Frequency meter (dynamometer type), single phase power factor meter (Electro dynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on Meter).

3.2 Instrument Transformers: Constructional details of

(a) CT

(b) PT and their ratio and phase

4. Power Measurements in 3-phasecircuits **(10hrs)**

4.1Three wattmeter method

4.2Two wattmeter method and simple numerical problems

5. Annunciators **(04Hrs)**

Circuits for control system

6. Errors **(8Hrs)**

Sources and classification of errors, their remedial action, Grounding and guarding,

REFERENCE BOOKS

1. A Course in Electrical Measurement and Measuring Instruments by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi
2. Electronic Instrumentation and Measurement Technique, by W. D. Cooper & A. D.Helfrick, Pearson INDIA
3. Engineering Metrology by R.K. Jain, Khanna Publishers
4. A Text Book of Production Engineering by P.C Sharma
5. Engineering Metrology by R.K. Rajput; S.K. Kataria& Sons

List of Practical

1. To measure power, power factor in a 1-phase circuit, using wattmeter.
2. Measurement of voltage and frequency of a sinusoidal signal with CRO/DSO.
3. Study and measurement of energy using energy meter.
4. Study of DSO/MSO.
5. Study of lissajous pattern to measure frequency using CRO/DSO.
6. Measurement of insulation using Meggar.
7. Measurement of earth resistance using earth tester

SUGGESTED DISTRIBUTION OF MARKS		
Topic Name	Time Allotted (Hrs)	Marks Allotted (%)
1	19	18
2	6	16
3	17	30
4	10	20
5	4	6
6	8	10
Total	64	100

3.3 TRANSDUCERS

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5 - 2

RATIONALE:

After the completion of the course contents of this syllabus the students should be able to identify different types of 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. In order to carry out routine preventive maintenance of output gadgets to fault location, commissioning of new equipments, selection of suitable apparatus, designing of small components for improvisation, the knowledge and skill of electronic instruments in essential.

DETAILED CONTENTS

1. **Basic Building Blocks of any Instrumentation System (06Hrs)**

   1.1 Scope and necessity of Instrumentation.
   1.2 Name of important process variables, their units.
   1.3 Building blocks of instrumentation system.
   1.4 Display systems, Analog and Digital.
   1.5 Typical specifications of an instrument.

2. **Variable resistance transducers (06Hrs)**

   2.1 Basic principles: potentiometers, strain gauges-load cells temperature compensation applications.
   2.2 Hot wire anemometers, Photo resistors, Humidity sensor, Resistive temperature transducers, Thermistors; Carbon microphones.

3. **Variable Inductance transducers (06Hrs)**

   3.1 Basic working principle of inductive transducers, LVDT (Linear variable differential transformer), variable reluctance accelerometers.

4. **Variable Capacitance Transducers (06Hrs)**

   Basic working principle of capacitive transducer, condenser microphones, Measurement of pressure, liquid level, and moisture using capacitive transducers.

5. **Piezo Electric Transducers (06Hrs)**

   Piezoelectric crystals and their properties, general forms of peizo electric transducers, accelerometers.

6. **Magnetostrictive Transducers (04Hrs)**

   Magnetostrictive property of nickel and perm alloy. Measurement of force, acceleration, torque using magnetostrictive transducers.

7. **Other Transducers (16Hrs)**

   7. Hall effect sensor, eddy current based transducers, transducers based on ionization effect.
   7.2 Digital transducers, single shaft encoders.

7.3 Thermocouple sensor, photovoltaic cell and electrochemical cells
7.4 Tachogenerator.
7.5 Synchros.
7.6 Optical encoders and shaft encoders
7.7 Selection of sensors for measurement of following parameters:
Temperature, pressure, flow and level, vibration, displacement, speed.
7.8 Smart Sensors.

8. **Principles of Analog Signal Conditioning (08Hrs)**

8.1 OPAMP circuits used in Instrumentation, instrumentation amplifiers.
8.2 Analog-digital sampling, Introduction to A/D and D/A conversion.
8.3 Signal filtering, averaging, correlation
8.4 Interference, grounding and shielding
8.5 Impedance Matching.

REFERENCE BOOKS

1. Electrical Measurements and Measuring Instruments by Golding and Widdis; Wheeler Publishing House, New Delhi
2. Industrial Instrumentation by Dr. Umesh Rathore, KATSON Publication, New Delhi
3. A Course in Electrical Measurement and Measuring Instruments by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi
4. Electronic Instrumentation and Measurement Technique, by W. D. Cooper & A. D. Helfrick, Pearson INDIA
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi
6. Industrial Instrumentation by Dr. Umesh Rathore, KATSON Publication

PRACTICAL

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 of RTD (Resistance Temperature Detector).
5. Study and calibration of LVDT.
6. Study of variable capacitance transducer.

SUGGESTED DISTRIBUTION OF MARKS		
Topic Name	Time Allotted (Hrs)	Marks Allotted (%)
1	06	06
2	06	10
3	06	08
4	06	08
5	04	05
6	16	20
7	08	10
8	12	15
9	06	06
10	10	12
Total	80	100

3.4 DIGITAL ELECTRONICS

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4 - 2

RATIONALE

To familiarize students with Boolean algebra, concepts of logic circuits, realization of various logic circuits using different logic gates. After this course the student will be able to design simple logic circuits, understand flip-flops, counters, registers and A/D & D/A converter circuits and their applications in electronic based control and switching circuits.

Pre-Requisite -

1. Basic Electronics Engineering

DETAIL CONTENTS

1. Introduction **5 hrs**

Analog Signal, Digital Signal, Difference between Analog & Digital Signal, Applications & Advantages of Digital Signal

2. Number System **9 hrs**

- Binary, Octal, & Hexadecimal number systems, Conversion from Decimal, Octal & Hexadecimal Systems to Binary System & Vice Versa.
- Binary Addition, Subtraction, Multiplication, Division, 1's and 2's compliment methods of subtraction.
- Concept of code: 8421, BCD, Excess 3 and Gray Code
- Concept of Parity

3. Logic Gates & Families **11 hrs**

- Logic symbol, logical expression and truth table of AND, OR, NOT, NAND, NOR, EX-OR gates,
-Universal property of NAND and NOR gate.
- Logic Simplification Circuits-Basic laws of Boolean algebra, Duality theorem, De Morgan's Theorems.
- Boolean expressions using Sum of Products (SOP) and Product of Sums (POS) forms.
- K-map representation of logical functions.
- Minimization of logical expressions using K-map (2, 3, 4 variables).
-Logic Gates & Families (SSI, MSI, LSI, VLSI, ULSI)

4. Arithmetic Circuits **7 hrs**

- Half Adder/Full Adder Circuit, their design and implementation
- Half Subtracter /Full Subtracter Circuit, their design and implementation

5. Decoder, Encoder, Multiplexer & De-Multiplexer 9 hrs

- Basic binary decoder, Encoder-Decimal to BCD Encoder
- Block diagram, Truth table, Logical expression and logic diagram of Multiplexers (4:1 and 8:1).
- Block diagram and Truth table of Demultiplexer (1:4 and 1:8)

6. Flip Flops, Counters, Shift-Registers 15 hrs

-One-bit memory cell, clock signal, Latch-SR Latch, Difference between Latch & Flip-Flop

-**Flip Flops**: S-R Flip flop, D- Flip Flop, J-K Flip Flop, Master Slave Flip-Flop, T- Flip Flop

-**Counters**: Asynchronous Counters/Ripple Counter (2 bit, 3-bit, Decade)

: Synchronous Counters (2-bit, 3-bit, decade synchronous counter), Ring Counter

Shift Registers: Concept of Shift registers, Types of Shift registers (SISO, SIPO, PISO, PIPO and Universal Shift Registers)

- Applications of Flip-Flops, Counters & Shift Registers

7. Memories 03 hrs

Classification of Memories RAM, ROM, PROM, EPROM, E^2PROM, Cache Memory, Static and Dynamic RAM

8. D/A & A/D Converters 05 hrs

- Digital to Analog Converters (Weighted register, R-2R Ladder D/A Converter)

-Analog to Digital Converter (Dual Slope method, Successive Approximation A/D Converter)

- Applications of A/D & D/A Converter

LIST OF PRACTICAL

1) Verification of truth table of various logic gates (NOT, OR, AND, NAND, NOR, EXOR) using logic circuit ICs and breadboard.
2) To verify Universal property of NAND and NOR gates.
3) Verification of De-Morgan's theorem.
4) To design and implement Half adder Circuit.
5) To design and implement Full adder Circuit.
6) Implementation of Multiplexer/Demultiplexure using Logic gates.

7) Construction of 7-segment decoder driver circuit.
8) Verification of State Table for RS, JK, D & T Flip-Flops.
9) Design and verify 2 or 3-bit Synchronous counter.
10) Design and verify 2 or 3-bit Asynchronous counter.

RECOMMENDED BOOKS

1. Digital Principles and Applications by Leach & Malvino, Tata McGraw Hill Publicatiom
2. Modern Digital Electronics by R. P. Jain, Tata McGraw Hill Publications
3. Fundamentals of Digital Circuits by A. Anand Kumar, PHI Publications
4. Digital Electronics by Vipan Arora, Eagle's Publication Jullundhar
5. Digital Electronics by Pratima Manhas & Shaveta Thakral, KATSON Publication, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Chapter No	Time Allotted	Marks Allotted %age
1	05	05
2	09	15
3	11	15
4	07	10
5	09	15
6	15	25
7	03	05
8	05	10
Total	**64**	**100**

3.5 OPTO-ELECTONICS

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4-2

RATIONALE:

This syllabus has been designed to integrate the basic knowledge given in earlier semesters and to make the base of understanding Optoelectonics Instruments. The basic principles involved in, Fundamental of Light, Source of Light, Photodectors, Fibre Optics, Opto electronic transducers are included in the syllabus. This concept will help the students to pick up the higher knowledge which is to be imparted in the following semesters.

DETAILED CONTENTS

1. **Fundamentals of Light** **(06Hrs)**
   Wave & Particles theory, Electromagnetic Spectrum, Luminous Intensity, Luminous Flux, Photometric and Radio-metric units of Measurements.

2. **Source of Light** **(08Hrs)**
   Natural Light Sources, Standard Light Source, Incandescent Lamps, Gas Discharge Lamps, Light Emitting Diodes, various types of lasers (eg. Gas Laser, Semiconductor Laser) Distributed feedback Laser diodes, Applications of laser.

3 **Photodetectors** **(10Hrs)**
Human Eye Response, Principle of Photo detection various types of Detectors: LDR, Photodiodes, Phototransistors, PMT, photo FET.

4 **Fibre Optics** **(12Hrs)**
Fundamentals: An Optical Fiber, Principle of Light propagation through Fibre, types of Fibre, type of Fibre optics cables, Comparison of Optical Fibre with other interconnectors, Losses in Optical Fibre.

5 **Optoelectronic Device** **(10Hrs)**
Opto couplers, Opto isolatos.

6. Design Concepts of Optical Power Meter, OTDR, Spectrum Analyzers etc**.** **(06Hrs)**

7. **Displays & Recorders** **(12Hrs)**
   7.1 LED, LCD, bar graph, plasma and CRT.
   7.2 Various indicating, integrating and recording methods and their combinations.
   7.3 Merit and Demerit of circular chart and strip chart recorders.
   7.4 Basics of printing and scanning devices.

REFERENCE BOOKS:

1. A.K. Ghatak "Optics" 2nd Edition Tata Mc Graw-Hill, New Delhi(1992)
2. Deboo and Burows, " Integrated Circuits and Semiconductor Devices", MCGaw-Hill
3. Wilson and Hawkes, "Optoelectronics: An Introduction(PHI).
4. C.K. Kao "Optical Fibre Systems(MGH)
5. Opto- electronics Devices by Wilson Halks(PHI)

PRACTICALS

(1) To determine the characteristics of LED's and Laser diode
(2) To determine the Characteristics of Photo detectors
(3) Numerical Aperture Measurement of Optical Fibers.
(4) Optical power measurement using optical power meter.
(5) Opto-coupler.

SUGGESTED DISTRIBUTION OF MARKS		
Topic Name	Time Allotted (Hrs)	Marks Allotted(%)
1	06	10
2	08	14
3	10	16
4	12	20
5	10	16
6	06	10
7	12	14
Total	64	100

3.6 FUNDAMENTAL OF ELECTRICAL AND ELECTRONICS ENGINEERING

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4 - 2

RATIONALE:

The subject FEEE will give the basic ideas of various electrical laws and commonly used electrical machines and the transformation schemes. After studying the subject, the students will be able to identify and use the basic electrical components for simple practical purposes and design the basic electronic circuits.

1. **DC Circuits** **(12hrs)**
   Definition and measurement of resistance, voltage, current, charge, energy, power, ohm's law, series and parallel resistance circuits, voltage and current divider circuits, Kirchoff law, Thevenin, Norton, Superposition, Maximum Power Transfer Theorem

2. **Electromagnetic Induction** **(6 hrs)**
   Faraday's law, Lenz's law, Fleming right and left hand rule, principle of self and mutual induction, RLC Circuits and concept of resonance, expressions for energy stored in L and C.
3. **DC Machines** **(8hrs)**
   Construction and principle of working of DC motor and generator, Concept of Back EMF

4. **AC Machines:** **(8 hrs)**
   Types of AC motors, construction and working principle of 3 phase induction motor, comparison of squirrel cage and slip ring induction motor, DOL starter, Working principle of synchronous machine.
5. **Transformer:** **(5 hrs)**
   Construction and working of transformer, transformation ratio, auto-transformer

6. **PN junction** **(7hrs)**
   Working principle and characteristics of PN junction diode, Diode as a rectifier, Zener diode, Zener diode as a voltage regulator

7. **Transistor:** **(8hrs)**
   Construction features of PNP and NPN transistors, working principles, transistor as an amplifier, concept of transistor biasing and selection of operating point, potential divider biasing circuit, need for stabilisation of operating point, configuration of transistors, CC, CE, CB and their input/output characteristics.

8. **Field Effect Transistor** **(13 hrs)**
   Construction and working principle, VI characteristics of FET, difference between FET and BJT, difference between MOSFET and FET, comparison between BJT, FET and MOSFET and their applications.

9. **Op-Amps:** **(7hrs)**

Introduction to op-amp, application as voltage follower, inverting, non-inverting, differential amplifier, V to I converter, I to V converter, integrator, differentiator, sample and hold circuit

10. **555 Timer**: **(6hrs)**
    Working of Mono-stable, A-stable and Bi-stable circuits.

Text Book:

1. "Fundaments of Electric Circuits" by Charles K. Alexander, and Matthew N. O. Sadiku
2. "Electronics Principles" by Albert Paul Malvino
3. "Electronics Devices and Circuits Theory" by Louis Nashelsky and Robert Boylsted
4. "Microelectronics Circuits" by Sedra and Smith
5. Schaum's Outline of Basic Electrical Engineering" by JJ Cathey, Syed A. Nasar
6. "Solid State Electronic Devices" by Ben G. Streetman and Sanjay Banerjee

List of Practical's:

1. To identify and test various types of electronics components such as resistors, capacitors, inductors, diodes & transistors and to identify the terminals of diodes & transistors.
2. Use of Multimeter for measurement of voltage and current (A.C, D.C)
3. To plot VI characteristics (forward and reverse) of semiconductor diode.
4. Study of Zener diode as voltage regulator.
5. To plot the input and output characteristics of transistor in CE configuration of a BJT.
6. To observe waveform of Mono-stable/A-stable/Bi-stable multi-vibrator using 555 Timer.
7. To study Inverting and Non-inverting configuration of Op-Amp.

SUGGESTED DISTRIBUTION OF MARKS		
Topic Name	Time Allotted (Hrs)	Marks Allotted(%)
1	09	12
2	05	08
3	06	10
4	06	10
5	05	6
6	06	8
7	06	10
8	09	16
9	06	10
10	06	10
Total	64	100

4.1 BASIC MECHANICAL ENGINEERING

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4 - 2

RATIONALE

The subject basic mechanical engineering deals with the basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion, gears and simple machines which are required by the students of instrumentation engineering for understanding the application of instrumentation in machines and mechanisms. The subject enhances the analytical ability of the students.

DETAILED CONTENTS

1. Introduction (06 hrs)

1.1 Concept of Engineering mechanics (Applied Mechanics), definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields.

1.2 Definition of mass and weight, basic quantities and derived quantities, basic units and derived units

1.3 Concept of rigid body, scalar and vector quantities

2. Laws of forces (10 hrs)

2.1 Definition of force, measurement of force in SI units, its representation, Point force, concentrated force & Uniformly distributed force, characteristics of a force, effects of force

2.2 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position

2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components

2.4 Equilibrant force and its determination [Simple numerical problems on above topics]

3 Fluid mechanics

3.1 Properties of Fluids: density, specific gravity, viscosity, compressibility, surface tension, cohesion, adhesion

3.2 Bernoulli's Theorem, Pascal Law and its application, Types of Pressure & units

4. Thermodynamics

Boyle's Law, Charles's Law, Joules's Law, Universal Gas Constant, Laws of Thermodynamics (Zeroth Law, First Law and Second Law)

5. Pneumatic Systems

5.1 Basic Components and function of Air Compressor (Reciprocating & Centrifugal Type)

5.2 Air Cylinder: Single acting, double acting, piston type, and diaphragm type

5.3 Air filter regulators and applications of compressed air

7. Gears & Cams (12 hrs)

7.1 Toothed gearing spur, bevel, spiral, worm and worm wheels, precision gears, gear trains: simple, compound and reversed gear trains. Backlash in gearing and its elimination.

7.2 Types and characteristics of cams, followers and cam profiler, and limited cases of specified contours.

[Simple numerical problems on the above topics]

LIST OF PRACTICALS

1. Verification of the following laws:
   a) Parallelogram law of forces
   b) Triangle law of forces
   c) Polygon law of forces
2. Verify Bernoulli's theorem
3. Study of reciprocating air-compressor
4. Demonstration of Gears and CAMs
5. Study of Single acting & double acting pneumatic cylinder
6. To study the motion transmission using gears.
7. To find the velocity ratio in gear train.

RECOMMENDED BOOKS

1. A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.
2. Applied Mechanics By, Col. Harbhajan Singh, TL Singla and Parmod Kumar Singla Published By Abhishek Publication,
3. A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.
4. Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.
5. Engineering Mechanics by Parsad, Standard Publications, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	**Time Allotted (Hrs)**	**Marks Allotted (%)**
1	06	10
2	10	14
3	10	16
4	08	12
5	08	12
6	10	16
7	12	20
Total	**64**	**100**

4.2 CONTROL SYSTEM

L T P
5 - 2

RATIONALE:

This syllabus has been designed to integrate the basic knowledge given in earlier semesters and to make the base of understanding Instruments Technology. The basic principles involved in, process system, Instrumentation system, display etc. are included in the syllabus. This concept will help the students to pick up the higher knowledge which is to be imparted in the following semesters.

1. **Introduction to Control Systems (12Hrs)**
   Introduction, brief classification of control systems: Open loop v/s closed loop, feedback v/s feed forward, linear v/s non-linear, stable v/s unstable, time invariant v/s time variant, causal v/s non-causal (definitions only), representation of electrical, mechanical, electromechanical, thermal, pneumatic, hydraulic systems, force to voltage and force to current analogies.

2. **Transfer function, block diagram algebra and signal flow graph (16Hrs)**
   Concept of transfer function, block diagram algebra: Rules of block diagram reduction and determination of overall transfer function, Signal flow graph: Mason gain formula and its use to determine the overall transfer function, Conversion of block diagram to signal flow graph.

3. **Time domain analysis of control systems (52Hrs)**
   Standard test signals: impulse, step, ramp, sinusoidal, impulse response of a control system (from transfer function using inverse Laplace transform),
   Concept of pole, zero, order and type of a control system, first order , second order systems and their response to impulse and step inputs (for second order systems treat undamped, critically damped, under damped and over damped cases separately), time domain specifications of first order control systems from step response (first five time constants), time domain specifications of second order control systems from step response (natural frequency, damping factor, damped frequency, delay time, rise time, peak time, peak overshoot, settling time for 2% and 5% settling derivation is expected), static error constants (k_p, k_v, k_a, e_{ss}), dynamic error constants.

PRACTICALS

1. Study the circuit and working of the open loop system.
2. Study the circuit and working of the closed loop system,
3. Find the time response of the first order system.
4. Find the time response of the second order system.
5. Study of a temperature system.
6. Study of a flow system.
7. Study of a pressure system.

Text Book:

- Gopal, M., Digital Control System, Wiley Eastern (1986).
- Nagrath, I.J. and Gopal, M., Control System Engineering, New Age International (P) Limited, Publishers (2003).
- Ogata, K., Modern Control Engineering, Prentice–Hall of India Private Limited (2001).

- Kuo, B.C., Automatic Control System, Prentice–Hall of India Private Limited (2002).
- Sinha, N.K., Control System, New Age International (P) Limited, Publishers (2002).

SUGGESTED DISTRIBUTION OF MARKS		
Topic Name	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	16	30
3	52	50
Total	80	100

4.3 MICROPROCESSORS AND MICROCONTROLLERS

L T P
4 - 2

RATIONALE

The course provides the student with the opportunity to study Architecture and memory management of 8 bit & 16 bit microprocessor (i.e8085&8086), to study assembly language programming and to implement different system interfacing.

DETAILED CONTENTS

1. Evolution of Microprocessor (6 hrs)

Microprocessor, its evolution, function and impact on modern society

2 Architecture of 8085 Microprocessor (10 hrs)

Concept of Bus, Bus organization of 8085, functional block diagram of 8085 and function of each block, Pin details and related signals, demultiplexing of address/data bus, generation of Read/Write Control signals, steps to execute and store program.

3. Memories and I/O Interfacing (10 hrs)

Memory organization, Concept of memory mapping, partitioning of total memory space, address decoding, concept of I/O mapped I/O and memory mapped I/O. Interfacing of memory mapped I/O devices, concept of Stack and its functions, Basic RAM cell, NXM RAM, Expansion of word length and Capacity, Static and Dynamic RAM, Basic ideas of ROM, PROM, EPROM, EEPROM

4. Programming of 8085 (10 hrs)

Brief idea of machine and assembly languages, machine and Mnemonic codes.
Addressing modes and Instruction Set
Programming of 8085 using 'C'

5. 16 Bit Microprocessor (8086) (12 hrs)

Salient features of 8086 microprocessor, Architecture of 8086, Register organization, concepts of pipe lining, memory segmentation

6. Microcontroller (10 hrs)

8051 Architecture, instruction set and programming.

7. **Basic Interfacing Applications (06 hrs)**

Interfacing Microcontroller, timers, serial port programming, Interrupts LCD, Keyboard interfacing, ADC- DAC & Sensor Interfacing, external memory, interface, stepper motor and waveform generation.

List of Practical

1. Addition of two 8-bit numbers using 8085Microprocessor (using Machine language)
2. Subtraction of two 8-bit numbers using 8085Microprocessor (using 'C' language)
3. Multiplication of two 8-bit numbers using 8085Microprocessor (using 'C' language)
4. Division of two 8-bit numbers using 8085Microprocessor (using Machine language)
5.To find Largest number in an Array using 8085
6. To arrange data of an Array in ascending order using 8085
7. Study of Assembly Language Programming (ALP) using 8086
8. Stepper motor interfacing using 8051 Microcontroller/PIC Controller
9. Traffic Light Interface using 8051/PIC

Text Books:

1. An introduction to the Intel family of Microprocessors James L. Antonakos Pearson Education Asia.
2. Microprocessor Architecture programming & application with the 8085 Ramesh A. Gaonkar, Penfam International.
3. Digital Electronics and Applications by Malvino Leach; Publishers McGraw Hills, New Delhi
4. Microprocessor Architecture, Programming and Applications with 8080/8085 by Ramesh S Gaonker, Willey Eastern Ltd. New Delhi. Microprocessor and Applications by B Ram

SUGGESTED DISTRIBUTION OF MARKS		
Topic Name	Time Allotted (Hrs)	Marks Allotted (%)
1	06	10
2	10	15
3	10	15
4	10	15
5	12	20
6	10	15
7	06	10
Total	64	100

4.4 Energy Management

L T P
5 - 2

RATIONALE

1. **Definition**: (08 hrs)
   Concepts of NCES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of these energy sources.

2. **Solar Energy**: (24 hrs)
   Definition, Energy available from Sun, Solar radiation, solar energy conversion into heat, Components of Solar Power System: Solar Panels, Sun Tracking system, Invertor, battery Flat plate and Concentrating collectors, Principle of natural and forced convection, Photo voltaic: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power system, common faults and maintenance

3. **Wind Energy**: (12 hrs)
   Energy available from wind, Basis of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Windmill rotors, Horizontal axis and Vertical axis rotors, components and Working of wind power plant, common faults and maintenance

4. **Geothermal Energy**: (08 hrs)

   Definition and classification of resources, types, Production, Economics, Environmental effects and Renewability and sustainability

5. **Energy Audit and Management**: (28 hrs)
   5.1 Definition and Objective of Energy Management, General Principles of Energy Management,
   Energy Audit: Need, Types, Methodology and Approach. Energy Management Approach, Understanding Energy Costs, Energy performance, matching energy usage to requirements, Maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.

   5.1 Procedures and Techniques: Data gathering: Level of responsibilities, control of energy and uses of energy**,** Evaluation of saving opportunities: Noneconomic factors contributing to energy consumption, Conservation opportunities, estimating cost of implementation.
   Energy Audit Reporting: The plant energy study report- Importance, contents, effective Organization, report writing and presentation.

Practicals:

1. Study of solar power system.
2. Study of solar water heater.
3. To prepare a schedule for periodic maintenance of solar station.
4. Measurement of Power output from a Solar Panel.
5. Study of Sun tracking system for Solar Panel.

6. Study of two-way power meter.
7. To conduct Energy audit of one department of Polytechnic.

Reference Books:

1. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
2. Energy Management Principles: C.B.Smith (Pergamon Press).
3. Efficient Use of Energy: I.G.C.Dryden (Butterworth Scientific)
4. Energy Economics - A.V.Desai (Wieley Eastern)
5. Industrial Energy Conservation: D.A. Reay (Pergammon Press)
6. Energy management by Dr. Umesh Rathore, KATSON Publication

SUGGESTED DISTRIBUTION OF MARKS		
Topic Name	Time Allotted (Hrs)	Marks Allotted (%)
1	08	10
2	24	28
3	12	16
4	08	10
5	28	36
Total	80	100

4.5 MINOR PROJECT

L	T	P
-	-	6

RATIONALE:

Project work is an important component to develop confidence amongst the students to design, fabricate, repair and maintain the various equipments used by them in the institute and in the industry.

Suggested Projects

1) Regulated power supply.
2) Temperature regulator.
3) Light intensity regulator.
4) Temperature measuring system.
5) Pressure measuring system.
6) Relative humidity measuring system.
7) Digital display system.
8) Construction of temperature sensor.
9) Calibration of different types of indicating (Analog/Digital) instruments.
10) Measurement of different process variables.
11) Repair of different instruments being used in various laboratories.
12) To make the small chaises using different types of transducers.

Note: - Faculty members and students can choose other suitable projects also.

4.6 BASICS OF MANAGEMENT & ENTREPRENEURSHIP DEVELOPMENT

L	T	P
3	1	-

RATIONALE

In present scenario, there is an urgent need to develop right kind of attitude, knowledge and skills amongst the Diploma engineers leading them to achieve gainful wage/ self-employment. There is a huge gap in perceptions of employers and employees regarding meeting the job requirements. Also the dual challenges of competing in global working environment and keeping pace with the rapid technological advancements call for re-design of curricula and thus enabling the importance of generic and managerial skills. Entrepreneurship development aim at developing conceptual understanding for setting up owns' business/enterprise to cope up with the problem of unemployment and also to promote the socio- economic development of our country. Both the subject areas, "Basics of Management and entrepreneurship development" are supplementary to each other. Knowledge and skills of these must be imparted to diploma engineering students for enhancing their employability and confidence in their personal and professional life.

DETAIL CONTENTS

1. Introduction to Management

Definition and concept of Management, Functions of management- planning, organizing, staffing, coordinating and controlling. Various areas of management, Structure of an Organization

2. Self Management and Development

2.1 Life Long Learning Skills Concept of Personality Development, Ethics and Moral values

2.2 Concept of Physical Development; Significance of health, hygiene, body gestures

2.3 Time Management Concept and its importance

2.4 Intellectual Development: Reading skills, speaking, listening skills, writing skills (Note taking, rough draft, revision, editing and final drafting), Concept of critical Thinking and problem solving (approaches, steps and cases).

2.5 Psychological Management: stress, emotions, anxiety and techniques to manage these.

2.6 ICT & Presentation skills; use of IT tools for good and impressive presentations.

3. Team Management

3.1 Concept of Team Dynamics. Team related skills such as; sympathy, empathy, leading, coordination, negotiating and synergy. Managing cultural, social and ethnic diversity.

3.2 Effective group communication and conversations.

3.3 Team building and its various stages like forming, storming, norming, performing and adjourning

3.4 Leadership, Qualities of a good leader

3.5 Motivation, Need of Motivation, Maslov's theory of Motivation

4. Project Management

4.1 Concept of Management and features

4.2 Stages of Project Management; initiation, planning, execution, closing and review (through case studies), SWOT analysis concept.

5. Introduction to Entrepreneurship

5.1 Entrepreneurship, Need of entrepreneurship, and its concept, Qualities of a good entrepreneur

5.2 Business ownerships and its features; sole proprietorship, partnership, joint stock companies, cooperative, private limited, limited, public limited, PPP mode.

5.3 Types of industries viz, micro, small, medium and large

6. Entrepreneurial Support System (Features and Roles in Brief)

District Industry Centers (DIC's), State Financial Corporation's (SFC's), Small Industries Service Institutes (SISI), Commercial Banks, Micro Financing Institutions, SIDBI, NABARD, National Small Industry Corporations (NSIC), Cooperative Societies, Venture Capitalists, Khadi and Gramodyog Board (H.P.).

7. Market Study and Opportunity Identification

Types of market study: primary and secondary, product or service identification, assessment of demand and supply, types of survey and important features; qualitative, empirical, schedules, questionnaire, interview.

8. Project Report Preparation

8.1 Preliminary Report, Techno-Economic Feasibility Report, Detailed Project Report (DPR) and illustration of these through examples.

8.2 Exercises on writing project reports of micro and small budgeted projects.

LIST OF TUTORIAL EXERCISES

1. Understanding Self Management and Development (Related to Chapter 02); through examples, cases, exercises, panel discussions, seminars, meditation and yoga techniques.
2. SWOT Analysis
3. Team Management (Related to chapter 03); through examples, cases, role plays, group discussions and panel discussions.
4. Market Study and Opportunity Identification (Related to Chapter 07); through literature reviewing, making questionnaires, conducting mock interviews and analyzing data for

product/service identification and demand assessment.

5. Project Management and Project Report Preparation through exercises on making project reports on micro and small enterprises. Case studies and SWOT analysis of projects can be taken.

INSTRUCTIONAL STRATEGY

Since the emphasis of present training need and work requirements is on budding entrepreneurs as well as intelligent and multi skilled work force. Therefore skill development and knowledge imparting should be focussed on generic and entrepreneurial skill development. Thus instructional strategy of the subject should be more practical oriented and theories must be taught up to conceptual or informal levels. Different methodologies may be used with inclusive approach and must be supported with different training tools such as group and panel discussions , role plays, case studies, field surveys through questionnaires, schedules and interviews, presentations, seminars and expert talks in practical lectures and through student centred activities. Students may also be provided with extracted study material and handouts too.

RECOMMENDED BOOKS

1. Generic Skill Development Manual, MSBTE, Mumbai
2. Lifelong Learning, Policy Brief (www.oecd.orf)
3. Towards Knowledge Society, UNESCO Publication, Paris
4. Entrepreneurship Development by CB Gupta and P Srinivasan: Sultan Chand and sons: New Delhi
5. Essentials of Management by H Koontz, C O' Daniel , Mc Graw Hill
6. Principles and Practice of Management by Shyamal Bannerjee: Oxford and IBM Publishing Co, New Delhi
7. Management by James AF Stoner, R Edward Freeman and Daniel R Gilbert Jr., Prentice Hall of India Pvt Ltd, New Delhi
8. Entrepreneurship Development by S. L. Gupta and Arun Mittal: IBH Publication
9. A Handbook of Entrepreneurship, Edited by B S Rathore and Dr. J S Saini
10. Entrepreneurship Development and Small Business Enterprises by Poornima M: Pearson Education India
11. Handbook of Small Scale Industry by P M Bhandari

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs.)	Marks Allotted %
1	06	10
2	12	20
3	08	15
4	04	05
5	06	10
6	06	15
7	06	10
8	08	15
Total	**56 (42 Th + 14 Tutorials)**	**100**