CURRICULUM

FOR

DIPLOMA PROGRAMME

IN

INSTRUMENTATION ENGINEERING
(N-2022 SCHEME)

2nd Year (3rd & 4th Semester)

FOR THE STATE OF HIMACHAL PRADESH

Implemented w.e.f. Session 2023-24

Prepared by:-
Composite Curriculum Development Centre,
Directorate of Technical Education, Vocational & Industrial Training,
Sundernagar, District- Mandi (H.P.)

TABLE OF CONTENTS

THREE YEAR DIPLOMA IN

Instrumentation Engineering

3rd& 4th Semester

SALIENT FEATURES

Program	Diploma in Instrumentation Engineering
Duration	Three Years (Six Semesters)/ Two Years (Four Semesters)
Entry Qualification	As prescribed by H.P. Takniki Shiksha Board /AICTE: • 3yr Diploma after 10th • 2yr Diploma after 12th (Science/Vocational) or ITI.
Intake	As prescribed by H.P. Takniki Shiksha Board /AICTE
Pattern	Semester System

The course content for 3rd& 4th Semester Instrumentation Engineering facilitates the students to grasp the basic knowledge following:-

- Basics of Electrical & Electronics.
- Basics of Measuring Instruments, Instrumentation & Transducers.
- Basics of Digital Electronic System.
- Implementation of Instrumentation in Industries through field instruments.
- Control of Processes through field instruments including sensors/transducers, controllers & final control elements.
- Opto-Electronic Instrumentation.
- Microprocessors/Microcontrollers.
- Data Acquisition & Networks.
- Analytical Instruments.

Course Code and Definitions

Course Code	Definitions
IE	Instrumentation Engineering
L	Lecture
T	Tutorial
P	Practical
HS	Humanities and social science courses
BS	Basic Science Courses
ES	Engineering science Courses
PCC	Programme core courses
PE	Programme Elective Courses
OE	Open Elective Courses
AU	Audit Courses
SI	Summer Internship
PR	Project
SE	Seminar
DCS	Doubt Clearing Session

List of Programme Core Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	IEPC201	Electric Circuits	2	1	-	3	2 (2+0+0)	III
2	IEPC203	Electrical & Electronic Instruments	2	1	-	3	2 (2+0+0)	III
3	IEPC205	Transducers	3	1	-	4	3 (3+0+0)	III
4	IEPC207	Digital Logic Design	3	1	-	4	3 (3+0+0)	III
5	IEPC209	Electronic Circuits	3	1	-	4	3 (3+0+0)	III
6	IEPC211	Electric Circuits Lab	-	-	3	3	1.5 (0+0+1.5)	III
7	IEPC213	Electrical & Electronic Instruments Lab	-	-	3	3	1.5 (0+0+1.5)	III
8	IEPC215	Transducers Lab	-	-	3	3	1.5 (0+0+1.5)	III
9	IEPC217	Digital Logic Design Lab	-	-	3	3	1.5 (0+0+1.5)	III
10	IEPC219	Electronic Circuits Lab	-	-	2	2	1 (0+0+1)	III
11	IEPC202	Control System	3	1	-	4	3 (3+0+0)	IV
12	IEPC204	Industrial Instrumentation-I	2	1	-	3	2 (2+0+0)	IV
13	IEPC206	Process Control-I	2	1	-	3	2 (2+0+0)	IV
14	IEPC208	Control System Lab	-	-	2	2	1 (0+0+1)	IV
15	IEPC210	Industrial Instrumentation-I Lab	-	-	2	2	1 (0+0+1)	IV
16	IEPC212	Process Control-I Lab	-	-	2	2	1 (0+0+1)	IV
Total Credits							**30**	

List of Programme Elective Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	IEPE202-I	Opto Electronics	3	-	-	3	3 (3+0+0)	IV
2	IEPE202-II	Microprocessor and Microcontrollers						
3	IEPE204-I	Data acquisition and Network	3	-	-	3	3 (3+0+0)	IV
4	IEPE204-II	Analytical Instrumentation						
5	IEPE206-I	Opto Electronics Lab	-	-	2	2	1 (0+0+1)	IV
6	IEPE206-II	Microprocessor and Microcontrollers Lab						
7	IEPE208-I	Data acquisition and Network Lab	-	-	2	2	1 (0+0+1)	IV
8	IEPE208-II	Analytical Instrumentation Lab						
Total Credits							**08**	

List of Project Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	IEPR202	Minor Project	-	-	4	4	2 (0+0+2)	IV

List of Audit Courses

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	IEAU202	Essence of Indian Knowledge and Tradition	2	-	-	2	-	IV

List of Internship

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1	SI-I	Internship-I	-	-	-	-	2	At the end of IIIrd Semester
2	SI-II	Internship-II	-	-	-	-	3	At the end of IVth Semester

List of Student Centered Activities

Sr. N.	Course Code	Course Title	Hours per Week			Total Hr/week	Credit (L+T+P)	Semester
			L	DCS	P			
1		SCA	-	-	4	4	-	III
2		SCA	-	-	4	4	-	IV

STUDY AND EVALUATION SCHEME (3rd Semester)

Sr. No.	Subjects	Code No.	Study Scheme Hours/ Week			Total Study Hr/Week	Credits	Evaluation Scheme								Total
								Internal			External					
			L	DCS	P			Th	Pr	Total Marks	Th	Hrs	Pr	Hrs	Total Marks	
1	Electric Circuits	IEPC201	2	1	-	3	2	40	-	40	60	3	-	-	60	**100**
2	Electrical & Electronic Instruments	IEPC203	2	1	-	3	2	40	-	40	60	3	-	-	60	**100**
3	Transducers	IEPC205	3	1	-	4	3	40	-	40	60	3	-	-	60	**100**
4	Digital Logic Design	IEPC207	3	1	-	4	3	40	-	40	60	3	-	-	60	**100**
5	Electronic Circuits	IEPC209	3	1	-	4	3	40	-	40	60	3	-	-	60	**100**
6	Electric Circuits Lab	IEPC211	-	-	3	3	1.5	-	40	40	-	-	60	3	60	**100**
7	Electrical & Electronic Instruments Lab	IEPC213	-	-	3	3	1.5	-	40	40	-	-	60	3	60	**100**
8	Transducers Lab	IEPC215	-	-	3	3	1.5	-	40	40	-	-	60	3	60	**100**
9	Digital Logic Design Lab	IEPC217	-	-	3	3	1.5	-	40	40	-	-	60	3	60	**100**
10	Electronic Circuits Lab	IEPC219	-	-	2	2	1	-	40	40	-	-	60	3	60	**100**
11	Student Centered Activities		-	-	4	4	-	-	25	25	-	-	-	-	-	**025**
Total			**13**	**05**	**18**	**36**	**20**	**200**	**225**	**425**	**300**	**15**	**300**	**15**	**600**	**1025**

For 3rd Semester: The students shall undergo Internship-I at the end of 3rd semester (During semester break after board examinations of duration 04 weeks) which will be evaluated and reflected in study and evaluation scheme of 4th semester.

STUDY AND EVALUATION SCHEME (4th Semester)

Sr. No.	Subjects	Code No.	Study Scheme Hours/ Week			Total Study Hr/Week	Credits	Evaluation Scheme								Total Marks
								Internal			External					
			L	DCS	P			Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
1	Control System	IEPC202	3	1	-	4	3	40	-	40	60	3	-	-	60	**100**
2	Industrial Instrumentation-I	IEPC204	2	1	-	3	2	40	-	40	60	3	-	-	60	**100**
3	Process Control-I	IEPC206	2	1	-	3	2	40	-	40	60	3	-	-	60	**100**
4	Program Elective-I (Opto Electronics / Microprocessor and Microcontrollers)	IEPE202-I/ IEPE202-II	3	-	-	3	3	40	-	40	60	3	-	-	60	**100**
5	Program Elective-II (Data acquisition and Network / Analytical Instrumentation)	IEPE204-I/ IEPE204-II	3	-	-	3	3	40	-	40	60	3	-	-	60	**100**
6	Control System Lab	IEPC208	-	-	2	2	1	-	40	40	-	-	60	3	60	**100**
7	Industrial Instrumentation-I Lab	IEPC210	-	-	2	2	1	-	40	40	-	-	60	3	60	**100**
8	Process Control-I Lab	IEPC212	-	-	2	2	1	-	40	40	-	-	60	3	60	**100**
9	Program Elective-I Lab (Opto Electronics Lab / Microprocessor and Microcontrollers Lab)	IEPE206-I/ IEPE206-II	-	-	2	2	1	-	40	40	-	-	60	3	60	**100**

10	Program Elective-II Lab (Data acquisition and Network Lab / Analytical Instrumentation Lab)	IEPE208-I/ IEPE208-II	-	-	2	2	1	-	40	40	-	-	60	3	60	**100**
11	Minor Project	IEPR202	-	-	4	4	2	-	40	40	-	-	60	3	60	**100**
12	Audit Course- Essence of Indian Knowledge and Tradition	IEAU202	2	-	-	2	-	40	-	40	60	-	-	-	60	**100**
13	Internship-I	SI-I	-	-	-	-	2	-	-	-	-	-	100	3	100	**100**
14	Student Centered Activities		-	-	4	4	-	-	25	25	-	-	-	-	-	**025**
Total			**15**	**03**	**18**	**36**	**22**	**240**	**265**	**505**	**360**	**15**	**460**	**21**	**820**	**1325**

For 4th Semester: The students shall undergo Internship-II at the end of 4th semester (During semester break after board examinations of duration 06 weeks) which will be evaluated and reflected in study and evaluation scheme of 5th semester.

DIPLOMA PROGRAMME OUTCOME

PO1	**Basic and discipline specific knowledge:** Apply the knowledge of basic mathematics, science and engineering fundamentals and an engineering specialization to solve the engineering problems.
PO2	**Problem analysis:** Identify and analyze well defined engineeringproblems using codified standard methods.
PO3	**Design/development of solutions:** Design solutions for well defined technical problems and assist with the design of systems components or processes to meet specified needs.
PO4	**Engineering Tools, Experimentation and Testing:**.Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
PO5	**Engineering Practices for Society,Sustainability and Environment:** Apply appropriate technology in context of society,sustainability environment and ethical practices.
PO6	**Project management:**Use engineering management principles individually,as a team member or a leader to manage projects and effectively communicate about well defined engineering activities.
PO7	**Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

PROGRAMME SPECIFIC OUTCOMES

PSO 1	Students will have a strong foundation in mathematical, scientific & engineering fundamentals necessary to formulate, solve & analyze complex instrumentation problems.
PSO 2	Apply Instrumentation in multidisciplinary domains related to research& entrepreneurship development. (Domains: Process, Biomedical, Environment, Control etc.)
PSO 3	Communicate effectively to work as a team with professional ethics for the benefit for society.

DETAILED CONTENTS OF SECOND YEAR

(3rd and 4th Semester)

Course Code	**:**	**IEPC201**
Course Title	**:**	**Electrical Circuits**
Numbers of Credits	**:**	**2 (L: 2, DCS: 1 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- AC and DC circuit fundamentals.
- Basics of Electrical Machines.

Course Content

1. Basic Fundamentals

1.1 Definition & Units of-Voltage, Current, Power, Energy & Power Factor.
1.2 Basic Concept of Resistance, Inductance & Capacitance.
1.3 Basic Concept of Series & Parallel Combination of Passive Elements.
1.4 Basics Concept of AC & DC.
1.5 Ohm's Law.

2. Circuit Analysis:-

2.1 KCL and KVL.
2.2 Thevenin's Theorem
2.3 Norton's Theorem
2.4 Superposition Theorem
2.5 Maximum Power Transfer Theorem.

3. Fundamentals of AC Circuit:-

3.1 Instantaneous, Average & RMS Value- Voltage/Current
3.2 Form Factor & Peak Factor.
3.3 Concept of Power Triangle.
3.4 Laws of Electromagnetic Induction
3.5 Basic Concept of Single Phase & Three Phase Circuit.

4. Transformers:-

4.1 Transformer- Principle, Construction & Working of Transformer.
4.2 Types of Transformers- Step Up & Step Down.
4.3 Auto-Transformer- Theory, Advantage, Disadvantage & Applications.

5. AC &DC Motors:-

5.1 DC Motor- Principle, Construction & Working of DC Motor.

5.2 AC Motor- Basic Operation of Single Phase Induction Motor

5.3 Three Phase Inductor Motor- Principle, Construction & Working.

Reference Books:

1. Principles of Electrical Engineering & Electronics; V.K. Mehta; S.Chand Publications
2. Basic Electrical & Electronics Engineering; Kothari &Nagrath; Mc-Graw Hill
3. Basic Electrical & Electronics Engineering; J.B. Gupta; S.K. Kataria

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify various electrical components

CO-2: To select suitable technique to solve an electrical circuit

CO-3: To identify the various parts of electrical machines

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	07	20
2	06	20
3	06	20
4	06	20
5	07	20

Course Code	**:**	**IEPC203**
Course Title	**:**	**Electrical & Electronic Instruments**
Numbers of Credits	**:**	**2 (L: 2, DCS: 1 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant electrical & electronic measuring instruments in various domains.

Course Content:

1. **Basics of Electrical Instruments**
   - **1.1** Electrical quantities and instruments for their Measurements.
   - **1.2** Types of Electrical Measuring Instruments– Indicating, Integrating and RecordingInstrument.
   - **1.3** Essentials of Indicating Instruments- Deflecting, Controlling and Damping Torques**.**
   - **1.4** Classification of Instruments:- PMMC, Moving Iron, Electrodynamometer, Hot Wire, Thermocouple, Induction, Electrostatic & Rectifier Type.

2. **Electrical Measuring Instruments 1**
   - **2.1** PMMC Type Ammeter & Voltmeter.
   - **2.2** Dynamometer Type Wattmeter.
   - **2.3** Single Phase Induction Type Energy Meter.

3. **Electrical Measuring Instruments 2**
   - **3.1** Megger.
   - **3.2** Earth Tester.
   - **3.3** Power Factor Meter.
   - **3.4** Frequency Meter.
   - **3.5** Tong-Tester.

4. **Instrument Transformer**
   - **4.1** Current Transformer and its need in measurement.
   - **4.2** Potential Transformer and its need in measurement.

5 **Electronic instruments**

5.1 Digital Multimeter.

5.2 Cathode Ray Oscilloscope (CRO) or Digital Storage Oscilloscope (DSO).

5.3 Function Generator.

Reference Books:-

1. A Course in Electrical Measurement and Measuring Instruments; AK Sawhney; Dhanpat Rai Publication.
2. Electronic Instrumentation and Measurement Technique; W. D. Cooper &A.D.Helfrick; Pearson.
3. Electronic Instrumentation; H.S. Kalsi; McGraw Hill

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify the type of electrical/ electronic measuring instrument

CO-2: To purpose suitable type of electrical/ electronic instruments for electrical parameter measurement

CO-3: To identify electrical insulation failure in electrical wiring

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	07	20
2	06	20
3	06	20
4	06	20
5	07	20

Course Code	**:**	**IEPC205**
Course Title	**:**	**Transducers**
Numbers of Credits	**:**	**3 (L: 3, DCS: 1 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Sensors/ Transducers used in various domains.

Course Content:

1. Introduction to Transducers

1.1 Introduction to Instrumentation and Generalized Measurement System.
1.2 Basics of Sensors & Transducers.
1.3 Classification of Transducers.
1.4 Basic Principles of-
- 1.4.1 Variable Resistance Transducers.
- 1.4.2 Variable Inductance Transducers.
- 1.4.3 Variable Capacitance Transducers.
- 1.4.4 Piezoelectric Transducers- Basic Properties Piezoelectric Crystals.

2. Transducers based on Resistive, Capacitive & Inductive Effects:-

2.1 Variable Resistance Transducers-
- 2.1.1 Potentiometer
- 2.1.2 Hot Wire Anemometers
- 2.1.3 Photo Resistor
- 2.1.4 Resistance Thermometer

2.2 Variable Inductance Transducers- LVDT
2.3 Variable Capacitance Transducers-
- 2.3.1 Pressure Measurement.
- 2.3.2 Liquid Level Measurement.

3. Transducers based on Piezoelectric &Piezo ResistiveEffect: -

3.1 Piezo-electric Transducer.
3.2 Piezo-resistive Transducer- Strain Gauge
3.3 Application of Strain Gauge as Load Cell.

4. Other Transducers:-

4.1 Hall effect Transducer
4.2 Optical Shaft Encoder
4.3 Tachometer.
4.4 Synchros.
4.5 Concept of Smart Transducers

5. Signal Conditioning:-

5.1 Basic concept and need of Signal Conditioning
5.2 Basics of Operational Amplifiers- Inverting & Non-Inverting Configuration.
5.3 Op-Amps with negative feedback
5.4 Applications of Op-Amps in Signal Conditioning
- 5.4.1 Voltage Follower
- 5.4.2 Integrator
- 5.4.3 Differentiator
- 5.4.4 Summing Amplifier
- 5.4.5 Difference Amplifier
- 5.4.6 I to V & V to I Converter

Reference Books:-

1. A Course in Electrical Measurement and Measuring Instruments; AK Sawhney; Dhanpat Rai Publication.
2. Measurement Systems; E.O. Doebelin; McGraw Hill
3. An Introduction to Measurements & Instrumentation; Arun K. Ghosh; PHI
4. Industrial Instrumentation & Control; S.K. Singh; McGraw Hill

Course Outcome:

After By the end of the course the students are expected to learn:
CO-1: To identify the operation of commonly used transducers
CO-2: To purpose suitable type of transducer for industrial process parameter measurement
CO-3: To purpose suitable signal conditioning technique for specific transducer

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	08	10
2	12	30
3	08	20
4	08	20
5	12	20

Course Code	**:**	**IEPC207**
Course Title	**:**	**Digital Logic Design**
Numbers of Credits	**:**	**3 (L: 3, DCS: 1 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Concepts of digital logic& digital logic circuits.

Course Content:

1. Basics of Digital Logic

1.1 Introduction to Analog & Digital Signals.
1.2 Comparison of Digital & Analog Systems.
1.3 Basic Concept of Binary Logic.
1.4 Number Systems-
1.4.1 Decimal.
1.4.2 Binary.
1.4.3 Octal.
1.4.4 Hexadecimal.
1.5 Concept of BCD &Gray Code.
1.6 Binary Addition, Multiplication & Division
1.7 Concept of 1's & 2's Compliment.

2. Logic Gates & Boolean Algebra

2.1 Logical Symbol, Boolean Expression & Truth Table of-
2.1.1 NOT Gate
2.1.2 AND Gate
2.1.3 OR Gate
2.1.4 NAND Gate
2.1.5 NOR Gate
2.1.6 Ex-OR Gate
2.1.7 Ex-NOR Gate
2.2 Concept of Universal Gate (NAND & NOR)
2.3 Boolean Laws-
2.3.1 Commutative Law
2.3.2 Associative Law
2.3.3 Distributive Law
2.3.4 AND Law

2.3.5 OR Law
2.3.6 Inversion Law
2.3.7 Principle of Duality
2.4 Boolean Theorems-
2.4.1 Duality Theorem
2.4.2 De-Morgan's Law
2.5 SOP & POS Representations for Logical Expressions.
2.6 K-Map Simplifications- 2,3 & 4 Variable.

3. Combinational Logic Circuits

3.1 Introduction to Combinational Circuits.
3.2 Half Adder & Full Adder.
3.3 Half Subtractor& Full Subtractor.
3.4 Multiplexer- 2:1, 4:1, 8:1
3.5 De-Multiplexer- 1:2, 1:4, 1:8.
3.6 Encoders & Decoders.

4. Sequential Logic Circuits

4.1 Introduction to Sequential Circuits.
4.2 Concept of Latch & 1-bit Memory Cell.
4.3 Concept of Triggering.
4.4 Flip-flops- SR, JK, T & D Flip Flop.
4.5 Shift Registers- SISO, SIPO, PISO & PIPO.
4.6 Counters- 3 Bit Synchronous & Asynchronous (UP/Down Counter).

5. Analog-Digital Conversion

5.1 Concept of Analog to Digital Conversion - Sampling, Quantization & Encoding.
5.2 A/D Converter- Successive Approximation ADC &Dual Slope Integrator ADC.
5.3 Basics of Digital to Analog Conversion
5.4 D/A Converter - Binary Weighted Resister DAC & R-2R Ladder DAC.

Reference Books:-

1. Digital Principles & Applications; Albert Malvino; McGraw Hill
2. Digital Design; M. Morris Mano; Pearson
3. Modern Digital Electronics; R P Jain; Mc-Graw Hill
4. Fundamentals of Digital Circuits; A. Anand Kumar; PHI
5. Electronics Analog & Digital; I.J. Nagrath; PHI
6. Digital Electronics; J.S. Katre; TechMax Publications

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To understand basic digital electronics mathematics/ Techniques.

CO-2: To identify general purpose components of Digital devices.

CO-3: To purpose digital logic circuits for basic operations.

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	08	10
2	12	25
3	09	20
4	12	25
5	07	20

Course Code	**:**	**IEPC209**
Course Title	**:**	**Electronic Circuits**
Numbers of Credits	**:**	**3 (L: 3, DCS: 1 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Electronic Circuits based on Semiconductors.

Course Content:

1. Basic Fundamentals

1.1 Basic Concept of Semiconductor
1.2 Properties & Energy Band Description of Semiconductors.
1.3 Concept of Intrinsic & Extrinsic Semiconductor.
1.4 Basic concept of pn Junction.

2. Semiconductor Diode

2.1 Semiconductor Diode- its symbol, forward & reverse biasing and V-I characteristics.
2.2 Application of Semiconductor Diode as Half Wave, Full Wave & Bridge Rectifier.
2.3 Zener Diode
2.4 Application of Zener Diode as Voltage Stabilizer.

3. Bipolar Juction Transistor

3.1 Basic Concept of Bipolar Junction Transistor.
3.2 BJT- Symbol, npn&pnp configuration, their working.
3.3 Basics of Transistor Biasing
3.4 Basic application of transistor- Transistor as a Switch.
3.5 Transistor Connections- CB, CE & CC Configuration.

4. Transistor Amplifiers

4.1 Basic Application of Bipolar Junction Transistor as an Amplifier.
4.2 Classification of Amplifiers.
4.3 Basic Concept of Multistage Transistor Amplifier.
4.4 Basic Concept of Feedback in Amplifiers.

5. Field Effect Transistor

5.1 Basics of FET- Principle and Working of JFET.
5.2 Basic Concept of MOSFET.

5.3 Comparison of BJT & FET.
5.4 Comparison of FET & MOSFET.
5.5 Salient Features of CMOS.

Reference Books:-

1. Principles of Electrical Engineering & Electronics; V.K. Mehta; S.Chand Publications
2. Basic Electrical & Electronics Engineering; Kothari &Nagrath; Mc-Graw Hill
3. Analog Electronics; J.B. Gupta; S.K. Kataria
4. Analog Electronics; A. K. Maini; Khanna Publication
5. Electronic Principles; Albert Paul Malvino; Mc Graw Hill
6. Microelectronic Circuits; Adel S. Sedra; Oxford.
7. Electronic Dervices& circuits; S. Salivahanan; Mc Graw Hill.
8. Electronic Devices & Circuits; MillmanHalkias; Mc Graw Hill.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify the basic electronics components

CO-2: To select a suitable component for dedicated application

CO-3: To design basic circuits for voltage rectification, and signal amplification

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	08	10
2	08	20
3	15	30
4	09	20
5	08	20

Course Code	**:**	**IEPC211**
Course Title	**:**	**Electrical Circuits Lab**
Numbers of Credits	**:**	**1.5 (L: 0, DCS: 0 , P:3)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- AC and DC circuit fundamentals.
- Basics of Electrical Machines.

List of Practicals:

Sr. No.	Practicals
1	Measurement of Voltage & Current in AC & DC Electric Circuit.
2	Measurement of Passive Component Parameters like Resistance, Inductance & Capacitance.
3	Measurement of Power & Power Factor in Single Phase Electric Circuit.
4	Verification of Ohm's Law in an Electric Circuit.
5	Measurement of Output Voltage of any Step-Down Transformer.
6	To observe the output variation of Auto Transformer by varying its no. of turns.
7	Use voltmeter, ammeter to verify KCL & KVL in an electrical circuit.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify various electrical components

CO-2: To select suitable technique to solve an electrical circuit

CO-3: To identify the various parts of electrical machines

Course Code	**:**	**IEPC213**
Course Title	**:**	**Electrical & Electronic Instruments Lab**
Numbers of Credits	**:**	**1.5 (L: 0, DCS: 0 , P:3)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use suitable electrical & electronic measuring instruments in industrial domains.

List of Practicals:

Sr. No.	Practicals
1	Use of Ammeter, Voltmeter & Wattmeter in an Electric Circuit.
2	To observe the functionality & operation of Digital Multi-meter.
3	To observe the functionality & operation of DSO or CRO.
4	Measurement of voltage and frequency of a sinusoidal signal using CRO or DSO.
5	To plot lissajous patterns on CRO or DSO.
6	Measurement of Energy using Single Phase Energy Meter for Resistive load for certain time duration.
7	To demonstrate the working of Megger.
8	To demonstrate the working of Earth Tester.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify the type of electrical/ electronic measuring instrument

CO-2: To purpose suitable type of electrical/ electronic instruments for electrical parameter measurement

CO-3: To identify electrical insulation failure in electrical wiring

Course Code	**:**	**IEPC215**
Course Title	**:**	**Transducers Lab**
Numbers of Credits	**:**	**1.5 (L: 0, DCS: 0 , P:3)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Sensors/ Transducers used in various engineering domains.

List of Practicals:

Sr. No.	Practicals
1	To observe the output of Potentiometer with the variation of slider contact.
2	To observe the working of LVDT.
3	To observe the working of any Variable Capacitance Transducer.
4	To observe the working of Synchros
5	To demonstrate the working of Strain Gauge.
6	To observe the output of Op-Amp as Voltage Follower.
7	To observe the output of Op-Amp as Summing Amplifier.
8	To observe the output of Op-Amp as Difference Amplifier.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify the operation of commonly used transducers

CO-2: To purpose suitable type of transducer for industrial process parameter measurement.

CO-3: To purpose suitable signal conditioning technique for specific transducer

Course Code	**:**	**IEPC217**
Course Title	**:**	**Digital Logic Design Lab**
Numbers of Credits	**:**	**1.5 (L: 0, DCS: 0 , P:3)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Concepts of digital logic& digital logic circuits.

List of Practicals:

Sr. No.	Practicals
1	Verification of truth table of various logic gates (NOT, OR, AND, NAND, NOR, EXOR & EXNOR)
2	Verification of De-Morgan's theorem.
3	To design and implement Half adder Circuit.
4	To design and implement Full adder Circuit.
5	To design and implement any Multiplexer.
6	To design and implement any De-multiplexer.
7	To design and implement RS or JK Flip Flop.
8	To design and implement 3-Bit Up/Down Counter.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To understand basic digital electronics mathematics/ Techniques

CO-2: To identify general purpose components of Digital devices

CO-3: To purpose digital logic circuits for basic operations.

Course Code	**:**	**IEPC219**
Course Title	**:**	**Electronic Circuits Lab**
Numbers of Credits	**:**	**1.5 (L: 0, DCS: 0 , P:3)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Electronic Circuits based on Semiconductors.

List of Practicals:

Sr. No.	Practicals
1	To identify the terminals of diodes & transistors and test p-n Junction Diode, Zener Diode & Bipolar Junction Transistor (NPN/PNP)
2	To plot VI characteristics of p-n junction diode (forward & reverse biased)
3	To plot VI characteristics of Zener Diode.
4	To observe the use of Zener Diode as Voltage Regulator.
5	To plot the input and output characteristics of transistor in CB configuration of a BJT.
6	To plot the input and output characteristics of transistor in CE configuration of a BJT.
7	To plot the input and output characteristics of transistor in CC configuration of a BJT.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify the basic electronics components

CO-2: To select a suitable component for dedicated application

CO-3: To design basic circuits for voltage rectification, and signal amplification

Course Code	**:**	**IEPC202**
Course Title	**:**	**Control System**
Numbers of Credits	**:**	**3 (L: 3, DCS: 1 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Fundamental concepts of Control Systems and its Time Domain Analysis.

Course Content:

1. INTRODUCTION TO CONTROL SYSTEM:

1.1 Basic terminology used in Control system
1.2 Open Loop & Closed Loop system.
1.3 Requirements of a Good Control System.
1.4 Basic concept of Transfer Function and Mathematical Modelling- Mass Spring Damper System.
1.5 Concept of Poles and Zeroes.
1.6 Introduction to Laplace Transform.

2. BLOCK DIAGRAM & SIGNAL FLOW GRAPH REPRESENTATION:

2.1 Fundamentals of Block Diagram
2.2 Advantages and Disadvantages of Block Diagram
2.3 Derivation of Transfer Function of Closed Loop System
2.4 Block Diagram Reduction Rule.
2.5 Signal Flow Graph, Mason's Gain Formula, Conversion of a Block Diagram to Signal Flow Graph
2.6 Comparison of Block Diagram and Signal Flow Graph

3. TIME DOMAIN ANALYSIS

3.1 Introduction to Time Domain Analysis- Transient & Steady State Response
3.2 Standard Test Signals- Impulse, Step, Ramp & Parabolic
3.3 Steady State Error
3.4 Type of Control System, Relation between steady state error and type of system
3.5 First Order Control System
3.6 Second Order Control System
3.7 Time Domain Specifications

4. STABILITY ANALYSIS USING TIME DOMAIN TECHNIQUES- I

4.1 Basic Concept Of Stable System And Unstable System
4.2 Concept of Relative Stability
4.3 Routh Hurwitz Criterion.
4.4 Simple Problems on Routh Hurwitz Criterion

5. STABILITY ANALYSIS USING TIME DOMAIN TECHNIQUES- II

5.1 Introduction to Root Locus
5.2 Angle and Magnitude Criterion
5.3 Rules of Construction of Root Locus
5.4 Simple Problems on Root Locus

Reference Books:-

1. Automatic Control System; B. C. Kuo; Pearson
2. Modern Control Engineering; K. Ogata; PHI
3. Linear Control System; B. S. Manke; Khanna Publication
4. Control System Engineering; S. K. Bhattacharya; Pearson
5. Linear Control System; R A Barapate;Tech-Max Publication
6. Control System Engineering; I J Nagrath& M. Gopal; New Age Publication.

Course Outcome:

After By the end of the course the students are expected to learn:
CO-1: To identify the importance of control system in industrial environment
CO-2: To understand the basic techniques and terminology of control system
CO-3: To identify the role and technique of time domain in solving basic industrial control problems.

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	09	10
2	09	20
3	12	30
4	09	20
5	09	20

Course Code	**:**	**IEPC204**
Course Title	**:**	**Industrial Instrumentation-I**
Numbers of Credits	**:**	**2 (L: 2, DCS: 1 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Measurement of Process Parameters like Temperature, Level, Pressure & Flow.
- Instrumentation employed in Industry for the measurement of Temperature & Level.

Course Content:

1. Basics of Industrial Instrumentation & Temperature Measurement

1.1 Introduction to Industrial Instrumentation.
1.2 Introduction to Temperature
1.3 Temperature Scales- Deg C, Deg F, Kelvin, Reaumur, Rankine.
1.4 Conversions from one temperature scale to another.
1.5 Concept of Thermal Expansion.
1.4 Methods of Temperature Measurements:
1.4.1 Expansion Type Temperature Measurement:-
1.4.1.1 Bi-Metallic Thermometer
1.4.1.2 Liquid In Glass Thermometer.

2. Electrical Type Temperature Measurement

2.1 Concept of Thermal Coefficient of Resistance.
2.2 Resistance Temperature Detector (RTD):- Principle, Construction & Working.
2.3 Concept of Lead Wire Compensation in RTD.
2.4 Thermistor:-Principle, Construction, Types& Working.
2.5 Thermocouple:-
- 2.5.1 Working Principle of Thermocouple (Seeback Effect)
- 2.5.2 Thermocouple Construction.
- 2.5.3 Types of Thermocouple: J, K, T, E, N, S, R and B Type (only Material of Constructions and their Ranges)

2.6 Concept of Cold Junction Compensation in Thermocouple.
2.7 Pyrometers:-
- 2.7.1 Radiation Pyrometers
- 2.7.2 OpticalPyrometer.

3. Basics of Level Measurement

3.1 Introduction toLevel Measurement.
3.2 Units of Level Measurement.
3.3 Methods of Level Measurement: Direct Methods and Indirect Methods.

3.4 Direct Methods:
- 3.4.1 Visual level indicator.
- 3.4.2 Hook Type Level Indicator.
- 3.4.3 Float Type Level Indicator.
- 3.4.4 Displacer Type Level Measurement.

4. Indirect Level Measurement

4.1 Indirect Methods (Hydrostatic Pressure Type):
- 4.1.1 Pressure Gauge Method.
- 4.1.2 Air Bellows.
- 4.1.3 Air Purge System.

4.2 Indirect Methods (Electrical Type):
- 4.2.1 ResistanceType Level Measurement.
- 4.2.2 Capacitance Type Level Measurement Methods.
- 4.2.3 Gammaray Type (Radiation Type) Level Measurement.
- 4.2.4 Ultrasonic Type Level Measurement.

5. Fundamentals of Pressure & Flow Measurement

5.1 Introduction to Pressure
5.2 Different types of Pressure- Absolute, Gauge & Vacuum Pressure.
5.3 Pressure Units & their inter-conversion.
5.4 Introduction toFlow Measurement
5.5 Different Types of Flow- Laminar & Turbulent Flow.
5.6 Concept of Volumetric and Mass Flow Rate.
5.7 Concept of Reynolds Number in Flow Measurement
5.8 Different Units of Flow Measurement.

Reference Books:-

1. Industrial Instrumentation and Control; S. K. Singh; TMH.
2. Introduction to Instrumentation and Measurement; A. K. Ghosh; PHI.
3. Instrumentation Measurement and Analysis; B. C. Nakra and K. K. Chaudhary; TMH.
4. Industrial Instrumentation; UmeshRathore; S. K. Kataria.
5. Industrial Instrumentation; K. Krishnaswamy; New Age Publication.
6. Measurement, Instrumentation & Sensors; John G. Webster; Springer.

Course Outcome:

After By the end of the course the students are expected to learn:
CO-1: To understand the basics of Process parameters (i.e., Temperature, Pressure, Flow and Level)
CO-2: To identify various industrial process instruments
CO-3: To select a suitable instrument for specific process parameter measurement.
CO-4: To perform process parameter measurement with suitable industrial instrument

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	06	20
2	10	35
3	05	10
4	07	25
5	04	10

Course Code	**:**	**IEPC206**
Course Title	**:**	**Process Control-I**
Numbers of Credits	**:**	**2 (L: 2, DCS: 1 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Understand Process Control Systems.

Course Content:

1. Introduction to Process Control:

1.1 Introduction to Process Control.
1.2 Block Diagram Representation of Process Control System.
1.3 Various Components/Elements & Terms of Process Control System: Sensor/Transducer, Controller, Final Control Element, Error Detector, Controlled Variable, Process Variable, Set Point, Manipulated Variable, Disturbances.
1.4 Process Characteristics: Process Equation, Process Load, Process Lag, Self-Regulation.
1.5 Control System Parameters: Error, Control Lag, Dead Time, Cycling, Reverse-Direct Action.

2. Discontinuous Controller Modes:

2.1 Introduction & Classification of Controllers.
2.2 Important Terminology and Issues related to Controllers:
Proportional Band, Neutral Zone, Gain, Reset Time, Derivative Time
2.3 Discontinuous Controllers:-
2.3.1 On-Off Controller Mode
2.3.2 Multi-Position Controller Mode
2.3.3 Floating Control Mode.

3. Continuous Controller Modes:

3.1 Proportional (P) Controller
3.2 Integral (I) Controller
3.3 Derivative (D) Controller
3.4 Proportional-Integral (PI) Controller
3.5 Proportional-Derivative (PD) Controller
3.6 Proportional- Integral-Derivative (PID) Controller

4. Process Control Systems:

4.1 Feedback & Feed-Forward Control.
4.2 Cascade Control
4.3 Ratio Control

Reference Books:-

1. Process Control Instrumentation Technology; Curtis D. Johnson; Pearson Education
2. Process Control Principles and Applications; SurekhaBhanot; Oxford
3. Process System Analysis and Control; Donald R. Coughanowr; McGraw-Hill
4. Chemical Process Control; George Stephanopoulos; PHI
5. PID Controllers: Theory, Design and Tuning; Karl J. Aström and Tore Hägglund; Instrument Society of America
6. Instrument Engineer's Handbook; Bela G Liptak; CRC Press.

Course Outcome:

After By the end of the course the students are expected to learn:
CO-1: To understand the flow of a generalized process control System
CO-2: To identify the controller for continuous/ discrete processes
CO-3: To select a suitable industrial controller for a specific process
CO-4: To identify the types of processes.

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	08	25
2	08	20
3	10	35
4	06	20

Course Code	**:**	**IEPE202-I**
Course Title	**:**	**Opto Electronics**
Numbers of Credits	**:**	**3 (L: 3, DCS: 0 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Elective Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Understand the applications of Optics as Opto Electronics Instruments.

Course Content:

1. Fundamentals of Light

1.1 Wave & Particles Theory of Light.
1.2 Introduction of Electromagnetic Spectrum.
1.3 Various Photometric and Radiometric Units of Measurement.
1.4 Definition of Photometry & Radiometry.
1.5 Definition of Luminous Intensity & Luminous Flux.

2. Sources of Light

2.1 Concept of Natural & Manmade Light Sources.
2.2 Incandescent Lamp
2.3 Gas Discharge Lamps
2.4 Light Emitting Diode
2.5 Advantages & Disadvantages of LED.
2.6 Lasers- Semiconductor & Gas Laser
2.7 Applications of LASER.

3. Photo Detectors

3.1 Introduction to Photo Detectors
3.2 Principle of Photo Detection
3.3 Photo Diode
3.4 Photo Resister
3.5 Photo Transistor
3.6 Photo Multiplier Tube.

4. Fibre Optics

4.1 Fundamentals of Optical Fibre
4.2 Principle of Light propagation through Fibre- Total Internal Reflection
4.3 Construction of Optical Fibre Cable- Core, Clad, Jacket.
4.4 Single Mode & Multi Mode Fibre.
4.5 Step Index & Graded Index Fibre.

4.6 Basic Concept of Losses in OFC
4.7 Comparison of OFC with Coaxial Cable.

5. Miscellaneous Topics

5.1 Opto Coupler
5.2 Optical Power Meter
5.3 OTDR

Reference Books:-

1. A Course in Electrical Measurement and Measuring Instruments; AK Sawhney; Dhanpat Rai Publication.
2. Optics; A. Ghatak; Mc-Graw Hill
3. Opto Electronics & Optical Fibre Sensors; Asin B. Maity; PHI
4. Electronic Devices & Circuits; Salivahanan&Vallavaraj; Mc Graw Hill
5. Opto Electronic Devices; Wilson Halk;McGraw Hill.

Course Outcome:

After By the end of the course the students are expected to learn:
CO-1: To identify various sources of light
CO-2: To select a suitable light source for a specific application
CO-3: To purpose a suitable photo-detector for radiometric/ photometric measurement application
CO-4: To identify an optical fiber cable and its components
CO-5: To select a suitable instrument for light characteristics measurement

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	08	10
2	13	30
3	08	20
4	13	30
5	06	10

Course Code	**:**	**IEPE202-II**
Course Title	**:**	**Microprocessor & Microcontroller**
Numbers of Credits	**:**	**3 (L: 3, DCS: 0 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Elective Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Microprocessor & Microcontrollers- Basics & Applications.

Course Content:

1. Basics of Microprocessors

1.1 Microprocessor, its evolution, function and impact on modern society
1.2 Architecture of 8085 Microprocessor
1.3 Concept of Bus, Bus organization of 8085
1.4 Functional block diagram of 8085.
1.5 Pin Diagram of 8085

2. Memories and I/O Interfacing

2.1 Memory Organization
2.2 Concept of Memory Mapping
2.3 Concept of I/O Mapped I/O and Memory Mapped I/O
2.4 Concept of Stack and its Functions
2.5 Basic RAM cell, Static and Dynamic RAM
2.6 ROM, PROM, EPROM & EEPROM

3. Programming of 8085

3.1 Introduction to Assembly Language Programming
3.2 Addressing Modes of 8085
3.3 Instruction Set of 8085
3.4 Basic Programs in ALP:-
3.4.1 Addition
3.4.2 Subtraction
3.4.3 Multiplication
3.4.4 Division

4. 8051 Microcontroller

4.1 Introduction to 8051 Microcontroller
4.2 Pin Diagram of 8051
4.3 Architecture of 8051
4.4 Addressing Modes
4.5 Instruction Set

5. Interfacing

5.1 Introduction to Interfacing
5.2 Interfacing of Microprocessor or Microcontroller with LCD/LED Display
5.3 Interfacing of Microprocessor or Microcontroller with Stepper Motor

Reference Books:-

1. Microprocessors & its Applications; U.S. Shah; Tech-max Publication
2. Microprocessor Architechture, Programming & Applications with the 8085; Ramesh Geonkar; Penram.
3. Microprocessor & Interfacing; Doughlas V Hall; Mc-Graw Hill
4. 8051 Microcontroller & Embedded Systems; M.A. Mazidi; Pearson

Course Outcome:

After By the end of the course the students are expected to learn:
CO-1: To identify the role of microcontroller/ microprocessors
CO-2: To purpose a machine language/ C program for small industrial applications
CO-3: To understand the basic concepts to interfacing of microcontroller with an external hardware.
CO-4: To understand the microcontroller programming techniques

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	08	15
2	08	15
3	14	30
4	12	30
5	06	10

Course Code	**:**	**IEPE204-I**
Course Title	**:**	**Data Acquisition & Networks**
Numbers of Credits	**:**	**3 (L: 3, DCS: 0 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Elective Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant Industrial Data Acquisition & Communication technique.

Course Content:

1. **Computer Network Model:**
   - 1.1 Definition of Protocol.
   - 1.2 The Network Core– Packet Switching, Circuit Switching; Delay, Loss, and Throughput in Packet- Switched Networks.
   - 1.3 OSI Model and TCP/IP Model: Architecture, Description and function of Layers.

2. **Industrial Communication and Networking:**
   - 2.1 Types of communication interface.
   - 2.2 Parallel communication interface: IEEE-488 Bus and Handshaking Process.
   - 2.3 Serial communication interface: Balanced and Unbalanced systems.
   - 2.4 Communication mode: Simplex, Half Duplex and Full Duplex.
   - 2.5 Serial Interface RS 232 & RS485
   - 2.6 HART Communication: HART Network Connection; HART Communication Modes and HART Protocol Layers.
   - 2.7 Field buses: MODBUS, PROFIBUS, Device Net and ControlNet.

3. **Data Transmission:**
   - 3.1 Introduction to data transmission.
   - 3.2 Digital Transmission: Line coding, Digital rate v/s Signal rate, Bandwidth, Baseline wandering, D.C components, Self-synchronization; Block coding; Digitization using PCM.
   - 3.3 Aspects of digital to analog conversion; Data element v/s Signal element, Data rate v/s Signal rate (Baud rate); Frequency Shift Keying; Phase Shift Keying.
   - 3.4 Analog Transmission: Aspects of analog to analog conversion; Amplitude Modulation (AM); Frequency Modulation (FM); Phase Modulation (PM). PAM, PWM & PPM.

4. **Transmission Media:**
   4.1 Guided Media: Twisted-Pair Cable, Unshielded v/s Shielded Twisted-Pair Cable, EIA category, Connectors; Coaxial Cable**,** Coaxial Cable Standards, Coaxial Cable Connectors, Fiber-Optic Cable.
   4.2 Unguided Media (Wireless): Propagation methods, Radio Waves, Omni-directional Antenna and applications, Microwaves, Unidirectional Antenna and applications, Infrared and applications.

5. **Data Acquisition**
   5.1 Introduction to Data Acquisition.
   5.2 Typical Data Acquisition System.
   5.3 Multiplexer and Sample Hold circuits.
   5.4 Components of Digital and Analog Data Acquisition System.

Reference Books:-

1. Data Communications and Networking; Behrouz A. Forouzan; TMH.
2. Telemetry Principles ; D. Patranabis; TMH.
3. PC-Based Instrumentation: Concepts and Practice; N. Mathivanan; PHI.
4. A course in Elec. & Electronic Meas. & Instrumentation; A.K. Sahwney; Dhanpat Rai Pub.

Course Outcome:

After By the end of the course the students are expected to learn

CO-1: To identify various industrial communication protocols

CO-2: To select a suitable industrial communication protocol for a specific industrial application

CO-3: To select a suitable data transmission technique for data communication application

CO-4: To identify various components of a Data Acquisition System

CO-5: To perform data acquisition of small industrial processes

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	08	20
2	15	35
3	12	25
4	08	10
5	05	10

Course Code	**:**	**IEPE204-II**
Course Title	**:**	**Analytical Instrumentation**
Numbers of Credits	**:**	**3 (L: 3, DCS: 0 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Elective Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Applications of Instrumentation in Analytical Chemistry.

Course Content:

1. INTRODUCTION:

1.1 Elements of an Analytical Instrument
1.2 Properties of Analytes& Techniques used in Analytical Instruments, Types of Analytical Methods.
1.3 Electromagnetic Radiation & Optical Spectrum (UV, Visible & IR)
1.4 Radiometry & Photometry- Definition.
1.5 Concept of Interaction of Radiation with Matter.
1.6 Laws related to Absorption of Radiation: Lambert's Law, Beer's Law & Beer-Lambert law.

2. SPECTROSCOPY:

2.1 Absorption Instruments & its Various Components: Block Diagram having Sources of Radiation, Optical Components & Detecting System.
2.2 UV-Visible Absorption Spectroscopy.
2.3 Filter Photometers: Single Beam Filter Photometer & Double Beam Filter Photometer.
2.4 UV Spectrophotometers: Single Beam Spectrophotometer & Double Beam Spectrophotometers.
2.5 IR Spectrophotometer: Introduction to Infrared Spectroscopy, Basic Components of IR Spectrophotometers: Radiation Sources, Mono-chromators, Slits, Mirrors & Detectors.
2.5.1 Double Beam IR Spectrophotometer.

3. FLAME EMISSION SPECTROSCOPY:

3.1 Flame Photometers: Principle of Flame Photometry, Constructional details of Flame Photometers: Emission System, Optical System & Recording Systems.

4. ATOMIC ABSORPTION SPECTROSCOPY:

4.1 Atomic Absorption Spectrophotometer: Atomic Absorption Spectroscopy, Atomic Absorption Spectrophotometer.

5. NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY:

5.1 Introduction to NMR Spectroscopy.
5.2 Principles of NMR: Nuclear Spin, Nuclear Energy Levels, Resonance Conditions, NMR Absorption Spectra, Chemical Shift.
5.3 Nuclear Magnetic Resonance Spectrometer: Block Diagram, Construction & Working.

Reference Books:-

1. Handbook of Analytical Instruments; R.S. Khandpur; TMH
2. Handbook of Analytical Instrumentation; Bela G. Liptak

Course Outcome:

After By the end of the course the students are expected to learn
CO-1: To identify various analytical instruments for an analytical process
CO-2: To select a suitable spectroscopic technique for an analytical process
CO-3: To identify various components of spectroscopic techniques

Suggested Distribution of Marks:

Topic /Unit No.	Time (In Hrs.)	% age Distribution of Marks
1	12	20
2	14	35
3	07	15
4	06	15
5	09	15

Course Code	**:**	**IEPC208**
Course Title	**:**	**Control System Lab**
Numbers of Credits	**:**	**1 (L: 0, DCS: 0 , P:2)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Fundamental concepts of Control Systems and its Time Domain Analysis.

List of Practicals:

Sr. No.	Practicals
1	To simulate a Closed Loop Control System.
2	To observe the response of First Order Control System for any stimulus.
3	To observe the response of Type-0 Control System for any stimulus.
4	To observe the response of Second Order Control System for any stimulus.
5	To observe the response of Type-1 Control System for any stimulus.
6	To observe the response of Third Order Control System for any stimulus.
7	To observe the response of Type-2 Control System for any stimulus.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify the importance of control system in industrial environment

CO-2: To understand the basic techniques and terminology of control system

CO-3: To identify the role and technique of time domain in solving basic industrial control problems.

Course Code	**:**	**IEPC210**
Course Title	**:**	**Industrial Instrumentation-I Lab**
Numbers of Credits	**:**	**1 (L: 0, DCS: 0 , P:2)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Measurement of Process Parameters like Temperature, Level, Pressure & Flow.
- Instrumentation employed in Industry for the measurement of Temperature & Level.

List of Practicals:

Sr. No.	Practicals
1	To demonstrate the construction of RTD & To observe the output of RTD in the form of change in resistance with variation in temperature.
2	To study the concept of contact type temperature measurement & to measure temperature using RTD on trainer kit.
3	To study the concept of non-contact type temperature measurement & to measure temperature using IR Thermometer.
4	To observe the structure of visual level indicator & its working.
5	To observe the low & high level indication in a process vessel or tank.
6	To demonstrate the construction & working of Pressure Gauge.
7	To demonstrate the construction & working of Temperature Gauge.

Course Outcome:

After By the end of the course the students are expected to learn

CO-1: To understand the basics of Process parameters (i.e., Temperature, Pressure, Flow and Level)

CO-2: To identify various industrial process instruments

CO-3: To select a suitable instrument for specific process parameter measurement.

CO-4: To perform process parameter measurement with suitable industrial instrument.

Course Code	**:**	**IEPC212**
Course Title	**:**	**Process Control-I Lab**
Numbers of Credits	**:**	**1 (L: 0, DCS: 0 , P:2)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Core Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Understand Process Control Systems.

List of Practicals:

Sr. No.	Practicals
1	To familiarize with Feedback Elements, Controllers & Final Control Elements of any Process Control System.
2	To observe the response of On/Off Controller.
3	To observe Proportional Control Action of a P-Controller.
4	To observe Proportional-Integral Control Action of a PI-Controller.
5	To observe Proportional-Derivative Control Action of a PD-Controller.
6	To observe Proportional-Integral-Derivative Control Action of a PID-Controller.
7	To study Cascade Control System.
8	To study Ratio Control System.

Course Outcome:

After By the end of the course the students are expected to learn

CO-1: To understand the flow of a generalized process control System

CO-2: To identify the controller for continuous/ discrete processes

CO-3: To select a suitable industrial controller for a specific process

CO-4: To identify the types of processes.

Course Code	**:**	**IEPE206-I**
Course Title	**:**	**Opto Electronics Lab**
Numbers of Credits	**:**	**1 (L: 0, DCS: 0 , P:2)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Elective Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Understand the applications of Optics as Opto Electronics Instruments.

List of Practicals:

Sr. No.	Practicals
1	To determine the characteristics of LED.
2	To determine the characteristics of Laser Diode.
3	To determine the characteristics of any Photo Detector.
4	To demonstrate the core-clad-jacket of OFC.
5	To demonstrate the working of Optical Power Meter.
6	Numerical Aperture Measurement of Optical Fiber.
7	To observe the working of Opto-Coupler.

Course Outcome:

After By the end of the course the students are expected to learn

CO-1: To identify various sources of light

CO-2: To select a suitable light source for a specific application

CO-3: To purpose a suitable photo-detector for radiometric/ photometric measurement application

CO-4: To identify an optical fiber cable and its components

Course Code	**:**	**IEPE206-II**
Course Title	**:**	**Microprocessor & Microcontroller Lab**
Numbers of Credits	**:**	**1 (L: 0, DCS: 0 , P:2)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Elective Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Microprocessor & Microcontrollers- Basics & Applications.

List of Practicals:

Sr. No.	Practicals
1	To perform addition of two numbers using 8085 Microprocessor.
2	To perform subtraction of two numbers using 8085 Microprocessor.
3	To perform multiplication of two numbers using 8085 Microprocessor.
4	To perform division of two numbers using 8085 Microprocessor.
5	To determine largest number in an array using 8085 Microprocessor.
6	To determine smallest number in an array using 8085 Microprocessor.
7	To interface any display with Microcontroller or Microprocessor.

Course Outcome:

After By the end of the course the students are expected to learn

CO-1: To identify the role of microcontroller/ microprocessors

CO-2: To purpose a machine language/ C program for small industrial applications

CO-3: To understand the basic concepts to interfacing of microcontroller with an external hardware.

CO-4: To understand the microcontroller programming techniques

Course Code	**:**	**IEPE208-I**
Course Title	**:**	**Data Acquisition & Networks Lab**
Numbers of Credits	**:**	**1 (L: 0, DCS: 0 , P:2)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Elective Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant Industrial Data Acquisition & Communication technique.

List of Practicals:

Sr. No.	Practicals
1	To conserve an AM wave on CRO/DSO & measure its modulation index.
2	To observe Frequency Modulation on CRO/DSO.
3	To perform time division multiplexing of two given signals on CRO/DSO.
4	To observe the modulated signals using PAM and compare them with the corresponding analog input signal on CRO/DSO.
5	To observe the modulated signals using PWM and compare them with the corresponding analog input signal on CRO/DSO.
6	To observe the Data Acquisition operation
7	To demonstrate communication between two devices through USB or Ethernet or RS232 Communication.

Course Outcome:

After By the end of the course the students are expected to learn

CO-1: To identify various industrial communication protocols

CO-2: To select a suitable industrial communication protocol for a specific industrial application

CO-3: To select a suitable data transmission technique for data communication application

CO-4: To identify various components of a Data Acquisition System

CO-5: To perform data acquisition of small industrial processes

Course Code	**:**	**IEPE208-II**
Course Title	**:**	**Analytical Instrumentation Lab**
Numbers of Credits	**:**	**1 (L: 0, DCS: 0 , P:2)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**Program Elective Course**

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Applications of Instrumentation in Analytical Chemistry.

List of Practicals:

Sr. No.	Practicals
1	To study about the components/parts of a Filter Photometer.
2	To observe the working of Colorimeter or Filter Photometer.
3	To study about the components/parts of a Single Beam Spectrophotometer.
4	To observe the working of Double Beam UV-Vis Spectrophotometer.
5	To study about the components/parts of a Flame Photometer.
6	To observe the flame & output of Flame Photometer.
7	To observe the working of an Analytical Balance.

Course Outcome:

After By the end of the course the students are expected to learn:

CO-1: To identify various analytical instruments for an analytical process

CO-2: To select a suitable spectroscopic technique for an analytical process

CO-3: To identify various components of spectroscopic techniques

Course Code	**:**	**IEAU202**
Course Title	**:**	**Essence of Indian Knowledge and Tradition**
Numbers of Credits	**:**	**0 (L: 2, DCS: 0 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**AU(Audit Course)**

Course Learning Objectives:

The objective of this course is to expose the students with the concepts of Indian traditional knowledge and to make them appreciate the importance of the roots of indigenous knowledge system.

Unit 1 Indian Knowledge System *(IKS):*----------*25%*

- Introduction and Function of Indian Knowledge System(IKS).
- The Basic Structure of Indian Knowledge System(IKS) (only Introduction)
    1. The 4 Vedas,Namlyऋग्वेद (Rigveda) ,यजुर्वेद (Yajurveda),सामवेद (Samaveda) ,अथर्ववेद (Atharvaveda) .
    2. The 4 UpVedas, Namelyआयुर्वेद(Ayurveda (health-care)), धनुर्वेद(Dhanurveda (archery)), गंधर्ववेद(Gandharva-veda (dance, music etc.)) and स्थापत्यवेद (Sthapatyaveda (architecture)).
    3. The 6 Vedagangs ,namelyShiksha (शिक्षा), Kalpa(कल्प),Vykaraṇa (व्याकरण), Chhandasछंदस्),Nirukta (निरुक्त), and Jyotisha(ज्योतिष).
    4. Itihasa (इतिहास)(Ramayanaरामायण and Mahabharata महाभारत) and Puranaपुराण (Vishnupuranaविष्णुपुराण, BhagavataPurana (भागवतपुराण) etc.)
    5. Dharmashatraधर्मशास्त्र (Manusmritiमनुस्मृति, Yajnavalkya-smritiयाज्ञवल्क्यस्मृति, etc.).
    6. Darshanदर्शन (आस्तिकतथानास्तिक).
    7. Nyaya न्याय (Logic तर्कशास्त्रand Epistemologyज्ञानमीमांसा).

Unit 2 : Modern Science **20% Marks**

- Modern science: Introduction, Characteristics, importance and Example

- Difference between modern Science and Indian knowledge system
- Role of IKS in modern science

Unit 3 : Traditional knowledge **15% Marks**

- Traditional knowledge: Definition, nature, characteristics, scope and importance
- Indigenous Knowledge (IK): characteristics
- Traditional knowledge vis-a-vis Indigenous knowledge
- Traditional knowledge Vs western knowledge
- The need for protecting traditional knowledge

Unit 4 : Yoga and Holistic Health Care **25% Marks**

- Yoga: Meaning and Importance of Yoga
- Yoga and physical health, Yoga and psychological health, Yoga and intellectual health, Yoga and spiritual health, Yoga and social approach.
- Introduction to Ashtanga Yoga, Yogic Kriyas (Shat Karma)
- Pranayama and its types; Active lifestyle and stress management through Yoga
- Physical Fitness, Health and wellness: Meaning and Importance of Wellness,
- Components of Wellness, Health and physical Fitness;
- Traditional sports & Regional Games for promoting wellness:
- Leadership through Physical Activity and Sports; Introduction to First Aid.

Unit 5 : Himachal Pradesh: A Basic Information **15% Marks**

- History, Culture, Heritage/ Tradition, Customs & Manners,
- Regional Knowledge, Geographical Features, Constitutional History
- Tourism Place & Scope
- Festivals and Fairs

Suggested Text/ Reference Books

1. Cultural Heritage of India-Course Material by V. Sivaramakrishna Bharatiya, Vidya Bhavan, Mumbai, 5th Edition, 2014

2. Modern Physics and Vedant by Swami Jitatmanand Bharatiya, Vidya Bhavan
3. The wave of Life by Fritz of Capra
4. Tao of Physics Fritzof Capra
5. Tarkasangraha of Annam Bhatta, International by V N Jha, Chinmay Foundation, Velliarnad, Ernakulam
6. Science of Consciousness Psychotherapy and Yoga Practices by RN Jha, Vidyanidhi Prakashan, Delhi, 2016
7. Himachal Pradesh History, Culture & Economy by Mian Goverdhan Singh &Prof. Dr. C.L. Gupta.

Course Outcome:

After completing this course the students will be able to:

CO-1.Identify the concept of Indian Knowledge system (IKS)

CO-2.Understand the need and importance of protecting traditional knowledge

CO3. Compare the Indian traditional knowledge and modern science

CO-4. Understand the use of Yoga in stress management, mental health, mindfulness, healthy eating, weight loss and quality sleep.

CO-5. Aware of the general knowledge of Himachal Pradesh

SUGGESTED DISTRIBUTION OF MARKS (Internal Assessment)		
Project Component	**Time Allotted (Hrs)**	**Marks Allotted (%)**
Unit 1 : Indian Knowledge System (IKS)	8	25%
Unit 2 : Modern Science	6	20%
Unit 3 : Traditional knowledge	5	15%
Unit 4 : Yoga and Holistic Health Care	8	25%
Unit 5 : Himachal Pradesh: A Basic Information	5	15%
Total	32	100%

Course Code	**:**	**SI-I**
Course Title	**:**	**Internship-I**
Numbers of Credits	**:**	**2 (L: 0, DCS: 0 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**SI (Internship)**

Guidelines

An internship of four weeks after 3rd semester during vacations should be undertaken in an industry/ Govt. or Pvt. Certified Agencies which are in social sector/ Govt. Skill Centres/ Institutes/ Schemes. The assessment of internship will be carried out in 4th semester. The faculty members must visit the internship site during the course of internship to monitor the progress of the students.

Evaluation Criteria

The internal assessment of internship is to be carried out by the Industry/ Organization where the students have undergone the internship. The internal assessment done by the industry/ organization may be rationalized by the Department, if needed. The external assessment is to be done at the Institute. The department shall finalize external assessment within a month of the beginning of the 4th semester. The students have to prepare a daily diary of their internship period and the same has to be submitted at the institute after completion of the internship. The students have also to present the experience gained during internship in a seminar for the purpose of external evaluation.

(a) The assessment criteria (Internal Assessment) by the industry/ organization where the students have undergone the internship is as follows:

- Attendance and general behaviour : 20%
- Daily diary maintenance : 20%
- Initiative and participative attitude during internship : 20%
- Performance in the assigned activities by the industrial supervisor : 40%

(b) The assessment criteria (External Assessment) by the institute is as follows:

- Presentation : 60%
- Report : 20%
- Viva : 20%

Course Code	**:**	**SI-II**
Course Title	**:**	**Internship-II**
Numbers of Credits	**:**	**3 (L: 0, DCS: 0 , P:0)**
Prerequisites	**:**	**Nil**
Course Category	**:**	**SI (Internship)**

Guidelines

An internship of Six weeks after 4th semester during vacations should be undertaken by the students in relevant Industry. The objective of this mandatory internship is to expose the students to the real world of work and get experience with the latest tools, best practices, work & culture, etiquettes and ethics followed in modern industries. The assessment of internship will be carried out in 5th semester. The faculty members must visit the internship site during the course of internship to monitor the progress of the students.

Evaluation Criteria

The internal assessment of internship is to be carried out by the Industry/ Organization where the students have undergone the internship. The internal assessment done by the industry/ organization may be rationalized by the Department, if needed. The external assessment is to be done at the Institute. The department shall finalize external assessment within a month of the beginning of the 5th semester. The students have to prepare a daily diary of their internship period and the same has to be submitted at the institute after completion of the internship. The students have also to present the experience gained during internship in a seminar for the purpose of external evaluation.

(a) The assessment criteria (Internal Assessment) by the industry/ organization where the students have undergone the internship is as follows:

- Attendance and general behaviour : 20%
- Daily diary maintenance : 20%
- Initiative and participative attitude during internship : 20%
- Performance in the assigned activities by the industrial supervisor : 40%

(b) The assessment criteria (External Assessment) by the institute is as follows:

- Presentation : 60%
- Report : 20%
- Viva : 20%