Regulation 2023
Program Structure

Diploma in Instrumentation and Control Engineering

Program Outcomes (PO's)

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability, attitude, and behavior that students acquire through the program.

The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during the program. As such, POs define the professional profile of an engineering diploma graduate.

NBA has defined the following seven POs for an Engineering diploma graduate:

PO1: Basic and Discipline-specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and an engineering specialization to solve the engineering problems.

PO2: Problem analysis: Identify and analyse well-defined engineering problems 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 the context of society, sustainability, environment and ethical practices.

PO6: Project Management: Use engineering management principles individually, as a team member or as a leader to manage projects and effectively communicate about well-defined engineering activities.

PO7: Life-long learning: Ability to analyze individual needs and engage in updating in the context of technological changes.

Credit Distribution:

Semester	No of Courses	Periods	Credits
Semester I	8	640	20
Semester II	8	640	20
Semester III	7	640	21
Semester IV	7	640	19
Semester V	8	640	22
Semester VI	3	640	18
Total			**120**

Semester III

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1042233110	Sensors and Transducers	3-0-0	45	3	Theory
2	Program Core	Practicum	1042233230	Measurements and Instruments	3-0-2	75	4	Theory
3	Program Core	Practical	1042233320	Sensors and Transducers Practical	0-0-4	60	2	Practical
4	Program Core	Practicum	1042233440	Circuit Theory and Machines	1-0-4	75	3	Practical
5	Program Core	Practicum	1042233540	Principles of Electronics Engineering	1-0-4	75	3	Practical
6	Program Core	Practicum	1042233640	Basics of C Programming	1-0-4	75	3	Practical
7	Open Elective	Advanced Skill Certification	1042233760	Advanced Skills Certification - 3	1-0-2	60	2	NA
8	Humanities & Social Science	Integrated Learning Experience	1042233880	Growth Lab	-	30	0	NA
9	Audit Course	Integrated Learning Experience	1042233881	Induction Program - II	-	16	0	-
10	Audit Course	Integrated Learning Experience	1042233882	I&E/ Club Activity/ Community Initiatives	-	16	0	-
11	Audit Course	Integrated Learning Experience	1042233883	Shop Floor Immersion	-	15	0	-
12	Audit Course	Integrated Learning Experience	1042233884	Student Led Initiative		15		
13	Audit Course	Integrated Learning Experience	1042233885	Emerging Technology Seminars	-	8	0	-
14	Audit Course	Integrated Learning Experience	1042233886	Health & Wellness	0-0-2	30	1	-
Library						**15**		
Test & Revisions						**30**		
Total						**640**	**21**	

Semester IV

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1042234110	Measurement of Process Variables	3-0-0	45	3	Theory
2	Program Core	Practicum	1042234230	Control Engineering	2-0-2	60	3	Theory
3	Program Core	Practical	1042234320	Measurement of Process Variables Practical	0-0-4	60	2	Practical
4	Program Core	Practical	1042234440	Virtual Instrumentation	0-0-4	60	2	Practical
5	Program Core	Practicum	1042234540	Analog and Digital Electronics	1-0-4	75	3	Practical
6	Program Core	Practicum	1042234640	8051 Micro Controller	1-0-4	75	3	Practical
7	Open Elective	Advanced Skill Certification	1042234760	Advanced Skills Certification - 4	1-0-2	45	3	NA
8	Audit Course	Integrated Learning Experience	1042234882	I&E/ Club Activity/ Community Initiatives	-	15	0	-
9	Audit Course	Integrated Learning Experience	1042234883	Shop floor Immersion	-	15	0	-
10	Audit Course	Integrated Learning Experience	1042234884	Student-Led Initiative	-	24	0	-
11	Audit Course	Integrated Learning Experience	1042234885	Emerging Technology Seminars	-	16	0	-
12	Audit Course	Integrated Learning Experience	1042234886	Health & Wellness	-	30	0	-
13	Audit Course	Integrated Learning Experience	1042234887	Special Interest Groups (Placement Training)	-	30	0	-
Library						**30**		
Test & Revisions						**60**		
Total						**640**	**19**	

Semester V

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1042235110	Process Control Instrumentation	5-0-0	75	5	Theory
2	Program Elective	Theory	104223531X	Elective-1	4-0-0	60	4	Theory
3	Program Core	Practical	1042235420	Process Control Instrumentation Practical	0-0-4	60	2	Practical
	Program Elective	Practical	104223542X	Elective-2	0-0-4	60	2	Practical
	Program Core	Practicum	1042235540	Industrial Automation using PLC	1-0-4	75	3	Practical
	Humanities & Social Science	Practicum	1042235654	Innovation & Startup	1-0-2	45	2	Project
	Project/Internship	Project/Internship	1042235773	Industrial Training* [Summer Vacation - 90 Hours]	-	-	2	Project
	Open Elective	Advanced Skill Certification	1042235760	Advanced Skills Certification - 5	1-0-2	60	2	NA
	Audit Course	Integrated Learning Experience	1042235881	Induction program III	-	40	0	-
	Audit Course	Integrated Learning Experience	1042235884	Student-Led Initiative	-	30	0	-
	Audit Course	Integrated Learning Experience	1042235886	Health & Wellness	-	30	0	-
	Audit Course	Integrated Learning Experience	1042235887	Special Interest Groups (Placement Training)	-	45	0	-
Library						15		
Test & Revisions						45		
Total						640	**22**	

Note:* *Internship shall be offered in the summer break between 4th and 5th semester followed by a review and award of credits in the 5th semester*

Semester VI

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Open Elective	Theory	104223611X	Elective 3 (Pathways)	3-0-0	45	3	Theory
2	Open Elective	Theory	104223621X	Elective-4 (Specilization)	3-0-0	45	3	Theory
3	Project / Internship	Project / Internship	10422363XX	Internship / Fellowship / In-house Project	-	550	12	Project
Total						**640**	**18**	
3	Project / Internship	Project / Internship	1042236351	Internship	-	550	12	Project
3	Project / Internship	Project / Internship	1042236353	Fellowship	-	550	12	Project
3	Project / Internship	Project / Internship	1042236374	In-house Project	-	550	12	Project

Elective 1

#	Course Category	Course Type	Code	Course Title
1	Program Elective	Theory	1042235311	Industrial Instrumentation
2	Program Elective	Theory	1042235312	Fiber Optics and LASER Instrumentation
3	Program Elective	Theory	1042235313	Embedded system Design with ARDUINO
4	Program Elective	Theory	1042235314	Industrial Power Electronics
5	Program Elective	Theory	1042235315	Analytical Instrumentation

Elective 2

#	Course Category	Course Type	Code	Course Title
1	Program Elective	Practical	1042235421	Industrial Instrumentation Practical
2	Program Elective	Practical	1042235422	P&ID CAD Practical
3	Program Elective	Practical	1042235423	Embedded system Design with ARDUINO Practical
4	Program Elective	Practical	1042235424	Industrial Power Electronics Practical
5	Program Elective	Practical	1042235525	Automated Pneumatic Instrumentation Practical

Elective 3 (Pathway)

#	Course Category	Course Type	Code	Course Title
1	Program Elective - Higher Education	Theory	6000236111	Advanced Engineering Mathematics
2	Program Elective - Entrepreneur	Theory	6000236112	Entrepreneurship
3	Program Elective - Technocrats	Theory	6000236113	Project Management
4	Program Elective -Technocrats	Theory	6000236114	Finance Fundamentals
5	Program Elective - Technologist	Theory	1042236115	Biomedical Instrumentation
6	Program Elective - Technologist	Theory	1042236116	Power Plant Instrumentation
7	Program Elective - Technologist	Theory	1042236117	Industrial Process Control Instrumentation

Elective 4 (Specialization)

#	Course Category	Course Type	Code	Course Title
1	Program Special Course	Theory	1042236211	Industrial Automation and Drives
2	Program Special Course	Theory	1042236212	Instrumentation in Paper and Cement Industries
3	Program Special Course	Theory	1042236213	Computer Control of Process
4	Program Special Course	Theory	1042236214	Industrial Robotics

1042233110	Sensors and Transducers	L	T	P	C
Theory		3	0	0	3

Introduction

Sensors and transducers is a prominent course to make the students aware about the importance of measurement in control system design and development. This course is intended to develop the basic understanding as well as the competency to use, install and test various sensors and transducers used for measuring non-electrical quantities like displacement, temperature, pressure, flow, level etc. Sensors and Transducers are used in almost every industry and also in everyday life.

Course Objectives:

The objective of this course is to enable the students to

- Explain about various sensors used in industries to sense the physical parameters
- Explain the various Resistive type Transducers being used in industries
- Explain the various Inductive type Transducers being used in industries
- Explain the various capacitive type Transducers being used in industries
- Explain the various signal conditioning circuits to be interfaced with transducers to get useful output

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the Sensors to sense the displacement, Force, Pressure, Flow, proximity, magnetism etc.

CO2: Explain the Resistive transducers to measure force, strain, temperature

CO3: Explain the Inductive type transducers to measure Linear and Angular Displacement

CO4: Explain the Capacitive type transducer to measure displacement, level

CO5: Explain various signal conditioning circuit like Bridge, Op_amp based circuits to interface with transducer

Pre-requisites

Basic knowledge of Electrical, Electronics and Instrumentation

1042233110	Sensors and Transducers	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	-	-	-
CO2	3	2	2	2	-	-	-
CO3	3	2	2	2	-	-	-
CO4	3	2	2	2	-	-	-
CO5	3	2	2	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different types of sensors and transducers. Teachers should use PPT presentation to show video of application of the various types of sensors and transducers. Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- Students may be shown all the available sensors in the lab. The demonstration can make the subject exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to show the working of different types of sensors and transducers.
- Teachers are advised to follow inductive strategy to help the students to know the working principle of special sensors.
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any

1042233110	Sensors and Transducers	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042233110	Sensors and Transducers	L	T	P	C
Theory		3	0	0	3

Unit I	SENSORS	
Mechanical sensor: Mechanical Springs and its types - Pressure sensor: Bourdon tube and its types - Measurement of Pressure with Bourdon tube and LVDT – Diaphragm – Bellows - Temperature Sensor: Construction- working principle – Application of Bimetallic strip - Hydro Pneumatic Device - Float – working principle - Special sensors: Working principle of Proximity sensor - Magnetic Sensor - LDR		9
Unit II	**RESISTIVE TRANSDUCER**	
Transducer – Definition – Sensing and Transduction -Classification-Primary and Secondary transducer - Active and Passive transducer- Analog and Digital transducer - Inverse transducer - Examples		2
Resistive Transducer: Potentiometer- Translational-Rotational – Strain gauge-Types of Strain gauges-Wire wound (Bonded and Un bonded) - Foil type-semi conductor strain gauges - Load cell- Thermo couple - Resistance Temperature Detector (RTD) - Thermistor - characteristics – Applications.		7
Unit III	**INDUCTIVE TRANSDUCERS**	
Self Inductance Type Transducer and its types – Variable Reluctance type transducer – Differential output- Mutual Inductance type - LVDT- Construction - Working – Characteristics- Advantage – Disadvantage- RVDT-working principle - Synchros – Principle of operation- Hall Effect Transducer		9
Unit IV	**CAPACITIVE TRANSDUCERS**	
Capacitive Transducers: Principle of operation – change in area type-change in distance type – change in dielectric constant –Capacitance type level measurement - Advantage - Disadvantage - Application.		5
Piezo Electric Transducers: Principle of operation – Modes of operation – Properties of Piezo electric crystal-Equivalent circuit – Applications.		4

1042233110	Sensors and Transducers	L	T	P	C
Theory		3	0	0	3

Unit V	SIGNAL CONDITIONING CIRCUITS	
Signal conditioning: DC signal conditioning system – AC signal conditioning system – Wheatstone bridge with single variable element – Wheatstone Bridge with two variable element –Null type bridge- Deflection type Bridge		4
Op_Amp based circuits: Buffer amplifier - Charge Amplifier- Instrumentation amplifier – Active filters : Low pass- High pass - Band pass - Band stop – (0 - 10V) to (4-20mA) translation circuit-Thermocouple compensating circuit –Strain gauge bridge circuit with op_amp		5
TOTAL HOURS		**45**

Suggested List of Students Activity (Ungraded):

- Check the web portal to study different types of sensors and transducers.
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce the different types of sensors and their working principles.
- Students might be asked to see the demonstration video of various sensors and transducer

Text Books for Reference:

1. A.K.Sawhney,A Course in Electrical and Electronic Measurements and Instrumentation,19th Edition, Dhanpatrai & sons, Educational and technical publishers, Delhi,2014
2. Patranabis, “Sensors and Transducers” 2ndEdition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010
3. R.K.Jain, Mechanical and Industrial Measurements, 3rd Edition,Khanna Publishers, New Delhi,2015

Web Reference: (Click Ctrl + link to view the web page)

Lecture notes

1. https://byjusexamprep.com/gate-ece/sensors-transducers
2. https://www.egr.msu.edu/classes/ece445/mason/Files/4-Sensors_ch2.pdf
3. https://calicut-university.teachics.org/study-materials/a12-sensors-and-transducers/

Video Lectures

1. https://youtu.be/vGlBlsTwCfA
2. https://youtu.be/hv-aBonZMRQ
3. https://youtu.be/1uPTyjxZzyo

1042233110	Sensors and Transducers	L	T	P	C
Theory		3	0	0	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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II. 5.
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III. 9.
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IV. 13.
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V. 17.
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1042233230	Measurements and Instruments	L	T	P	C
Practicum		3	0	2	4

Introduction:

The course "Measurements and Instruments" is a pivotal course for Instrumentation & Control Engineering. This course deals with the methods of measuring basic electrical parameters such as voltage, current, power, energy, frequency, resistance, inductance and capacitance. Principle of operation and constructional details, working of various instruments are dealt with this course.

Course Objectives:

At the end of the course, the students would be able to

- Explain Measuring Instruments to measure Voltage, Current, Resistance, and Energy
- Explain to use Bridge circuits to measure unknown Resistance, Inductance and Capacitance
- Explain the Measuring instrument to display, measure and analyze the waveforms
- Explain the various test instruments used in the Industry /Laboratory to test and record the values of the parameters
- Explain the Various Digital Instruments to measure the Frequency, Period, Voltage, Resistance etc.

Course Outcomes:

After successful completion of this course, the student will be able to

CO1: Explain the construction of Moving coil and Moving Iron Instruments and to use that Instruments as Ammeter, Voltmeter with different ranges. Also to explain the Energy meter and ohm meter to measure electrical energy consumed and to measure resistance.

CO2: Explain the Bridge circuits to measure unknown value of Resistance, Inductance and capacitance and also to explain the construction and working of CRO

CO3: Explain the various test instruments such as CT, PT

CO4: Explain the principle of operation and constructional details of CT, PT

CO5: Explain the concept of CRO, Function Generator and recorders used to measure various electrical parameters

Pre-requisites:

Basic Electronics

1042233230	Measurements and Instruments	L	T	P	C
Practicum		3	0	2	4

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	2	-	-	-
CO2	2	2	1	2	-	-	-
CO3	2	2	1	2	-	-	-
CO4	2	2	1	2	-	-	-
CO5	2	2	1	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- Teachers have to use different teaching method for easy to learn of students.
- To help the students to learn different types of instruments and their measurements.
- To Give Demo to the students by teachers using various multimedia applications.

1042233230	Measurements and Instruments	L	T	P	C
Practicum		3	0	2	4

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test Theory (Any Two Units)	Written Test Theory (Another Two Units)	Practical Test (All Exercises)	Written Test (Complete Theory Portions)	Written Examination (Complete Theory Portions)
Duration	2	2	3	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Tentative Schedule	6th Week	12th Week	15th Week	16th Week	

Note:

CA1 and CA2: Assessment written test should be conducted for 50 Marks. The marks scored will be converted to 10 Marks for each test. Best of one will be considered for the internal assessment of 10 Marks.

CA1 and CA2, Assessment written test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks)

Eight questions will be asked, students should write Five questions.

Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA 3: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 15 Marks for the internal mark.

Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. Each exercise/experiment should be evaluated for 10 Marks. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

1042233230	Measurements and Instruments	L	T	P	C
Practicum		3	0	2	4

The details of the documents should be prepared as per the instruction below.

Each exercise observation and calculations should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate notebook or printed manual or file. The reading and calculations and graph should be written by the student manually. The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Block Diagram /Circuit Diagram	20
B	Procedure for Experimenting / Demonstrating	10
C	Performing Experiment / Demonstration	20
D	Procedure/ Observing Readings/Calculations	10
E	Record Note	30
F	Viva Voce	10
Total		100

CA4: Model examination should be conducted for complete theory portions as per the end semester question pattern. The marks awarded should be converted to 15 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042233230	Measurements and Instruments	L	T	P	C
Practicum		3	0	2	4

Unit I	Measuring Instruments	
Construction - working - Equations of Permanent magnet Moving coil instrument - Attraction and Repulsion type Moving iron instrument –Ammeter - Extending the range – simple problem - Multi range ammeter – Voltmeter - Extending the range - simple problem - Multi range voltmeter - Full wave rectifier type ac volt meter.		9
Ex.No.1: Extend the range of given Moving Coil Ammeter (0 – 10 mA) into (0 - 100 mA) Ex.No.2: Extend the range of given Moving Coil Voltmeter (0 – 1 V) into (0 – 10 V)		6
Unit II	Bridges and Oscilloscope	
DC Bridge - Construction, working, derivation of balance equation and application of measurement of resistance by Wheatstone bridge - AC Bridge – Balance equation of AC bridge in ratio form and product form - Maxwell's Bridge – Hay's bridge - Measurement of unknown capacitance by Schering bridge.		9
Ex.No.3: Measure the unknown Resistance using Wheatstone Bridge Ex.No.4: Measure the unknown Inductance using Maxwell's Bridge		6
Unit III	Test Instruments	
Block diagram, working and applications of DC power supply–fixed and variable – Megger – working and applications - Instrument transformer – Current Transformer (CT) and Potential Transformer (PT) - Block diagram of oscilloscope – construction and working of CRT –horizontal deflection and vertical deflection – time base generator –applications of CRO.		9
Ex.No.5: Demonstration of internal components and circuit of DC power supply Ex.No.6: Measure the Magnitude and frequency of the sine wave in CRO		6

1042233230	Measurements and Instruments	L	T	P	C
Practicum		3	0	2	4

Unit IV	Digital Instruments - I	
Digital Vs Analog instruments – inverting and non inverting Schmitt trigger circuit - Digital frequency meter – block diagram - circuit diagram for Frequency measurement – Period measurement - Simple problems - Digital tachometer – Digital storage oscilloscope - Mixed storage oscilloscope -Applications.		9
Ex.No.7: Construct Non-Inverting Schmitt trigger circuit using Operational Amplifier IC741 and observe the output waveform in Digital storage CRO. Ex.No.8: Measure the speed using tachometer		6
Unit V	Digital Instruments - II	
Digital voltmeter - Linear ramp type voltmeter – Digital ramp type voltmeter – successive approximation type volt meter - Dual slope voltmeter - Digital Multimeter– auto ranging – auto zeroing – auto polarity – Function generator to generate triangular, pulse and sinusoidal wave - Block diagram - Circuit diagram.		9
Ex.No.9: Demonstration of Function generator and observe the generated sinusoidal, triangular and pulse waveform in CRO Ex.No.10: Measure AC voltage, DC voltage, DC current, resistance value and check continuity using digital multimeter		6
TOTAL HOURS		75

Text Books for Reference:

- A Course in Electrical and electronic measurements and instrumentation by A. K. Sawhney, Dhanpat Rai & Sons. 1986
- Electronic Instrumentation and Measurements: David A. Bell
- Modern Electronics Instrumentation and Measurement Techniques by Albert D. Herfrick.

Web-based/Online Resources

1. https://www.tutorialspoint.com/electronic_measuring_instruments/measuring_instruments.html
2. https://circuitglobe.com/energy-meter.html
3. https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_bridges.htm
4. https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_basics_of_oscilloscopes.htm
5. https://www.electrical4u.com/digital-voltmeters-working-principle-of-digital-voltmeter/

1042233230	Measurements and Instruments	L	T	P	C
Practicum		3	0	2	4

Equipment Required:

S.No	Description	Range	Quantity Required
1	Ammeter	(0-10mA)	4
2	Voltmeter	(0-1V)	2
3	Bread board		5
4	Decade Resistance Box	Min: 10 Ohm Max: 100 K	2
5	Fixed Resistors	1 K, 10 K, 1.2 K, 2.2 K, 4.7K	2
6	Multimeter		
7	Function Generator		2
8	CRO		2
9	Digital storage oscilloscope		1
10	IC741		5
11	DC Regulated power supply	(0-30V)	5
12	Connecting wires		

1042233230	Measurements and Instruments	L	T	P	C
Practicum		3	0	2	4

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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II. 5.
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III. 9.
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V. 17.
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1042233320	Sensors and Transducers Practical	L	T	P	C
Practical		0	0	4	2

Introduction:

Sensors and Transducers play a crucial role in various applications to convert physical quantities into measurable signals. This syllabus is to provide a skill oriented practical exposure in sensor technologies ensuring that students not only grasp the theoretical foundations but also acquire the skills necessary for successful completion of their own project works in various domains. The chosen sensors are relevant to a wide range of industries including automation, robotics, environmental monitoring and safety. This syllabus aims to prepare students for real-world applications of sensor technologies aligning with industry needs and trends.

Course Objectives:

The objective of this course is to enable the student to

- Perform Experiment on potentiometer and strain gauge
- Perform Experiment on LVDT and thermistor
- Perform Experiment on RTD and Thermocouple
- Perform Experiment on LDR and Load cell
- Perform Experiment on Hall effect sensor and Piezo-Electric Transducer and in Signal conditioning circuits

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Conduct experiment to learn the behavior and characteristics Potentiometer and Strain Gauge

CO2: Conduct experiment to learn the behavior and characteristics of Thermistor, LVDT

CO3: Conduct Experiment to learn the Characteristics of RTD and Thermocouple

CO4: Conduct Experiment to learn the Characteristics of LDR and Load Cell

CO5: Conduct Experiment to verify the function of Hall Effect and Piezoelectric Transducer

Prerequisite:

Sensors and Transducers Theory

1042233320	Sensors and Transducers Practical	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	-	-	-
CO2	3	2	1	1	-	-	-
CO3	2	3	3	2	-	-	-
CO4	2	3	2	2	-	-	-
CO5	2	3	2	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

1042233320	Sensors and Transducers Practical	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	15
B	Experimenting with Procedure	15
C	Observing Reading / Calculations / Graph	15
D	Result	5
TOTAL		50

- **CA 3:** Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate.

  The details of the documents should be prepared as per the instruction below.

  The exercise should be completed on the day of practice.

  The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

  This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

  The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	20
B	Experimenting with Procedure	30
C	Readings Observed	20
D	Calculations / Graph	10
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042233320	Sensors and Transducers Practical	L	T	P	C
Practical		0	0	4	2

Ex.No.	Name of the Exercise	Hours
1	Experimentally obtain the V-I characteristics of Potentiometer and observe its linearity	5
2	Experimentally obtain the characteristics of strain gauge	5
3	Experimentally obtain the characteristics of LVDT	5
4	Experimentally obtain the characteristics of Thermistor	5
5	Experimentally obtain the characteristics of Resistance Temperature Detector (RTD)	5
6	Experimentally obtain the characteristics of Thermocouple	5
7	Experimentally obtain the characteristics of LDR	5
8	Experimentally calibrate the Load cell with known weights	5
9	Experimentally verify the function of Hall Effect Transducer	5
10	Experimentally verify the function of piezoelectric transducer	5
11	Construct and test Instrumentation amplifier circuit	5
12	Test the following sensors by giving suitable Input with desirable output device: (i) IC temperature Sensor (ii) Soil Moisture sensor (iii) IR sensor and (iv) Inductive proximity sensor	5
TOTAL HOURS		**60**

1042233320	Sensors and Transducers Practical	L	T	P	C
Practical		0	0	4	2

Equipment Required:

Sl.No	Item Description	Range	Qty. Required
1.	Ammeter	(0-50mA)	4
2.	Voltmeter	(0-5V),(0-10V)	4
3.	Regulated Power Supply	(0-30V)	4
4	Digital Multimeter	-	6
5	Rheostat	-	4
6	Strain gauge module	-	1
7.	LVDT module	-	1
8	Thermistor with industrial standard	-	1
9	3 wire RTD (PT50/PT-100)		1
10	Thermocouple(J/K type)		1
11	Water bath with heater arrangement		2
12	IR & Inductive proximity sensor	-	Each module 2 nos
16	IC temperature sensor	-	2 nos
17	Relays , LEDs and buzzers for actuation	-	As required
18	Trainer Kit to test Hall Effect sensor	-	2 nos
19	Trainer Kit to test Piezo Electric sensor	-	2 nos
20	Soil moisture sensor		2 nos

1042233440	Circuit Theory and Machines	L	T	P	C
Practicum		1	0	4	3

Introduction:

Electricity is one of the most vital forces that power the modern world and as such understanding the principles of electrical circuit is an important skill that students can develop. This subject helps to reinforce their understanding of principles of electrical circuits and electrical machines. .The fundamental knowledge about Electrical circuits both AC and DC is essential for all diploma holders. Practical exercises are essential for teaching in how to prove the theorems in electrical circuits and to conduct tests on electrical machines. Understanding the working principle of DC and AC machines, transformer is a prerequisite for technicians in their workplace.

Course Objectives:

The objective of this course is to enable the students to

- Demonstrate electric circuits and its analysis
- Impart knowledge the concept of 3 phase circuits
- Acquire skills on operating DC Generators and Motors
- Acquire skills on operating AC Motors
- Acquire skills on testing the transformer.

Course Outcomes

After successful completion of this course, the students will be able to

CO1: Experimentally verify Thevenin's, Norton's, Super position and maximum power transfer Theorems.

CO2: Construct circuit and to measure 3ϕ power by two wattmeter method

CO3: Construct circuit to perform Load test on DC shunt generator and to control the speed of DC shunt motor

CO4: Construct circuit to perform Load test on single phase and 3 phase induction motor.

CO5: Construct circuit to perform Load test, OC and SC test on Single phase transformer .

Pre-requisites:

High School Physics, Electrical & Electronics Fundamentals

1042233440	Circuit Theory and Machines	L	T	P	C
Practicum		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	1	1	-	-	-
CO2	3	3	1	1	-	-	-
CO3	3	2	1	1	-	-	-
CO4	3	2	1	1	-	-	-
CO5	3	2	1	1	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- Help students to learn different types of electrical machines and circuits. Teachers should use PPT presentation of electrical circuits to show video of application of the components. Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications where the electrical machines are used.
- Students may be shown the generators, motors, and starters in the lab. The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to Perform the experiments given in the curriculum
- Teachers are advised to follow inductive strategy to help the students to discover the working principle Electrical circuits.
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any?

1042233440	Circuit Theory and Machines	L	T	P	C
Practicum		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II Exercises	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise/experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of next exercise. The detailed date of practices and its evaluations should be maintained in the logbook and should be submitted for verification.

1042233440	Circuit Theory and Machines	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Drawing Circuit Diagram	10
B	Circuit Construction	15
C	Experimenting	15
D	Readings Observed / Calculations	10
TOTAL		50
E	Record Note	10
		60

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ questions	30 x 1 Mark	30 Marks
Part – B	7 questions to be answered out of 10 questions	7 x 10 Marks	70 Marks
TOTAL			100 Marks

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

1042233440	Circuit Theory and Machines	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	Drawing Circuit Diagram	20
B	Circuit Construction	20
C	Experimenting with Procedure	20
D	Readings Observed / Calculations / Graph	20
E	Result	10
F	Viva Voce	10
TOTAL		100

1042233440	Circuit Theory and Machines	L	T	P	C
Practicum		1	0	4	3

Unit I	Electric Circuit Analysis	
Kirchoff's voltage and current law - Thevenin's theorem, Norton's theorem , super position theorem and Maximum power transfer theorem – Statement and explanations – Calculation of Mesh current – Two loops only- Simple problems.		3
Ex.No.1: Verify the Thevenin's Theorem, by Constructing the two loop DC resistive circuit and measure the current through Load resistance and construct the single loop Thevenin equivalent of that circuit and measure the current through Load resistor. Ex.No.2: Verify the Norton's Theorem, by Constructing the two loop DC resistive circuit and measure the current through Load resistance and construct the single loop Thevenin equivalent of that circuit and measure the current through Load resistor. Ex.No.3: Verify Maximum power transfer theorem for the two loop DC resistive circuit. Ex.No.4: Construct the two loop Multi DC source Resistive circuit and Verify the Super position theorem.		12
Unit II	**Measurement of 3 Phase Power and Resonance**	
Concept of 3ϕ supply – Line and phase voltage and current in star and delta connected circuits - 3ϕ power – Measurement of 3ϕ power by two watt meter method - Resonance – condition for resonance – series resonance – resonance curve		3
Ex.No.5: Measure 3ϕ power by two wattmeter method by conducting an experiment. Ex.No.6: Construct the RLC series resonance circuit and Obtain the Frequency response curve experimentally.		12
Unit III	**DC Generators and Motors**	
DC machines – Constructional details of DC machines – DC generators - Types – working principle – EMF equation – characteristics of shunt, series and compound generators – applications. DC motor – Types – Motor action – Back EMF – Torque speed characteristics – Speed control of DC shunt motor – Applications.		3
Ex.No.7: Conduct a load test on DC Shunt Generator. Ex.No.8: Speed control of DC shunt motor using (a) Armature control (b) Field control		12

1042233440	Circuit Theory and Machines	L	T	P	C
Practicum		1	0	4	3

Unit IV	AC Motors and Alternators	
Ac machines - 3ϕ Alternator – Construction and working – Relation between speed and frequency. 3ϕ induction motor – construction – Types – Principle of operation – Methods of starting of 3ϕ Induction motor – 1ϕ induction motor – Principle of operation – Capacitor start – Applications.		3
Ex.No.9: Conduct a load test on 1ϕ induction motor. Ex.No.10: Conduct a load test on 3ϕ induction motor.		12
Unit V	**Transformers**	
Transformer – Ideal Transformer – Principle of working – Constructional details – EMF equation – Turns ratio – Core loss – Copper loss – Efficiency – Regulation – SC and OC tests – Transformer on No load – Transformer on load – Condition for maximum efficiency		3
Ex.No.11: Conduct a load test on Single phase transformer. Ex.No.12: Open circuit and short circuit test on single phase transformer.		12
TOTAL HOURS		**75**

Suggested List of Students Activity (Ungraded)

- Check the web portal for Image and video of different types of Electrical circuits and Machines
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce image of different types of Electrical circuits , and working principles
- Students might be asked to find the various components in real life electrical machines, equipment and circuits.
- Students might be asked to use virtual labs for the simulation of electrical circuits using simulation software

Text Books for Reference:

- Electric Circuit Theory by Arumugam and Prem Kumar, Khanna Publishers
- A Textbook of Electrical Technology by BLTheraja, S.Chand and publications
- Electrical Circuits by Sudhakar and Shyam Mohan, McGraw Hill Education

1042233440	Circuit Theory and Machines	L	T	P	C
Practicum		1	0	4	3

Web References

1. https://youtu.be/zs4MnEx7wTQ?list=PLMC_fsTBvdNgouV9R_PRjJHpYHWgMluxV
2. https://youtu.be/uyE_UhLwIXc?list=PLBlnK6fEyqRg41HzkHScol5bdRebCDOAZ
3. https://youtu.be/czeMTuxprpo
4. https://youtu.be/yR9KMC01diM
5. https://youtu.be/Ibq5Ljt9Epo

Equipment Required:

S.No	Name of the Equipment / Software	Required Quantity
1	Ammeters and Voltmeters	5
2	230V-9V,230V-6VTransformer	5
3	0-30V RegulatedPowerSupply	5
4	Digital Multimeter	5
5	Bread Board	10
6	Connecting wires	As reqd.
7	Resistors, DIB, DCB	5
8	Watt meters(cc-10A, pc-500V)	5
9	Dc shunt Generator	1
10	DC shunt motor	1
11	Single Phase Induction Motor	1
12	Three Phase Induction Motor	1
13	Single phase transformer	2
14	Voltmeter (0-500V) AC	5
15	Ammeter (0-10A) AC	5

1042233540	Principles of Electronics Engineering	L	T	P	C
Practicum		1	0	4	3

Introduction:

This subject forms the backbone of electronic engineering and related fields. It introduces students to the basics of electronic devices, their behavior, and how they form the building blocks of various circuits. This knowledge is fundamental for designing complex electronic systems. Understanding electronic devices and circuits prepares students to troubleshoot problems in electronic systems. Additionally, it equips them with the necessary knowledge to apply these concepts in real-world applications such as in telecommunications, consumer electronics, medical devices, etc.

Course Objectives:

The objective of this course is to enable the students to

- Use the Diode in various application circuits
- Use Transistor in Amplifier and Oscillator circuits
- Use the Field effect Transistor and MOSFET in different applications
- Experiment the characteristics of SCR , DIAC and TRIAC
- Experiment the characteristics of optoelectronic devices

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: To construct and test the Rectifier and Regulator circuits using Diodes

CO2: To construct and test the Amplifier and Oscillator circuit using BJT

CO3: To construct and test the JFET and MOSFET circuit

CO4: To demonstrate the characteristics of SCR, DIAC and TRIAC

CO5: To build the application circuits using optoelectronic devices

Pre-requisites:

High School Physics – Electrical and Electronics Fundamentals

1042233540	Principles of Electronics Engineering	L	T	P	C
Practicum		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	-	-	-	-
CO2	3	2	1	-	-	-	-
CO3	3	2	1	-	-	-	-
CO4	3	2	1	-	-	-	-
CO5	3	2	1	-	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different types of, electronic devices and circuits. Teachers should use PPT presentation of Electronic components and circuits to show video of application of the components. Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- Students may be shown all the electronic devices, in the lab. The demonstration can make the subject exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to Perform the experiments given in the curriculum
- Teachers are advised to follow inductive strategy to help the students to discover the working principle Electronic circuits.
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any?

1042233540	**Principles of Electronics Engineering**	L	T	P	C
Practicum		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II Exercises	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise/experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

  The details of the documents should be prepared as per the instruction below.

  The exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of next exercise. The detailed date of practices and its evaluations should be maintained in the logbook and should be submitted for verification.

1042233540	Principles of Electronics Engineering	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Drawing Circuit Diagram	10
B	Circuit Construction	15
C	Experimenting with Procedure	15
D	Readings Observed / Calculations	10
TOTAL		50
E	Record Note	10
		60

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ questions	30 x 1 Mark	30 Marks
Part – B	7 questions to be answered out of 10 questions	7 x 10 Marks	70 Marks
TOTAL			100 Marks

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

1042233540	Principles of Electronics Engineering	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	Drawing Circuit Diagram	20
B	Circuit Construction	20
C	Experimenting with Procedure	20
D	Readings / Result Observed	20
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042233540	Principles of Electronics Engineering	L	T	P	C
Practicum		1	0	4	3

Unit I	Diode and its Application Circuits	
Semiconductor Diodes: PN Junction Diode as Rectifier - Introduction - Classification of Rectifiers - Half wave rectifier - Full wave rectifier with two Diodes, Bridge Rectifier –Zener diode as Voltage Regulator.		3
Ex.No.1: Construct Half wave rectifier circuit using PN junction Diode IN4007 and observe the input and output waveforms in CRO. Ex.No.2: Construct the Bridge Rectifier circuit and observe the input and output waveforms in CRO Ex.No.3: Construct the Voltage regulator circuit using Zener Diode and check the regulated output voltage.		12
Unit II	**Bipolar Junction Transistor and its Application Circuits**	
Transistor – Transistor as an Amplifier – RC coupled amplifier circuit - Transistor oscillator – Classifications – Condition for oscillations (Barkhausen criterion) - Hartley Oscillator – Colpitts Oscillator – RC Phase Shift Oscillator.		3
Ex.No.4: Test the performance of RC coupled Amplifier circuit using NPN Transistor BC107 and observe voltage gain, Input and output waveforms. Ex.No.5: Test the performance of RC Phase shift oscillator circuit using NPN transistor BC107 and observe the output waveform in CRO Ex.No.6: Test the performance of Colpitts oscillator circuit using NPN transistor BC107 and observe the output waveform in CRO		12
Unit III	**FET and MOSFET and its Application Circuits**	
Field Effect Transistor (FET) : Construction – Working – Characteristics – P Channel FET - N Channel FET - Applications – FET amplifier (Common source amplifier) - Difference between FET and BJT MOSFET - Classification: Enhancement mode - Depletion mode - Construction – working - characteristics - MOSFET acting as switch		3
Ex.No.7: Construct a circuit to study the characteristics of JFET in common source configuration Ex.No.8: Test the performance of common source FET amplifier circuit. Ex.No.9: Test the performance of MOSFET as Switch		12

1042233540	Principles of Electronics Engineering	L	T	P	C
Practicum		1	0	4	3

Unit IV	SCR, DIAC and TRIAC	
SCR - Introduction - Working - VI Characteristics - SCR as a switch – SCR half wave rectifier - TRIAC- working principle - Characteristics - DIAC - working principle - characteristics.		3
Ex.No.10: Construct the circuit to test the VI characteristic of SCR Ex.No.11: Construct the circuit to test the VI characteristic of DIAC		12
Unit V	**Optoelectronic Devices**	
Photo Diode - Photo Transistor - Solar cell - LED – LCD - symbol - working principle - characteristic - applications.		3
Ex.No.12: Construct the circuit to test the characteristic of Photo diode Ex.No.13: Construct the circuit to test the characteristic of Photo transistor Ex.No.14: Construct a circuit to test the LCD Display		12
TOTAL HOURS		**75**

Suggested List of Students Activity (Ungraded)

- Check the web portal for Image and video of different types of Electronic Devices, and circuits.
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce image of different types of Electronic circuits, and working principles
- Students might be asked to find the various components in real life equipment circuits.
- Students might be asked to see the demonstration video of various electronics components.
- Students might work the series and parallel connection, working of components using simulation software in the virtual laboratory web portal.

Text Book for Reference:

1. V K Metha, Rohit Metha, Principles of Electronics , S Chand Publications
2. B L Theraja, Basic Electronics - Solid State, S Chand and Company Limited
3. Electronics Devices & Circuits by Salivahanan S, N.Suresh Kumar, A.Vallavaraj, Tata McGraw Publication 3rd Edition 2016

Web References:

1. https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html
2. https://vlab.amrita.edu/?sub=3&brch=60&sim=1112&cnt=2147

1042233540	**Principles of Electronics Engineering**	L	T	P	C
Practicum		1	0	4	3

Equipment Required:

S.No	Name of the Equipment / Software	Required Quantity
1	PN Junction Diode 1N4007	10
2	0 - 6V, 6V - 0 – 6V Transformer	5
3	0-30V Regulated Power Supply	5
4	CRO	2
5	Any Zener Diode among V3.3Z,V 5.1Z,V5.6Z, V7.5Z, V9.1Z	10
6	Transistor BC107	10
7	Resistors	20
8	Capacitors	20
9	Function Generator	5
10	JFET Device / Kit	10
11	MOSFET Device / Trainer Kit	10
12	SCR Device	10
13	DIAC Device	10
14	Digital Multimeter	5
15	Bread Board	10
16	LED	
17	Photo Transistor	10
18	16 X 2 LCD	2
19	Connecting wires	As per requirement

1042233640	Basics of C Programming	L	T	P	C
Practicum		1	0	4	3

Introduction:

C is the most widely used computer language, which is being taught as a core course. C is general purpose structural language that is powerful, efficient and compact, which combines features of high level language and low-level language.

It is closer to both Man and Machine. Due to this inherent flexibility and tolerance it is suitable for different development environments. Due to these powerful features, C has not lost its importance and popularity in recently developed and advanced software industry.

C can also be used for system level programming and it is still considered as first priority programming language. This course covers the basic concepts of C. This course will act as "Programming concept developer" for students.

Course Objectives:

The objective of this course is to enable the students to

- Comprehend the basic concept of programming language and to interface with computer
- Learn the Basic structure of C program and its various format
- Develop C program using its statements, function pointers
- Develop C program for Electronic circuits and Instrumentation Applications
- Execute C program through IDE and observe the result in console output

Course Outcomes:

On successful completion of this course, the student will be able to

CO1: Declare the constant, variables and use the operators in programming

CO2: Use the branch and loop statements and handle array in programming

CO3: Handle structure, pointers and functions in programming

CO4: Develop C program and execute it for Electronics and Instrumentation applications

CO5: Develop C program and execute it for any applications

Pre-requisites:

Digital Logic Theory, Basic Programming Concepts

1042233640	Basics of C Programming	L	T	P	C
Practicum		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	-	-	-
CO2	3	3	3	2	-	-	-
CO3	3	3	3	2	-	-	-
CO4	3	3	3	2	-	-	-
CO5	3	3	3	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers revise the prerequisite knowledge on Digital Logic theory, number representations, conversion through PPT presentation.
- It is recommended to ask the students to write their own program for the given problem statement, discussing with their batch mates and Teacher may analyze it for correctness, and help to develop their programming skill.
- Students may be asked to edit, compile and Debug the program in IDE and test it.
- Teacher can recommend relevant YouTube videos to students to master the procedure to work with IDE
- Teacher have to demonstrate the step by step procedure on working with IDE
- Teacher may recommend c programming tutorial in native language available in Spoken Tutorial of IIT Bombay.

1042233640	Basics of C Programming	L	T	P	C
Practicum		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II Exercises	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise/experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

  The details of the documents should be prepared as per the instruction below.

  The exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of next exercise. The detailed date of practices and its evaluations should be maintained in the logbook and should be submitted for verification.

1042233640	Basics of C Programming	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Algorithm	10
B	Program	10
C	Debugging & Executing the program	20
D	Result Observed	10
TOTAL		50
E	Record Note	10
		60

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ questions	30 x 1 Mark	30 Marks
Part – B	7 questions to be answered out of 10 questions	7 x 10 Marks	70 Marks
TOTAL			100 Marks

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

1042233640	Basics of C Programming	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	Writing the Algorithm	20
B	Writing the Program	30
C	Executing the program	20
D	Debugging the program	10
E	Result	10
F	Viva Voce	10
TOTAL		100

1042233640	Basics of C Programming	L	T	P	C
Practicum		1	0	4	3

Unit I	Introduction to C, Operators & I/O Statements	
Basic Structure of C program - C Character Set - Constants - Keywords - Identifiers - Constants and Variables - Data types - Declaration of variables - Defining symbolic constants. Arithmetic operators – Relational operators – Logical operators – Assignment operators - Increment and Decrement operators – Conditional operators – Bitwise operators Formatted Input: scanf() - Formatted Output: printf() - putchar() - getchar()		3
Ex.No.1: Write a C program to find simple and compound interest Ex.No.2: Write a C program to find the solution of a quadratic equation Ex.No.3: Write a C program to find whether the given number is a positive number, negative number or zero		12
Unit II	**Branching Statements, Looping Statements & Arrays**	
Branching Statements: Introduction – conditional and unconditional - if statement – if ... else – if ... else ... if - ladder - nested if ... else - switch statement – goto statement. Loop Statements: Introduction - while, do ... while statements for loop Arrays: Declaration - Initialization – Accessing Array Elements.		3
Ex.No.4: Write C program to find the sum of series using While loop Ex.No.5: Write C program to perform the arithmetic operation based on the numeric key press using switch case statement. (1-Addition, 2-Subtraction, 3-Multiplication, 4-Division) Ex.No.6: Write C program to implement matrix addition		12
Unit III	**Structures, Pointers and Functions**	
Structures: Structure - Definition – Initialization - Arrays of structures - Arrays within structures **Pointers**: Introduction to Pointer – Declaring and Initializing Pointers **Functions:** User Defined Functions: Function declaration and definition - Function parameters - Calling a function - Recursion.		**3**

1042233640	Basics of C Programming	L	T	P	C
Practicum		1	0	4	3

Ex.No.7: Write C program to find factorial of given N numbers using function Ex.No.8: Write C program to prepare the total marks for N students by reading the name, register number and marks1 to mark 6 using array of structure Ex.No.9: Write C program to swap the values of two variables using pointer	12
Unit IV **Application Programs for Electric Circuit Applications**	
Program to implement Ohms law - Program to find equivalent resistance of three resistances connected in series and parallel - Program to display the average, RMS, form factor and crest factor from the given peak value	3
Ex.No.10: Write a C program to implement ohms law Ex.No.11: Write C language program to calculate the equivalent resistance of three resistances connected (a) in series (b) in parallel Ex.No.12: Write C language program to display the average, RMS, form factor and crest factor from the given peak value	12
Unit V **Application Programs for Instrumentation Applications**	
Program to find the arithmetic mean – range - deviation - standard deviation for the given readings - Program to convert Celsius to Fahrenheit and vice versa using function.	3
Ex.No.13: Write C language program to find the Arithmetic mean, Range, Deviation and standard deviation of the give 10 readings Ex.No.14: Write C language program to convert Celsius to Fahrenheit using function	12
TOTAL HOURS	**75**

Suggested List of Students Activity

Other than classroom learning, the following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course.

- Students can practice to write their own C language program for the different problem statements taken from internet and test the program using online editor
- Students can visit spoken tutorial hosted by IIT Bombay and listen to the programming tutorial to understand
- Students can try to execute the program written by their own in Online simulators to practice more programs.
- Students can try a mini project using C language programming skill with necessary tools.

1042233640	Basics of C Programming	L	T	P	C
Practicum		1	0	4	3

Text Book for Reference:

- Programming in ANSI C, 4th Edition, Prof. E. Balagurusamy, Tata McGraw Hill Publications.
- Let Us C, Yeswanth Kanetkar, BPB Publications, 4th Revised Edition.
- Computer Concepts and C Programming by R. Rajaram, Scitech Publications, Chennai.

Web-Based / Online Resources

Online Compilers for C

1. https://www.programiz.com/c-programming/online-compiler/
2. https://www.onlinegdb.com/online_c_compiler
3. https://onecompiler.com/c
4. https://www.jdoodle.com/c-online-compiler/
5. https://www.tutorialspoint.com/compile_c_online.php

Online C programming Tutorial

1. https://www.tutorialspoint.com/cprogramming/index.htm

Free Visual Programming Language to learn Programming Concepts

2. https://scratch.mit.edu/

Spoken Tutorial Website

3. https://spoken-tutorial.org/

Equipment required (for 30 students)

S.No	Name of the Equipment / Software	Required Quantity
1	Desktop Computers / Laptop Computers	10
2	Laser Printer - A4 size	1
3	5 KVA UPS with at least 1 hour backup	1
4	C Compiler	-

1042234110	Measurement of Process Variables	L	T	P	C
Theory		3	0	0	3

Introduction:

Instrumentation engineers must be conversant with the details of measurement of process variables in industries. In any process industries, the major process variables involved are temperature, pressure, flow and level. This subject covers the detailed study to measure various process variables using transducers used in process industries. It also helps the students to understand about the availability of various transducers by different principles to measure the same process variable. This subject gives an idea about the selection of transducers for a given process variable by analyzing the advantages and limitations of each transducer

Course Objectives:

At the end of the course, the students would be able to

- Explain the measurement of temperature using mechanical and electrical methods
- Explain the measurement of pressure using mechanical and electrical methods
- Explain the measurement of Flow using mechanical methods
- Explain the measurement of Flow using electrical methods
- Explain the measurement of Level, Humidity and Moisture

Course Outcomes:

After successful completion of this course, the student will be able to

CO1: Explain the measurement of Temperature, High temperature using mechanical and Electrical methods.

CO2: Explain the measurement of Pressure using various meters, and LVDT

CO3: Explain the measurement of flow using Pitot tube, venturi and Flow nozzle

CO4: Explain the measurement of flow using Electro mechanical methods such as ultrasonic flow meter, Electromagnetic flow meter, Doppler flow meter etc.,

CO5: Explain measurement of Level, Moisture and Humidity

Pre-requisites:

Basics Electronics and instrumentation, Sensors and Transducers

1042234110	Measurement of Process Variables	L	T	P	C
Theory		3	0	0	3

CO-PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	2	-	-	-
CO2	2	2	1	2	-	-	-
CO3	2	2	1	2	-	-	-
CO4	2	2	1	2	-	-	-
CO5	2	2	1	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Teachers have to use different teaching method for easy to learn of students.
- Help the students to make them to understand the different concepts of measurement of process variables through animation video
- Give demo to the students using various multimedia applications.

1042234110	Measurement of Process Variables	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042234110	Measurement of Process Variables	L	T	P	C
Theory		3	0	0	3

Unit I	MEASUREMENT OF TEMPERATURE	
	Mechanical Methods: Measurement of Temperature using Liquid in glass thermometer– liquid in steel thermometers, Gas and vapour pressure thermometer - Bimetallic thermometer **Electrical Methods:** Measurement of temperature using Thermo couples with potentiometer and milli voltmeter –cold junction compensation - series and parallel combination – thermopile – RTD – Thermistor **High Temperature Measurement:** Non contact methods – Total Radiation Pyrometers – Photo electric pyrometers – Optical pyrometers – Temperature transmitter	9
Unit II	**MEASUREMENT OF PRESSURE**	
	Mechanical Methods: Measurement of Pressure using Different Types of U-Tube Manometer -Well type manometer-Inclined Manometer -Ring balance Manometer-Micro manometer **Electrical Methods:** Measurement of pressure using strain gauge, capacitive transducer, LVDT and Piezo-electric transducer. **Pressure Calibration**: calibration of pressure using Dead weight tester. **Pressure Transmitters**: Measurement of pressure using Differential pressure transmitter	9
Unit III	**MEASUREMENT OF FLOW USING MECHANICAL METHODS**	
	Bernoulli's theorem – Continuity equation – Reynolds's number – Types of flow - Measurement of flow - Inferential flow meters – Differential pressure type meters – Orifice plates – Venturi tube – Flow Nozzle – Dall tube - Pitot tube – Positive displacement type meters – Nutating type meter – Oscillation piston type meter	9
Unit IV	**MEASUREMENT OF FLOW USING ELECTRICAL METHODS**	
	Measurement of Flow : Electromagnetic flow meter – Ultrasonic flow meter – Doppler and Transit time method – Swirl meter – Vortex shedding meter - Thermal mass flow meter – solid flow measurement using conveyor belt method – Turbine flow – Target flow meter – Hot wire anemometer	9

1042234110	Measurement of Process Variables	L	T	P	C
Theory		3	0	0	3

Unit V	MEASUREMENT OF LEVEL , HUMIDITY AND MOSITURE	
	Measurement of Level: Sight glass method - level in open and closed vessel -Measuring by the movement of float - Change in conductance – change in capacitance - Radiation method – Level Transmitter **Measurement of Moisture:** Measurement of Moisture in granular materials - solid penetrable material in paper and textiles. **Measurement of Humidity:** Humidity – Absolute humidity –Relative humidity – measurement of humidity using Psychrometer – Hair Hygrometer. Density and specific gravity – Definition – Measurement using weighing tube type – viscosity – Saybolt Viscometer	9
	TOTAL HOURS	**45**

Suggested List of Students Activity (Ungraded):

- Students can view the video in YouTube related to Measurement of process variables
- Student can visit any food processing Industry, Cement factory, sugar factory, etc and can see the process equipment
- Student can interact with Industrial experts to know the latest technology adopted in Process industries
- Student can practice quiz on Measurement of process variables on any online quiz through internet
- Student can visit higher institutions having instrumentation laboratory and interact with other students and faculties to update the knowledge

Text Books for Reference:

1. A Course in Electrical and electronic measurements and instrumentation by A. K. Sawheny, Dhanpat Rai & Sons. 1986 (Page Nos: 292 – 329, 585 - 599, 605, 1171 - 1173, 785 - 814, 865 - 867, 390 - 412,1303 - 1315, 1295, 825, 1372)
2. Modern Electronics Instrumentation and Measurement Techniques by Albert D.Herfrick.
3. Electrical and Electronics Measurements and Instrumentation by Umesh Sinha, Satya Prakashan, Tech India Publication, 1992.

1042234110	Measurement of Process Variables	L	T	P	C
Theory		3	0	0	3

Web-based/Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ch23/preview
2. https://nsi.gov.in/study-materials/DIIPA_Instrumentation&Measurment_of_Process_Variables_07042020.pdf

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
2.
3.
4.

II. 5.
6.
7.
8.

III. 9.
10.
11.
12.

IV. 13.
14.
15.
16.

V. 17.
18.
19.
20.

1042234230	Control Engineering	L	T	P	C
Practicum		2	0	2	3

Introduction:

Control Engineering ensures that there is a strategic method to improve the productivity and enhance the best practices to eliminate the manual control and reduce human error. Engineers and researchers can design and implement systems that achieve desired performance, stability and robustness. Control engineering is crucial in fields such as aerospace, automotive, robotics, manufacturing and many others where precise and reliable control is necessary.

Course Objectives:

The objective of this course is to enable the students to,

- Introduce system, control system and its types and to impart knowledge on using Laplace transform and inverse Laplace transform tool.
- Comprehend the concept of obtaining Transfer function using Block diagram reduction techniques and signal flow graph.
- Impart knowledge on Time domain analysis of First order and second order system
- Impart knowledge on frequency domain analysis and its specifications.
- Comprehend the concept of stability and stability analysis of transfer function

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Perform the Laplace and Inverse Laplace transform for the given function. Draw the Pole zero plot and Implement using MATLAB/SCILAB

CO2: Reduce the Block diagram representation into transfer function of single Block and Obtain transfer function from signal flow gram and Implement it using MATLAB/SCILAB

CO3: Acquire the time domain response of First order and second order system and simulate it using MATLAB/SCILAB

CO4: Sketch the polar plot and Bode plot for the given transfer function and simulate it using MATLAB/SCILAB

CO5: Analyze the stability of given transfer function using Routh-Hurwitz criterion and sketch Root locus plot and simulate it using MATLAB/SCILAB

Pre-requisites:

High School Physics and Mathematics, Electrical engineering Fundamentals

1042234230	Control Engineering	L	T	P	C
Practicum		2	0	2	3

CO/PO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	1	2	-	-	-
CO2	2	2	1	2	-	-	-
CO3	2	2	1	2	-	-	-
CO4	2	2	1	2	-	-	-
CO5	2	2	1	2	-	-	-

Legend: 3-HighCorrelation, 2-MediumCorrelation, 1-LowCorrelation

Instructional Strategy:

- Students must be given time to understand the basics of control system, then they must be allowed to start the practical session. Let them discover how to write the code using MATLAB, SCILAB or Octavecode.
- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- Help students to learn different types of control systems. Teachers should usePPT presentation of different control system and should show video of mathematical modeling of system. Also, should explain examples fromdaily life, realistic situations, and real-world engineering and technological applications where the control system engineering is used.
- Students may be shown different types of plots and how the parameters vary with time in time response and with frequency in frequency response. The demonstration can makethesubject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Demonstration method may be used to explain the time domain specifications with process control systems
- Teachers are advised to follow inductive specific strategy to help the students to discover the design and analysis of control systems.

1042234230	Control Engineering	L	T	P	C
Practicum		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test Theory (Any Two Units)	Written Test Theory (Another Two Units)	Practical Test (All Exercises)	Written Test (Complete Theory Portions)	Written Examination (Complete Theory Portions)
Duration	2	2	3	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Tentative Schedule	6th Week	12th Week	15th Week	16th Week	

Note:

CA1 and CA2: Assessment written test should be conducted for 50 Marks. The marks scored will be converted to 10 Marks for each test. Best of one will be considered for the internal assessment of 10 Marks.

CA1 and CA2, Assessment written test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks)

Eight questions will be asked, students should write Five questions.

Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA 3: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 15 Marks for the internal mark.

Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. Each exercise/experiment should be evaluated for 10 Marks. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

1042234230	Control Engineering	L	T	P	C
Practicum		2	0	2	3

The details of the documents should be prepared as per the instruction below.

Each exercise observation and calculations should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate notebook or printed manual or file. The reading and calculations and graph should be written by the student manually. The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Program	20
B	Procedure for Experimenting	10
C	Debugging & Execution	20
D	Observing Output	10
E	Record Note	30
F	Viva Voce	10
Total		100

CA4: Model examination should be conducted for complete theory portions as per the end semester question pattern. The marks awarded should be converted to 15 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each. Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042234230	Control Engineering	L	T	P	C
Practicum		2	0	2	3

Unit I	Introduction to Control Systems	
Introduction, definition control systems, Classification of systems-Linear and Non-linear Systems, Time-invariant and Time variant systems, Static and Dynamic systems, Open loop and closed loop. Laplace transform and Inverse Laplace transform – Problems - Transfer function-Transfer function of RLC network -Poles, zeros and Pole-Zero Plot.		6
Ex.No.1: Write and execute Matlab/Scilab/Octave code to find (a) Laplace transform of given function (b) Inverse Laplace transform of given function Ex.No.2: Write and execute Matlab/Scilab/Octave code to obtain (a) Pole, zero and gain values from a given transfer function (b) Transfer function from pole, zero and gain values (c) Pole zero plot from transfer function		6
Unit II	**Block diagram and signal flow graph**	
Introduction to block diagram- Rule for block diagram reduction - simple problems Signal flow graph, terminologies used in signal flow graph- conversion of block diagrams to signal flow graph, Mason's gain formula – simple problems		6
Ex.No.3:Write and execute Matlab/Scilab/Octave code to obtain Transfer function of the following system using block diagram reduction techniques (a) Blocks connected in series (b) Blocks connected in parallel Ex.No.4:Write and execute Matlab/Scilab/Octave code to obtain Transfer function of the signal flow graph using Mason's gain formula		6
Unit III	**Time domain analysis of control system**	
Standard test signals-Type and order of the system-First order, second order systems and their response (Un damped and Critically damped only). Time domain specifications of second order system- (formulas and problems). Static error constants (Kp, Kv, Ka,) and steady state error (e_{ss}) and simple problems.		6
Ex.No.5:Write and execute Matlab/Scilab/Octave code to obtain (a) Step response of first order system (b) Impulse response of first order system Ex.No.6:Write and execute Matlab/Scilab/Octave code to obtain step response of second order system for critically damped, under damped, over damped and undamped conditions		6

1042234230	Control Engineering	L	T	P	C
Practicum		2	0	2	3

Unit IV	Frequency Domain Analysis	
Frequency Domain Analysis-frequency response definition- Advantages of frequency response-Frequency domain specifications (Definitions only)-Polar Plot, Bode plot. Definition and determination of gain margin, Phase margin, Gain cross over frequency and Phase crossover frequency from the plots.		6
Ex.No.7:Write and execute Matlab/Scilab/Octave code to sketch polar plot of the given transfer function Ex.No.8:Write and execute Matlab/Scilab/Octave code to sketch Bode plot of the given transfer function		6
Unit V	**Stability Analysis**	
Concept of Stability in s domain- Classification of Stability (BIBO stability, asymptotic stability, absolute stability and relative stability), Location of roots on s plane for stability-stability analysis by Routh Hurwitz criterion, Root locus: Definition, construction of root locus(real roots only).		6
Ex.No.9: Write and execute Matlab/Scilab/Octave code to sketch root locus plot of the given open loop transfer function transfer function Ex.No.10: Write and execute Matlab/Scilab/Octave code to determine the stability of the system using Routh Hurwitz criterion		6
TOTAL HOURS		**60**

Suggested List of Students Activity (Ungraded)

- Check the web portal for Image and video of different types of control systems, Laplace and inverse Laplace transforms.
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce
- Students might be asked to use virtual labs (LabVIEW software) for the verification of time response plots.

1042234230	Control Engineering	L	T	P	C
Practicum		2	0	2	3

Text Books for Reference:

1. A. Nagoorkani, Control systems by RBA publishers, 2006
2. U. A. Bakshi, V. U. Bakshi, Control System Theory, Technical Publication
3. A. Anand Kumar, Control Systems, PHI Publications

Web Reference:

1. https://youtu.be/dH6WFiKddJU
2. https://youtu.be/4_uTzc0CqE8?list=PLuwKjRfi2s1Vs1RmewlD2sWPbHEGS5fP6
3. https://youtu.be/2Ij1p64fcCU
4. https://youtu.be/EFMQM1KIRq8
5. https://youtu.be/Gi_tP3lF04M

Equipment required (for 30 students)

S. No	Name of the Equipment / Software	Required Quantity
1	Desktop Computer / Laptop Computer	30
2	Laser Printer - A4 size	1
3	5 KVA UPS with at least 1 hour backup	1
4	MATLAB/SCILAB/Octave	--

1042234230	Control Engineering	L	T	P	C
Practicum		2	0	2	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
2.
3.
4.

II. 5.
6.
7.
8.

III. 9.
10.
11.
12.

IV. 13.
14.
15.
16.

V. 17.
18.
19.
20.

1042234320	Measurement of Process variables Practical	L	T	P	C
Practical		0	0	4	2

Introduction:

Instrumentation and Control Engineers plays a major role in process industries. The students of Instrumentation and Control Engineering branch need practical knowledge to measure various parameters such as Temperature, pressure, Flow, etc. This subject gives practical exposure to the students about measurement of process variables of instrumentation industries.

Course Objectives:

The objective of this course is to enable the student to

- Measure Temperature using any type of thermometer and Temperature Transmitter
- Measure pressure using U tube manometer and Transducers
- Measure Differential Pressure using DPT
- Measure Flow rate of Fluid flow using flow transducer
- Measure Level of a liquid in a tank using Level Transmitter

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Measure temperature using Liquid in glass and Bi metallic thermometer and Temperature Transmitter

CO2: Measure pressure using U tube manometer and Bourdon tube-LVDT setup

CO3: Measure Flow rate and Differential pressure using DPT

CO4: Measure Flow rate of Fluid flow using Electromagnetic flow meter

CO5: Measure Level of a Liquid in a tank using Level transmitter

Prerequisite:

Sensors and Transducers Theory and Practical subject

1042234320	Measurement of Process variables Practical	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	-	-	-
CO2	3	2	1	1	-	-	-
CO3	2	3	3	2	-	-	-
CO4	2	3	2	2	-	-	-
CO5	2	3	2	2	-	-	-

Legend: 3-HighCorrelation, 2-MediumCorrelation, 1-LowCorrelation

1042234320	Measurement of Process variables Practical	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	15
B	Experimenting with Procedure	15
C	Observing Reading / Calculations / Graph	15
D	Result	5
TOTAL		50

1042234320	Measurement of Process variables Practical	L	T	P	C
Practical		0	0	4	2

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice.

The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	20
B	Experimenting with Procedure	30
C	Readings Observed	20
D	Calculations / Graph	10
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042234320	Measurement of Process variables Practical	L	T	P	C
Practical		0	0	4	2

Ex.No	Name of the Experiment	Hours
1	Conduct Experiment to measure Temperature using (i) Liquid in Glass Thermometer (ii) Bimetallic Thermometer	6
2	Conduct Experiment to measure Temperature using Temperature Transmitter and obtain the characteristics of it	6
3	Conduct Experiment to measure the low pressure using U tube manometer	6
4	Conduct Experiment to measure pressure using Bourdon tube and LVDT setup	6
5	Conduct Experiment to calibrate the pressure gauge using Dead weight tester	6
6	Conduct experiment to obtain the characteristics of Differential Pressure Transmitter (DPT)	6
7	Conduct Experiment to measure the flow rate using Electromagnetic flow meter.	6
8	Conduct Experiment to measure Level using sight glass method and using float method	6
9	Conduct Experiment to measure level using Level Transmitter	6
10	Experimentally measure the viscosity using say bolt viscometer	6
TOTAL HOUR		**60**

1042234320	Measurement of Process variables Practical	L	T	P	C
Practical		0	0	4	2

Equipment Required:

Sl. No	Item Description	Range	Qty. Required
1	Mercury in glass thermometer	-	4
2	Bimetallic Thermometer	-	2
3	Temperature Transmitter experimental setup	-	2
4	U tube Manometer experimental setup	-	2
5	Bourdon tube-LVDT Experimental Setup to measure pressure	-	2
6	Dead weight Tester	-	1
7	Differential Pressure Transmitter experimental setup	-	1
8	Electromagnetic flow meter experimental setup to measure flow	-	1
9	Level Measurement trainer	-	1
10	Say bolt viscometer	-	1

1042234440	Virtual Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Introduction:

Virtual instrumentation refers to the use of software-based tools and algorithms to emulate traditional hardware instruments, such as oscilloscopes, signal generators, and data loggers, typically for measurement and control applications**.** Traditional hardware instruments can be expensive, especially when multiple instruments are needed for various measurements. Virtual instrumentation allows students to access a wide range of instruments and functionalities without the need for physical hardware, significantly reducing costs for educational institutions. Incorporating practical exercises based on virtual instrumentation can enhance students' understanding of fundamental principles, promote hands-on learning experiences, and prepare them for careers in fields where measurement and control are essential components.

Course Objectives:

The objective of this course is to enable the student to

- Create Virtual Instrument for measuring purpose
- Create virtual Instrument with User friendly interface in the front panel
- Create Block diagram based program to define the function of instrument
- Create Block diagram using graphical programming tool
- Create Virtual Instrument to measure, Indicate , control applications

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Design and create virtual instrument for Temperature unit converter

CO2: Design and create virtual instrument for solving algebraic equation

CO3: Design and create virtual instrument calculator

CO4: Design and create virtual instrument CRO, DSO

CO5: Design and create virtual instrument for Tank Level control

Prerequisite:

Sensors and Transducers Theory and Practical subject

1042234440	Virtual Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	-	-	-
CO2	3	3	3	2	-	-	-
CO3	2	3	3	2	-	-	-
CO4	2	3	3	2	-	-	-
CO5	2	3	3	2	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

1042234440	Virtual Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Drawing Front Panel & Block Diagram in Paper	15
B	Constructing Front Panel & Block Diagram in Simulator with Procedure	25
C	Execution	5
D	Result	5
TOTAL		50

1042234440	Virtual Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice.

The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Drawing Front Panel & Block Diagram in Paper	20
B	Constructing Front Panel & Block Diagram in Simulator	30
C	Execution	10
D	Result	20
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042234440	Virtual Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Ex.No.	Name of the Experiment	Hrs.
1	Create a VI that takes temperature in degree Centigrade as input and displays the temperature both in degree Centigrade and degree Fahrenheit. Use temperature indicator for display.	5
2	Create a VI to evaluate the equation y = 4a + 3b + 5c using arithmetic block or formula node.	5
3	Create a VI to compute and display the roots of a quadratic equation: ax2 + bx + c by taking the values of a, b and c as inputs.	5
4	Create a VI to simulate a simple calculator which performs addition, subtraction, multiplication and division using case structure.	5
5	Design a VI to display whether the given integer is odd or even.	5
6	Design a VI that takes two integers as input and displays its remainder and quotient.	5
7	Device virtual function generator and CRO with front panel and block diagram for generation of signals using function generator and measurement of frequency and amplitude using CRO.	5
8	Design virtual CRO capable of addition of two waveforms with front panel and block diagram.	5
9	Design front panel and block diagram to simulate logic gate functions: AND, OR, NOT, NAND, NOR, EX-OR and EX-NOR.	5
10	Design front panel and block diagram to simulate temperature control system	5
11	Design front panel and block diagram to simulate tank control system.	5
12	Design a VI to simulate half adder.	5
TOTAL HOURS		**60**

1042234440	Virtual Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Equipment Required:

Sl.No	Item Description	Range	Quantity Required
1.	Desktop / Laptop Computer	-	30
2.	LABVIEW software	-	2
3.	LASER Printer	-	1
4	UPS 5 KVA with One Hour Backup	-	1

1042234540	Analog and Digital Electronics	L	T	P	C
Practicum		1	0	4	3

Introduction:

In Industrial Environment, analog sensors gather data, which can then be converted into digital signals for processing and analysis by digital system. Hence Instrumentation Engineer needs to have the proficiency in both analog signal conditioning circuits as well as Digital processing circuits and in addition conversion of Analog domain to Digital domain vice versa. It is mandatory for Instrumentation engineer to get practice with constructing and testing and analysis of fundamental Analog and Digital circuits.

Course Objectives:

The objective of this course is to enable the student to

- Design and test various signal processing circuits using operational amplifiers
- Design and test the voltage regulator circuit using IC's
- Design and test the Combinational Logic circuit using Basic and Universal GATES
- Design and test the Flip-flops to learn their characteristics
- Design and test Analog to Digital and Digital to analog conversion Circuits

Course Outcomes:

On successful completion of this course, the student will be able to

CO1: Construct and Test circuit using operational amplifier IC741 in Inverting, Non Inverting and Differential mode.

CO2: Construct and test Regulator circuit using IC78xx and IC79xx

CO3: Test Gate IC's and constructs combinational logic circuits using GATE IC's

CO4: Test Flip-flop IC's and constructs sequential logic circuits using GATE IC's and Flip-flop IC's

CO5: Construct and Test D/A converter and A/D converter circuits

Pre-requisite:

Digital Electronic circuits – Number systems

1042234540	Analog and Digital Electronics	L	T	P	C
Practicum		1	0	4	3

CO/PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	-	-	-
CO2	3	3	3	3	-	-	-
CO3	3	3	3	3	-	-	-
CO4	3	3	3	3	-	-	-
CO5	3	3	3	3	-	-	-

Legend: 3-HighCorrelation, 2-MediumCorrelation, 1-LowCorrelation

Instructional Strategy:

- It is advised that teachers revise the prerequisite knowledge through PPT presentation
- It is recommended to ask the students to design their own circuit for the given problem statement, discussing with their batch mates and Teacher may analyze it for correctness.
- Students may be asked to simulate the circuit designed by them using simulation software
- Teacher can recommend relevant YouTube videos to students to master the content of the subject
- Teacher can demonstrate the circuit using virtual lab portal of IIT Bombay

1042234540	Analog and Digital Electronics	L	T	P	C
Practicum		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II Exercises	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments should be completed as per the portions above and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise/experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of next exercise. The detailed date of practices and its evaluations should be maintained in the logbook and should be submitted for verification.

1042234540	Analog and Digital Electronics	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Drawing Circuit Diagram in Paper	10
B	Circuit Construction in Bread Board	15
C	Experimenting with Procedure	15
D	Readings / Result Observed	10
TOTAL		50
E	Record Note	10
		60

CA 3: Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions	7 x 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

1042234540	Analog and Digital Electronics	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	Drawing Circuit Diagram in Paper	20
B	Circuit Construction in Bread Board	20
C	Experimenting with Procedure	20
D	Readings / Result Observed	20
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042234540	Analog and Digital Electronics	L	T	P	C
Practicum		1	0	4	3

Unit I	Analog IC 741 Operational amplifier based circuits	
Operational Amplifier – Symbol- working- characteristics–Specifications - Circuit Diagram – Gain Derivation – Design of Inverting amplifier- Non Inverting amplifier – Integrator - Differentiator		3
Ex.No.1:	Construct the inverting amplifier with gain 10 and Non inverting amplifier with gain 11 and observe output voltages for the given positive and negative DC input voltages, and Draw the Voltage transfer characteristic curve.	12
Ex.No.2:	Construct the practical Integrator and Differentiator circuit using operational amplifier with DC gain and corner frequency. Observe the input and output waveforms and frequency response.	
Unit II	**Analog IC 7812 / 7912 and 555 Timer based circuits**	
Pin Details - specifications of IC78xx, IC79xx – Regulator circuit using IC7812 and IC7912 - Pin Details of 555 Timer IC – Operation of internal circuit diagram – Monostable multivibrator circuit - Astable multivibrator circuit		3
Ex.No.3:	Construct and test the IC voltage regulator circuit using IC7812 and IC7912.	12
Ex.No.4:	(i) Construct the circuit configuring 555 timer in mono stable mode and test the output using LED. Observe the LED is glowing for the set time. (ii) Construct and test the circuit configuring 555 timer in astable mode and test the circuit output using CRO. Observe the output pulse waveform for the set ON time and OFF time.	
Unit III	**Digital Logic Gate IC's based circuits**	
Symbol, Truth Table and Boolean expression of OR, AND, NOT,NOR, NAND, EX-OR,EX-NOR Logic - Design of Half adder- Half subtractor –Full Adder – Full subtractor		3
Ex.No.5:	Experimentally verify the Truth table of OR, AND, NOT, NOR ,NAND and XOR gate using IC 7432,7408,7404,7402 ,7400 and 7486	12
Ex.No.6:	Design, Construct and test Half adder, half subtractor using Gate IC 7486,7408,7404	

1042234540	Analog and Digital Electronics	L	T	P	C
Practicum		1	0	4	3

Unit IV	Digital Flip-flop IC based circuits	
SR Flip_ Flop –JK Flip-flop- JKMS Flip-flop – D Flip-flop - T Flip-flop – Counter: 4 bit ripple counter up counter- 4 bit ripple down counter		3
Ex.No.7: Experimentally verify the truth table of D, T, JKMS Flip-Flop Ex.No.8: Construct 4 bit ripple up counter using T Flip Flops and observe the counting sequence Using LED's		12
Unit V	**ADC and DAC circuits**	
Digital to analog conversion - Binary weighted resistor method - R-2R Ladder Method- DAC specifications – ADC IC 0808 pin details - successive approximation type ADC - Integration type ADC		3
Ex.No.9: Construct and verify R-2R ladder Digital to Analog converter using operational amplifier. Ex.No.10: Construct and verify A/D convertor using ADC 0808 IC.		12
TOTAL HOURS		**75**

Suggested List of Students Activity (Ungraded):

- Students can practice to design their own circuit using the algorithmic procedure
- Students can practice to work on the circuit virtual lab portal of IIT Bombay
- Students can simulate the circuit and see the output using simulation software

Text Book for Reference:

1. Linear Integrated circuits by D.Roy Choudhury
2. Digital Electronics by Godse, 3rd Edition.
3. Digital Principles and Applications by Albert Paul Malvino and Donald P. Leach, TMH.

Web-based/Online Resources:

1. https://www.vlab.co.in/participating-institute-iit-bombay
2. http://vlabs.iitkgp.ac.in/vlt/
3. https://www.tutorialspoint.com/digital_circuits/index.html

1042234540	Analog and Digital Electronics	L	T	P	C
Practicum		1	0	4	3

Equipment Required:

Sl.No.	Name of the Equipment	Qty. Required
1	Analog trainer kit with Bread board and Dual power supply (OR) Bread Board, Regulated Dual power supply (0-30V)	10
2	IC 741 operational amplifier	20
3	Function generator	3
4	CRO	2
5	Capacitors of required capacitance values	20 each
6	Resistors of required values	20 each
7	IC7812, IC 7912	20 each
8	555 Timer IC	20
9	Digital Multimeter	10
10	IC 7432, 7408, 7404, 7402, 7400, 7486	20 Each
11	IC7474, IC7476	20 Each
12	ADC 0808 IC	10
13	Connecting wires	As per requirement

1042234640	8051 Microcontroller	L	T	P	C
Practicum		1	0	4	3

Introduction

Controlling all the machineries are realized through Electronics. Without Electronics controlling the machines, devices, systems are not possible. Microcontroller is the most reliable, cost effective and flexible for all control activities. It plays major role in Machines, domestic gadgets, automobile etc. Here is an attempt to introduce the familiar Intel 8051 microcontroller with some programming examples. As microcontroller is like the brain of any Digital control system, it is obvious that control engineer must have practical knowledge about it. This subject gives opportunity to learn hardware, programming and interfacing of real system with microcontroller. This is the basis for embedded system.

Course Objectives:

The objective of this course is to enable the student to

- Learn the 8051 Microcontroller Hardware
- Write the Assembly Language program , compile and run through KEIL IDE
- Interface the various input and output devices with 8051 microcontroller
- Develop application program with 8051 microcontroller
- Develop program and embedding into 8051 on chip memory and test

Course Outcomes:

On successful completion of this course, the student will be able to

CO1: Test Assembly language program to perform arithmetic operations in 8051 through KEIL IDE

CO2: Test ALP to perform I/O operations through 8051 internal parallel port and To test the ALP program written to configure the internal Timer and Counter

CO3: Test ALP program written to configure the Interrupt facility of 8051 and to interface ADC and DAC circuits with 8051 microcontroller through internal ports.

CO4: Test ALP program to interface multiplexed multi digit 7-segment display with 8051 and to interface 16 X 2 LCD with 8051 microcontroller

CO5: Test ALP program to interface stepper Motor and DC Motor with 8051 Microcontroller.

Pre-requisite:

Digital Electronic circuits - Programming Knowledge – Number systems

1042234640	8051 Microcontroller	L	T	P	C
Practicum		1	0	4	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	3		
CO2	3	3	3	3	3		
CO3	3	3	3	3	3		
CO4	3	3	3	3	3		
CO5	3	3	3	3	3		

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- It is advised that teachers revise the prerequisite knowledge through PPT presentation
- It is recommended to ask the students to write their own program for the given problem statement, discussing with their batch mates and Teacher may analyze it for correctness, and help to develop their programming skill.
- Students may be asked to edit , compile and Debug the program in KEIL IDE and test it with Hardware
- Teacher can recommend relevant YouTube videos to students to master the procedure to work with KEIL IDE
- Teacher have to demonstrate the step by step procedure on working with KEIL IDE and embedding the program into the 8051 development board

1042234640	8051 Microcontroller	L	T	P	C
Practicum		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II Exercises	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments should be completed as per the portions above and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise/experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of next exercise. The detailed date of practices and its evaluations should be maintained in the logbook and should be submitted for verification.

1042234640	8051 Microcontroller	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Algorithm / Interfacing Diagram	10
B	Program	15
C	Editing / Execution with Procedure	15
D	Result Observed	10
TOTAL		50
E	Record Note	10
		60

CA 3: Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions	30 x 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions	7 x 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

1042234640	8051 Microcontroller	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	Algorithm / Interfacing Diagram	20
B	Program	20
C	Editing / Execution with procedure	20
D	Result observed	20
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042234640	8051 Microcontroller	L	T	P	C
Practicum		1	0	4	3

Unit I	Architecture and Instruction set	
8051 Microcontroller features- Pin details - Block diagram – Architectural Diagram - Instruction set - Assembly language program to perform arithmetic operation with 8 bit data – Addition – Subtraction – Multiplication - Division		3
Ex.No.1 (i) Write Assembly Language program in to Add two 8 bit data stored at two consecutive Internal memory locations and store the result in the next immediate internal memory location. Test the result in KEIL IDE Memory table. (ii) Write Assembly language program to subtract two 8 bit data stored at Two consecutive Internal memory locations and store the result in the next immediate internal memory location. Test the result in KEIL IDE memory table. Ex.No.2 (i) Write Assembly Language program in to Multiply two 8 bit data stored at two consecutive Internal memory locations and store the result in the next immediate internal memory locations. Test the result in KEIL IDE Memory table. (ii) Write Assembly language program to divide two 8 bit data stored at Two consecutive Internal memory locations and store the result in the next immediate internal memory locations. Test the result in KEIL IDE memory table.		6 6
Unit II	**I/O programming and Timer**	
I/O ports and their functions - Port 0 , Port 1, Port 2, Port 3 - Programming - Timers – Mode 0 , Mode 1, and Mode 2 Programming - Counters – Mode 0 , Mode 1, and Mode 2 Programming.		3
Ex.No.3 Write Assemble language program to perform the following through KEIL IDE (i) when a Toggle switch connected to Input port is ON, 8 LEDs connected to output port glows (ON) and when the toggle is switch is OFF, 8 LEDs are OFF. (ii) When Reed switch or LDR connected to input pin activated, Buzzer connected to output pin will be activated. Ex.No.4 (i)Write assembly language program to switch on a LED connected to Output Pin After 1 sec delay (Timer 0- Mode 1) through KEIL IDE (ii)Write and assembly language program through KEIL IDE to count the external event (through toggle switch) and display the count value in the LED's which are connected to output port.		6 6

1042234640	8051 Microcontroller	L	T	P	C
Practicum		1	0	4	3

Unit III	Interrupt programming and ADC/DAC interfacing	
8051 Interrupts- Programming External Hardware Interrupts - ADC and DAC interfacing programs.		3
Ex.No.5	Write assembly Language program through KEIL IDE to blink LED which is connected to P1.0 when the External interrupt INT0 (P3.2) is activated.	6
Ex.No.6	Write the assembly language program through KEIL IDE to interface 8 bit ADC and DAC and test it.	6
Unit IV	**LED and LCD Display interfacing with 8051 through ports**	
7-segment LED Display - Multiplexed Multi digit 7-segment LED interface with 8051 16 X 2 LCD Display interface with 8051- programs		3
Ex.No.7	Write an assembly language program through KEIL IDE to interface Multiplexed multi digit 7-segment displays with 8051 through internal parallel ports to display the word ”ICE”	6
Ex.No.8	Write an assembly language program through KEIL IDE to interface 16 X 2 LCD displays with 8051 to display the word ”Temperature”	6
Unit V	**Actuator control**	
Stepper Motor interface with 8051- Assembly language Program - DC Motor driver interfacing with 8051 microcontroller - H-bridge circuit working - Assembly language program.		3
Ex.No.9	Write an assembly program in KEIL to interface stepper Motor with 8051 through its internal port and to run clockwise direction to 90 degrees and to run Anticlockwise direction to 90 degrees. Choose the stepper motor with step angle 1.8 degree.	6
Ex.No.10	Write an assembly language program through KEIL IDE, to interface a DC motor through H-bridge and required driver circuit , to run the motor in forward and in the reverse direction	6
TOTAL HOURS		**75**

1042234640	8051 Microcontroller	L	T	P	C
Practicum		1	0	4	3

Suggested List of Student Activity (Ungraded):

- Students can practice to write their own Assembly language program for the different problem statements taken from internet and test the program using online editor
- Students can visit virtual lab hosted by IIT Bombay and practice the instruction set to understand
- Students can try any 8051 offline simulators downloaded from the internet and install in your own system and try to practice more programs
- Students can try a mini project using assembly language programming skill with necessary tools and hardware

Text Books for Reference:

1. Muhammad Ali Mazidi Janice Gillispie Mazidi Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C Second Edition
2. A. P Godse, Dr. D. A. Godse, Microcontroller 8051, Technical Publication
3. I. Scott Mackenzie, Raphael, C. W. Phan, The 8051 Microcontroller, Pearson

Web-based Online Resources:

- http://www.vlsiip.com/keil/
- https://www.youtube.com/watch?v=i2lqxC8YG1U&list=PLlJpeJ0GkQ5eU8ySELiG42N3QrOtWKdAT - KEIL software tutorial in TAMIL

Equipment Required:

Sl.No.	Item Description	Quantity Required
1	KEIL Development Board with USB /RS232 cable to connect with computer	As Required
2	KEIL µvision5 IDE software	-
3	Digital I/O interface Board with LDR, Buzzer, Toggle switches and 8 LED's	2
4	8 bit ADC interface Board	2
5	8 bit DAC interface Board	2
6	7-Segment multiplexed Multi digit Display Interface Board	2
7	16 X 2 LCD interface Board	2
8	Stepper motor Interface Board	2
9	DC Motor interface Board with H-Bridge circuit	2

1042235110	Process Control Instrumentation	L	T	P	C
Theory		5	0	0	5

Introduction

In industries, there is a huge demand of qualified engineers in the areas of Process Control Instrumentation. The basic concepts and the detailed study of Process Control are covered in this subject. The importance is given to make the students to understand about the elements of Closed Loop Control System in detail. The students of Instrumentation and Control engineering branch are having wide career options in process industries. This subject provide a general idea to the students to select anyone of the career options like Project engineers, Maintenance engineers, Erection and Commissioning engineers, Automation engineers, Design engineers etc.

Course Objectives

The objective of this course is to enable the students to

- Acquire knowledge on single loop process control system and its components
- Comprehend the concept of various controller principles and its implementation
- Acquire knowledge on different controller tuning methods
- Comprehend the various Final Control Elements being used to adjust the process parameter in the industry
- Acquire knowledge on Complex control systems such as Feed forward, Ratio control etc.,

Course Outcomes:

After successful completion of this course, the student will be able to

CO1: Explain the various components of process control loop and to achieve set point with example control system

CO2: Explain the different control principles being used in the industry and its implementation through Electronic and Pneumatic systems.

CO3: Find the optimum process parameter values and adjust the process control loop to achieve the set point using different tuning methods

CO4: Implement the various Final control elements to adjust the process parameters

CO5: Comprehend the concept of Complex Control methods such as Feed forward, Ratio control, Cascade control and its implementation in Heat exchanger

Pre-requisites

Basic knowledge of Electrical, Electronics and Instrumentation

1042235110	Process Control Instrumentation	L	T	P	C
Theory		5	0	0	5

CO/PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	-	-	-	-
CO2	3	2	3	-	-	-	-
CO3	3	3	3	2	-	-	-
CO4	3	3	3	2	-	-	-
CO5	3	3	3	2	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

Instructional Strategy:

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different types of process, controllers and final control elements. Teachers should use PPT presentation to show video of application of the various types of process, controllers and final control elements Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- Students may be shown all the available controllers in the lab. The demonstration can make the subject exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to show the working of different types of final control element.
- Teachers are advised to follow inductive strategy to help the students to know the working principle of complex control system
- Students may be given Process control simulation software and instructed to simulate the single process control loop for small applications

1042235110	Process Control Instrumentation	L	T	P	C
Theory		5	0	0	5

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each. Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042235110	Process Control Instrumentation	L	T	P	C
Theory		5	0	0	5

Unit I	SIMPLE PROCESSCONTROL SYSTEMS ANDTERMINOLOGY	
Process - Continuous and Batch process - process variables Functional block diagram of an automatic process control system - set point - measured value – error - liquid level control system – flow control system – temperature control system with transportation lag - self regulation - Introduction to Piping and Instrumentation diagram - symbols for equipment, piping, instrumentation and control, P&ID diagram for simple Liquid level control system		17

Unit II	CONTROL PRINCIPLES	
Controller - reverse and direct action, controller modes - discontinuous - ON-OFF Control with differential gap, without differential gap - continuous - proportional controller - proportional band(PB) - effect of PB on a controller output – offset - integral control - Derivative control - PI - PD - PID definition, salient features, applications and limitations of above controllers - selection of control action - electronic controllers - error detector - two position controller - P,I,D, PI, PD, PID controllers - pneumatic controllers for PID action - flapper nozzle mechanism, pneumatic relay.		17

Unit III	TUNING OF CONTROLLERS	
Concept of tuning - criteria for controller tuning – quarter Decay ratio - IAE - ISE - ITAE - methods of tuning - open loop response method - process reaction curve - closed loop response method - ultimate cycle method - damped oscillation method.		11

Unit IV	FINAL CONTROL ELEMENTS	
Signal converters - P to I converter, I to P converter - actuator - electrical - pneumatic - hydraulic - control valve - characteristics - quick opening - linear - equal percentage - pneumatic valve - solenoid valve - split range control valve - single seat and double seat plug - electric motor actuated control valve - control valve sizing - CV rating - selection of a control valve - effect of cavitations and flashing on control valve performance		15

1042235110	Process Control Instrumentation	L	T	P	C
Theory		5	0	0	5

Unit V	COMPLEXCONTROL SYSTEMS	
Feed forward control system - Feed forward control of heat exchanger - Comparison of feedback control system and feed forward control system. Ratio control - examples - Cascade control - cascade control of heat exchanger - cascade control of distillation column - Direct digital control (DDC) of single loop - Direct digital control with multiple control loops.		15
TOTAL HOURS		**75**

Suggested List of Students Activity (Ungraded)

- Check the web portal to study different types of controllers and final control elements.
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce the different types of controllers and their working principles.
- Students might be asked to see the demonstration video of various process control systems

Text Books for Reference:

1. Curtis D. Johnson, Process control instrumentation technology, 8th edition, Pearson education
2. Shuchen B Thakore & Bharat I Bhatt, Introduction to Process Engineering and Design, 2nd edition, McGraw-Hill Education, 2007.
3. R.P. Vyas, Process Control and Instrumentation, 8th edition, Denett & Co., 2015.

Reference Websites

- ocw.mit.edu/courses/10-450-process-dynamics-operations-and-control-spring-2006/pages/lecture-notes/
- www.control.lth.se/fileadmin/control/Education/EngineeringProgram/FRTF10/2019/book2016.pdf
- msubbu.in/ln/ctrl/index.html

VIDEO LECTURES

- nptel.ac.in/courses/103105064
- acl.digimat.in/nptel/courses/video/103101. 142/L01.html
- www.youtube.com/watch?v=1rO9nJriVR0

1042235110	Process Control Instrumentation	L	T	P	C
Theory		5	0	0	5

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042235311	Industrial Instrumentation	L	T	P	C
Theory		4	0	0	4

Introduction:

Industrial Instrumentation covers the topics of measurement of variables related to Mechanical instrumentation and Analytical instrumentation. It gives detailed information to the students about the measurement of variables related to velocity, acceleration, force, torque, shaft power, pH and gas analysis. It also provides an idea about Chromatographs, detectors and spectral analysis. This subject provides an exposure to the environmental pollution monitoring and control.

Course Objectives:

The objective of this course is to enable the student to

- Impart knowledge about the various types of comparators.
- Comprehend the different methods of measurement of linear, angular velocity and accelerometer.
- Acquire Knowledge on the different methods of force, torque and shaft power measurement.
- Learn the concept of pH and its measuring electrode.
- Acquire knowledge about the various gas analyser and chromatography

Course Outcomes

After successful completion of this course, the student will be able to

CO1: Illustrate the construction and working principle of various types of comparators.

CO2: Interpreting velocity and acceleration measuring instruments.

CO3: Interpreting the Force, Torque and Shaft power measuring instruments.

CO4: Understand the PH and gas analysis measuring instruments.

CO5: Analyze chromatography and spectrophotometer.

.

Pre-requisites:

Basics of Electronics and Instrumentation

1042235311	Industrial Instrumentation	L	T	P	C
Theory		4	0	0	4

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	2	-	-	-
CO2	2	-	-	3	-	-	-
CO3	2	-	-	3	-	-	-
CO4	3	2	-	3	2	-	-
CO5	3	2	-	2	1	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

1. It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
2. To help students to learn different types of comparator, accelerometer, dynamometer, PH meter and chromatography. Teachers should use PPT presentation of image and symbol of components and to show video of application of the components. Also should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
3. Students may be shown all the comparator, accelerometers and PH meter in the lab. The demonstration can make the subject exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
4. Demonstration method may be used with step by step procedure to test the various components using meters.
5. Teachers are advised to follow inductive strategy to help the students to discover the working principle of various comparators, force, torque and shaft measurement.
6. Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any?

1042235311	Industrial Instrumentation	L	T	P	C
Theory		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042235311	Industrial Instrumentation	L	T	P	C
Theory		4	0	0	4

Unit I	COMPARATORS	
Introduction – Types- Mechanical Comparators -Dial Gauge - Optical comparators - Zeiss ultra optimeter - Electrical Comparator - Electronic comparator - Pneumatic Comparators - Solex Pneumatic Comparator - construction - Principle of operation, , Advantages and Disadvantages		12
Unit II	**MEASUREMENT OF VELOCITY & ACCELERATION**	
Linear Velocity Measurement - Doppler effect method - Linear encoder - Angular velocity measurement – Drug cup rotor A.C tachogenerator Accelerometer - Seismic Accelerometer – Piezoelectric Accelerometer- strain gauge accelerometer – LVDT Accelerometer - Principle of operation - construction - Advantages - Disadvantages		12
Unit III	**MEASUREMENT OF FORCE, TORQUE AND SHAFT POWER**	
Force Measurement: Definition- Principle of operation - construction - Pendulum scale –Load cell - Hydraulic load cell – Pneumatic load cell – Strain gauge load cell. **Torque Measurement:** Definition - Principle of operation - construction - Optical torsion meter – Electrical torsion meter – Strain gauge torsion meter. **Shaft Power Measurement:** Definition- Principle of operation - construction - Prony brake Dynamometer – Rope Brake Dynamometer.		12
Unit IV	**MEASUREMENT OF pH & GAS ANALYSIS**	
Measurement of pH: Definition - Electrodes - Principle of operation - construction - Hydrogen electrode - Calomel electrode - Glass electrode. **Gas Analyzer:** Principle of operation - construction – Oxygen analyzer –Paramagnetic oxygen analyzer – CO analyzer – SO_2 analyzer.		

1042235311	Industrial Instrumentation	L	T	P	C
Theory		4	0	0	4

Unit V	CHROMATOGRAPHY AND SPECTRAL METHOD OF ANALYSIS
Chromatography: Definition - Classification - Principle of operation -Construction – Gas Chromatography – Liquid chromatography – Retention time - Dead time - Chromatogram - Significance - Advantages **Detectors:** Principle of operation - Construction - TCD - FPD- ECD. **Spectral Analysis:** - Beer's law - IR/UV radiation sources - IR/UV Spectro photometry - working -applications	**12**
TOTAL HOURS	**60**

Text Books for Reference:

1. A.K.Sawhney and Puneet Sawhney, "Mechanical measurements and Instrumentation & Control", Dhanpat Rai & Co (P) ltdR.K.Rajpat "Mechanical measurements and Instrumentation" S.K.Kataria & sons, NewDelhi-3.
2. Gurdeep R Chatwal and Sham K. Anand "Instrumentation methods and chemical Analysis"- Himalaya Publishing House.

Web-based/Online Resources:

1. https://www.visionxinc.com/what-is-an-optical-comparator
2. https://infinitalab.com/metrology-testing-service/what-is-zeiss-ultra-optimeter/
3. https://circuitglobe.com/electrical-tachometer.html

1042235311	Industrial Instrumentation	L	T	P	C
Theory		4	0	0	4

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042235312	Fiber Optics and Laser Instrumentation	L	T	P	C
Theory		4	0	0	4

Introduction

Fibre optics and Laser Instrumentation is an emerging field which enables the students to know about the significance of Fibre optics and Laser in measurement, instrumentation and industrial applications. This course is intended to develop the basic understanding of Fibre optic sensors used in the measurement of displacement, temperature, pressure, flow, level etc. as well as the competency to use, install and test various Laser Instruments used for measurement in Industrial and medical applications.

Fibre optic sensors are used in measurements in industries in day today life and Laser Instruments are used in measurements as well as surgical purposes in medical applications. The student will become familiar with the properties, characteristics of Fibre optics and Laser and its applications in Instrumentation industries and biomedical applications.

Course Objectives:

The objective of this course is to enable the students to

- Acquire knowledge on the theory behind light propagation in optical fibers, types of optical fibers, dispersion characteristics and sources and detectors in optical fibers.
- Gain knowledge in the recent advances in fiber optic sensor technology.
- Gain knowledge on the principles of laser generation, laser systems and its types.
- Acquire Knowledge on how Laser Beam is used for industrial applications.
- Gain knowledge on the fundamentals of holography and medical applications of lasers.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the principle, transmission, dispersion and attenuation characteristics of optical fibers.

CO2: Explain the optical fibers for its use as sensor for measurements as well as its use in Instrumentation and industrial applications.

CO3: Explain the Laser fundamentals, theory, modes and laser generation system.

CO4: Explain the principle of measurement of distance, length, acceleration, velocity using Laser and Industrial application of Laser Instruments

CO5: Explain the components, principle of Holography in surgical and Medical application of Laser instruments.

Pre-requisites:

Basic knowledge of Electrical, Electronics and Instrumentation

1042235312	Fiber Optics and Laser Instrumentation	L	T	P	C
Theory		4	0	0	4

CO/PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	-	-	-
CO2	3	3	3	3	-	-	-
CO3	3	-	-	-	-	-	-
CO4	3	-	3	2	-	-	-
CO5	3	-	3	3	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

Instructional Strategy:

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn fundamentals of Fibre Optics and Lasers. Teachers should use PPT presentation to show video of Industrial application and medical applications of Fibre Optics and Laser. Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to show the measurement methods using Fibre optics and Laser.
- Teachers are advised to follow inductive strategy to help the students to know the Industrial applications of Fibre optics and Laser.
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any

1042235312	Fiber Optics and Laser Instrumentation	L	T	P	C
Theory		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042235312	Fiber Optics and Laser Instrumentation	L	T	P	C
Theory		4	0	0	4

Unit I	OPTICAL FIBRE AND THEIR PROPERTIES	
	Principles of light propagation through a fibre -Total internal reflection- Acceptance angle - Numerical aperture - Skew mode **Types of fibres and their properties**: Single Mode - Multimode fibers - Step index - Graded index fibers - Fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors - splicers – Fibre termination **Optical sources and Detectors**: Light Emitting Diode- LASER– PIN Diode - Photo Diode	12
Unit II	**MEASUREMENT USING OPTICAL FIBRES**	
	Fibre optic sensors: Types - Intrinsic sensor – Extrinsic sensor- Temperature sensor - Pressure sensor - Phase Modulated Fibre Optic Sensor - Displacement sensor **Fibre optic instrumentation system**: Measurement of attenuation - cut back method- Optical domain reflectometers - Fiber Scattering loss Measurement - Fiber Absorption Measurement - Fiber dispersion measurement - End reflection method - Near field scanning techniques **Interferometric method of measurement**: Length – pressure – temperature – current – voltage - Liquid level and strain.	12
Unit III	**LASER FUNDAMENTALS**	
	LASER Fundamentals: Characteristics – Two-Level Laser - Three Level Laser- four level laser **Properties of LASER:** Monochromaticity – Coherence - Divergence - Directionality - Brightness – Laser modes – Resonator configuration – Q switching - mode locking – Cavity damping. **Types of lasers**: Gas lasers - solid lasers - liquid lasers - semiconductor lasers.	12
Unit IV	**INDUSTRIAL APPLICATION OF LASERS**	
	Measurement of Physical Quantity using LASER: Distance-Length-velocity – Acceleration – current - voltage **Material processing**: Laser instrumentation for material processing- Powder Feeder- Laser Heating- Laser Welding- Laser Melting- Conduction Limited Melting - Key Hole Melting **Laser trimming of material**: Laser Trimming process - Types Of Trim- Construction – Working- Advantages – Material Removal and vaporization: Process Of Material Removal	12

1042235312	Fiber Optics and Laser Instrumentation	L	T	P	C
Theory		4	0	0	4

Unit V	HOLOGRAM AND MEDICAL APPLICATIONS	
	Holography: Basic Principle – Comparison of Holography with photography - Principle of Hologram Recording - Condition For Recording a Hologram- Reconstructing and viewing the holographic image – Holography for Non-Destructive Testing – Holographic components. **Medical applications of lasers**: LASER-Tissue Interactions- Photochemical reactions- Thermalisation- collision relaxation- Types of Interactions - Selecting an Interaction Mechanism – Laser Instruments for surgery- removal of tumors of vocal cards- Brain surgery.	12
	TOTAL HOURS	**60**

Suggested List of Students Activity (Ungraded)

- Check the web portal to study properties and fundamentals of Fibre optics and Laser Instruments.
- Periodical quizzes should be conducted on a weekly basis to reinforce the use of Fibre optics and Laser in measurement and Industrial applications.
- Students might be asked to see the demonstration video of Holography and medical applications

Textbooks for Reference:

1. S.C.Gupta, Text book on Optical Fiber Communication and its applications, Prentice Hall of India, 2012
2. Eric Udd, William B., and Spillman, Jr., Fiber Optic Sensors: An Introduction for Engineers and Scientists, John Wiley & Sons, 2011
3. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012

Website links for Reference:

1. http://nptel.ac.in/courses/117101002/
2. https://nptel.ac.in/courses/115102124
3. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SIC1605.pdf

1042235312	Fiber Optics and Laser Instrumentation	L	T	P	C
Theory		4	0	0	4

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

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1042235313	Embedded System Design with Arduino	L	T	P	C
Theory		4	0	0	4

Introduction:

Embedded system is inevitable in today's Industrial applications. ARDUINO is an open source based prototyping platform used to sense and control physical devices. The purpose of this subject is to become familiar with ARDUINO based embedded system design methods both in hardware and software. Embedded applications at student level are dealt to give exposure to the students to build projects using ARDUINO.

Course Objectives:

The objective of this course is to enable the students to

- Acquire knowledge on Embedded system and its characteristics
- Acquire knowledge on the Arduino Board descriptions of various types of Arduino Boards
- Gain knowledge programming the Arduino through embedded c language
- Gain knowledge on various sensor modules , Actuator modules and Display devices modules to interface with Arduino
- Gain knowledge on using the Arduino for measurement applications

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain about Embedded system, its characteristics, applications and design of embedded system

CO2: Work with Different types of Arduino Boards available in the market

CO3: Install the Arduino IDE and to work with thatto edit, compile and download the Arduino program into Arduino Board

CO4: Interface the various sensor modules, Actuator modules and Display device modules with Arduino

CO5: Design and Develop Arduino sketch for various measurement applications and to make Digital meters

Pre-requisites:

Basic knowledge of Digital logic theory, Digital electronic circuits, Analog circuits, C programming

1042235313	Embedded System Design with Arduino	L	T	P	C
Theory		4	0	0	4

CO/POMapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	2	-	-	-
CO2	3	3	3	3	-	-	-
CO3	3	3	3	3	-	-	-
CO4	3	3	3	2	-	-	-
CO5	3	3	3	3	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

InstructionalStrategy:

- It is suggested that teachers have to use different teaching methods to stimulate the interest of students in learning.
  - To help students to learn fundamentals of Arduino Hardware and programming, Teachers should use PPT presentation and to show video of Arduino based student's projects.
- Demonstration method may be used with step-by-step procedure to work with ARDUINO IDE.
- Teachersaresuggestedtofollowinductivestrategytohelpthestudentsto know the Industrial applications of embedded systems.
- It is suggested to the teachers to make the students to learn Arduino Board description of One Arduino Board (Arduino UNO), sensor modules, actuator modules, LCD/LED display modules. After learning these, teacher may give their own idea of simple application and may ask the student to do the mini project to implement that application.
- It is suggested to the teachers to make use of tinkercad online portal to teach, demonstrate, simulate and to give mini project work to the students

1042235313	Embedded System Design with Arduino	L	T	P	C
Theory		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each. Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042235313	Embedded System Design with Arduino	L	T	P	C
Theory		4	0	0	4

Unit I	INTRODUCTION TO EMBEDDED SYTEM	
Embedded System – Definition - Embedded System Vs General Computing Systems – Characteristics - Classification - Small Scale- Medium Scale- Sophisticated – Major Application Areas – Purpose of Embedded Systems - Quality Attributes of Embedded Systems –structure of embedded system – Processors in embedded system - Microprocessor Vs Microcontroller-Compiler- cross compiler- Assembler-Simulator.		12
Unit II	**ARDUINO HARDWARE**	
Arduino – Arduino History – Features **Arduino Family**: Arduino Nano - Arduino Uno - Arduino Mega -Arduino Nano Board descriptions- Arduino uno Board descriptions –- Arduino Mega Board descriptions – Arduino Board installation - Digital and Analog Peripherals – Communication Models – Communication Interface.		12
Unit III	**ARDUINO PROGRAMMING& LIBRARY FUNCTIONS**	
Procedure to setup Arduino IDE– structure of Arduino sketch – **Data types-** constant – Variable - Boolean-Char-Unsigned char-int- unsgined int -Long-unsigned long-short-float-double - **Variable scope:** Local variable – Global Variable–**Operators:** Arithmetic – Comparison - Boolean- bitwise- compound **Control Statements:** if –if... else- if...elseif...else –switch case –While – Do while –for loop- infinite loop **Functions**: Function declaration-Time manipulation functions- declaring arrays **Arduino Function Libraries**: pinMode() - digitalRead() – digitalWrite()- analogRead()- analogReference()		12
Unit IV	**ARDUINO INTERFACE WITH DEVICES, SENSORS and ACTUATORS**	
Arduino Hardware and sketch for interfacing Devices: Blinking LED- Reading analog voltage- Reading Digital inputs- Interfacing seven segment Display- Interfacing 16 X 2 LCD display- Interfacing relays, buzzer and switches. **Arduino Hardware and Sketch for interfacing Sensors:** Temperature sensor LM35, Humidity sensor DHT22, IR motion sensor(PIR) – ultrasonic sensor HC-SR04 - Light sensor(LDR) **Arduino Hardware and Sketch for interfacing Actuators:** DC Motor - Servo motor – Stepper Motor		12

1042235313	Embedded System Design with Arduino	L	T	P	C
Theory		4	0	0	4

Unit V	EMBEDDED APPLICATION DEVELOPMENT WITH ARDUINO	
Arduino Hardware and sketch: Measurement of unknown resistance -Measurement of temperature –Measurement of light intensity –Measurement of distance in cm – Measurement of angle of rotation using potentiometer –Measurement of humidity – any application to communicate with android phone through Bluetooth – any application to use wifi and local area network – any application to send data through internet.		12
TOTALHOURS		**60**

Suggested List of Students Activity(Ungraded)

- Check the web portal to study Arduino Tutorial and learn Arduino Hardware and programming
- Periodical quizzes should be conducted on a weekly basis to reinforce the knowledge on Arduino hardware and programming
- Students might be asked to work with online/offline Arduino simulator software.
- Students might be given small project type assignment and can simulate it with online simulation portal

REFERENCE BOOKS:

1. Introduction to Embedded Systems (2nd Edition) by K V Shibu, McGrawHill India
2. Embedded Systems Architecture, Programming and Design by Raj Kamal, Tata McGraw-Hill Publishing
3. Arduino Based Embedded Systems Interfacing, Simulation and LabView GUI by Rajesh Singh, Anita Gehlot, Bhupendra Singh, Sushaban Choudhury, CRC Press
4. Sams Teach Yourself Arduino Programming in 24 Hours by Richard Blu
5. Arduino for Dummies by John Nussey
6. Arduino Cookbook (3rd edition) by Michael Margolis, Brian Jepson and Nicholas Robert Weldin, O'reilly
7. Arduino Made Simple with Interactive Projects by Ashwin Pajankar, BPB Publications

LIST OF LEARNING WEBSITE:

1. https://arduino.cc
2. https://www.tutorialspoint.com/arduino

1042235313	Embedded System Design with Arduino	L	T	P	C
Theory		4	0	0	4

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042235314	Industrial Power electronics	L	T	P	C
Theory		4	0	0	4

Introduction:

Industrial power electronics play a crucial role in modern manufacturing and industrial processes by providing efficient and precise control over electrical power. The widespread adoption of industrial power electronics lies in their ability to enhance energy efficiency, provide precise control, improve reliability and safety, and support the integration of emerging technologies like renewable energy sources. These factors contribute to the overall competitiveness and sustainability of industrial operations. Instrumentation Engineers must be convergent with Power electronics circuits, its operation, Debugging so that, they can maintain and manage the emerging situations in industry.

Course Objectives:

The objective of this course is to enable the student to

- Learn the Thryristor family devices and its Triggering circuit
- Control the output power in converter circuit
- Learn the Chopper circuits and its control applications
- Design the single and three phase inverters
- Regulate AC voltage through PWM

Course Outcomes:

On successful completion of this course, the student will be able to

CO1: Explain the power devices and Triggering circuits

CO2: Explain the single phase and three phase Converter circuits

CO3: Explain the single phase DC to DC converter circuits

CO4: Explain the Inverter circuits

CO5: Explain the AC voltage regulation circuits

Pre-requisite:

Basic Electronics - Analog Electronic circuits

1042235314	Industrial Power electronics	L	T	P	C
Theory		4	0	0	4

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	1	-	-	-
CO2	3	3	3	1	-	-	-
CO3	3	3	3	1	-	-	-
CO4	3	3	3	1	-	-	-
CO5	3	3	3	1	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is suggested that teachers revise the prerequisite knowledge through PPT presentation
- It is recommended to ask the students to see various power circuits in the website
- It is recommended to simulate the power electronics circuits using ORCAD, MATLAB
- Teacher can recommend relevant YouTube videos
- Teacher have to demonstrate the step by step procedure on working with simulation software tool

1042235314	Industrial Power electronics	L	T	P	C
Theory		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042235314	Industrial Power electronics	L	T	P	C
Theory		4	0	0	4

Unit I	POWER DEVICES AND TRIGGER CIRCUITS	
Thyristor family – Working principle ,VI characteristics, Applications of SCR. Triggering of SCR - Gate triggering –Types – Concepts of DC triggering, AC triggering, Pulse gate triggering – Pulse transformer in trigger circuit – Resistance firing circuit and waveform – Resistance capacitor firing circuit and waveform, Synchronized UJT triggering (ramp triggering) and waveform. MOSFET- IGBT - Construction - working principle - Applications		12
Unit II	**CONVERTERS**	
Converters – Definition – Single phase Half controlled bridge converter with resistive load and resistive inductive load- importance of flywheel diode – Single phase fully controlled bridge converter with resistive load – voltage and current waveforms – Single phase fully controlled bridge converter with RL load – voltage and current waveforms. Commutation: Natural commutation – Forced commutation – Types of forced commutation (mention the types only) 3 phase half controlled bridge converter with resistive load - current and voltage waveform -3 phase fully controlled bridge with resistive load – current and voltage waveforms.		14
Unit III	**CHOPPERS**	
Introduction – applications -principle of chopper-control strategies (time ratio and current limit control)-types of chopper- type A, B, C, D, and E- step up chopper – PWM control circuit for driving MOSFET in chopper. DC Transmission- principle – advantages – drawbacks		10
Unit IV	**INVERTERS AND APPLICATIONS**	
Inverter Definition Requirement of an inverter –Single phase inverter with resistive load – Single phase inverter with RL load –Methods to obtain sine wave output from an inverter - output voltage control in inverters - Basic three phase bridge inverter with 120 conduction mode – circuit, trigger sequence, waveform UPS – Need for UPS –ON Line UPS -OFF Line UPS - Comparison of ON line and OFF line UPS		12

1042235314	Industrial Power electronics	L	T	P	C
Theory		4	0	0	4

Unit V	AC VOLTAGE REGULATORS				
Introduction to AC Voltage Controller – Principle of On-Off Control – Principle of Phase Control – Single Phase voltage Controller with Resistive Loads – Single Phase voltage Controller with RL load -Three Phase Full Wave Controller – Cyclo converters – Single Phase Cyclo converters – AC Voltage controllers with PWM Control					12
TOTAL HOURS					**60**

Suggested List of Students Activity (Ungraded):

- Students can practice to simulate the learnt circuits using simulation software tool
- Students can read magazines related to power electronics to update the current scenario
- Students can visit the Industries to know the practical application of the circuits in the industry.

Text Books for Reference:

1. Power Electronics, M.H.Rashid, PHI Publications, 3rd edition, and 2005.
2. Power Electronics, Vedam Subrahmanyam, New Age International Publishers, Second Edition, 2006
3. Power Electronics, Dr. P.S. Bimbhra, Khanna Publishers

1042235314	Industrial Power electronics	L	T	P	C
Theory		4	0	0	4

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042235315	Analytical Instrumentation	L	T	P	C
Theory		4	0	0	4

Introduction:

Analytical instrumentation refers to a wide array of tools and techniques used to analyze and quantify the composition of substances or materials. These instruments are crucial in various scientific fields, including chemistry, biology, environmental, pharmaceuticals, and materials science. They enable researchers and professionals to determine the identity, concentration, and properties of chemical compounds or elements present in a sample.

Course Objective:

The objective of this course is to enable the students to

- Acquire knowledge on colorimeter and various spectrophotometers
- Acquire knowledge on various types of chromatograph and analytical techniques
- Acquire knowledge on Industrial gas analyzers and pollution monitoring instruments
- Gain knowledge on pH meters and Dissolved component analyzers
- Gain knowledge on Nuclear Magnetic Resonance based instruments and microscopic techniques.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain different types of Spectrometers used for analyzing sample's chemical composition, structure, and properties.

CO2: Explain different types of chromatograph used to separate mixtures into individual components.

CO3: Explain the analysis of Oxygen, Nitrozen, H_2S and to analyze the Industrial gas discharge to find Air Pollutants.

CO4: Explain the principle of pH measurement

CO5: Explain the Nuclear Magnetic Resonance based instruments and microscopic Techniques.

Pre-requisites:

Basics of instrumentation, Industrial Instrumentation

1042235315	Analytical Instrumentation	L	T	P	C
Theory		4	0	0	4

CO/PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	3	-	-	-
CO2	3	3	3	3	-	-	-
CO3	3	3	3	3	-	-	-
CO4	3	3	3	2	-	-	-
CO5	3	3	3	3	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

Instructional Strategy:

- It is suggested that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn fundamentals of Analytical instruments, Teachers should use PPT presentation and to show video
  Of various analyzing techniques using different types of instruments
- Demonstration method may be used with step-by-step procedure to analyze liquid, gas, air pollutants etc.,
- Teachers are suggested to follow inductive strategy to help the students to know the Industrial applications of Analytical Instruments.
- It is suggested to the teachers to show the YouTube video to handle different types of analytical instruments to the students

1042235315	Analytical Instrumentation	L	T	P	C
Theory		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042235315	Analytical Instrumentation	L	T	P	C
Theory		4	0	0	4

Unit I	SPECTROPHOTOMETRY	
Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.		12
Unit II	**CHROMATOGRAPHY**	
General principles – classification – chromatographic behaviour of solutes – quantitative determination - Column chromatography-Planer Chromatography-Paper Chromatography-Thin layer Chromatography- Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.		12
Unit III	**INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS**	
Gas analysers – Oxygen, NO_2 and H_2S types, IR analysers, thermal conductivity detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.		12
Unit IV	**pH METERS AND DISSOLVED COMPONENT ANALYZERS**	
Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors Dissolved oxygen analyzer - Sodium analyzer - Silicon analyser - Water quality Analyzer.		12
Unit V	**NUCLEAR MAGNETIC RESONANCE AND MICROSCOPIC TECHNIQUES**	
Basic principles, Instrumentation and Applications - NMR spectrometer - Electron spin Resonance spectroscopy -Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry		12
TOTAL HOURS		**60**

1042235315	Analytical Instrumentation	L	T	P	C
Theory		4	0	0	4

Suggested List of Students Activity (Ungraded)

- Check the web portal to study various analytical techniques and analytical instruments being used in the industry
- Periodical quizzes should be conducted on a weekly basis to reinforce the knowledge on Analytical Instrumentation

Text Books for Reference:

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.
2. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006.
3. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co.Ltd.,2nd Edition 2007.

1042235315	Analytical Instrumentation	L	T	P	C
Theory		4	0	0	4

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042235420	Process Control Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Introduction:

Process control instrumentation practical play a crucial role in the education and training of students by providing hands-on experience, fostering essential skills, and preparing them for careers in industries where process control is paramount**.** Practical sessions provide an opportunity for students to apply theoretical knowledge gained in lectures to real-world scenarios. It allows them to manipulate actual instruments, understand their functionalities, and observe how they interact with the processes they are controlling.

Course Objectives:

The objective of this course is to enable the student to

- Gain practical knowledge to handle the single loop process control station
- Control a simple process control station using different control algorithms such as P, PI, PID etc.
- Tune the single Process control loop using various tuning methods
- Gain hands on experience to handle the Final control element in the process station
- Gain hands on experience to achieve the set point in a temperature, pressure, flow process stations

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Implement the ON-OFF control of Temperature, Pressure, and Level Process

CO2: Implement the Proportional control of Temperature process

CO3: Implement the PI control in a Level process station

CO4: Implement the PID control in a Level Process station

CO5: conduct experiment to analyze the characteristics of control valve

Pre-requisites:

Basics of Instrumentation, sensors and Transducers and Process control Instrumentation Theory

1042235420	Process Control Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	-	-	-
CO2	3	3	2	2	-	-	-
CO3	3	3	2	2	-	-	-
CO4	3	3	2	2	-	-	-
CO5	3	3	2	2	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

1042235420	Process Control Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	15
B	Experimenting with Procedure	15
C	Observing Reading / Calculations / Graph	15
D	Result	5
TOTAL		50

1042235420	Process Control Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice.

The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	20
B	Experimenting with Procedure	30
C	Readings observed	20
D	Calculations / Graph	10
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042235420	Process Control Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Ex.No.	Name of the Exercise	Hours
1	Perform Closed loop control of temperature process using thermistor.	5
2	Experimentally implement On-Off Control in a Temperature Process.	5
3	Experimentally implement On-Off Control in a Level Process	5
4	Experimentally implement On-Off Control in a Pressure Process	5
5	Conduct experiment to observe response of a proportional controller in a Temperature Process	5
6	Conduct experiment to observe response of PD controller in a Pressure Process	5
7	Conduct experiment to observe response of PID controller in a Level Process	5
8	Conduct experiment to observe response of PI controller in a Level Process	5
9	Experimentally obtain the Characteristics of Control Valve	5
10	Experimentally obtain the characteristics of P to I converter	5
11	Experimentally obtain the characteristics of I to P converter	5
12	Conduct an experiment to determine the characteristics of a motorized control valve	5
TOTAL HOURS		**60**

1042235420	Process Control Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Equipment Required:

Sl. No	Name of the Equipment / Software	Required Nos.
1.	Temperature Control Station with accessories	1
2.	Level Control Station with accessories	1
3.	Pressure Control Station with accessories	1
4.	Control Valve setup with accessories	1
5.	Motorized Control Valve setup with accessories	1
6.	P/I Conversion setup and I/P converter setup with accessories	1
7.	Compressor unit	1

1042235421	INDUSTRIAL INSTRUMENTATION PRACTICAL	L	T	P	C
Practical		0	0	4	2

Introduction:

Industrial Instrumentation covers the topics of measurement of Variable related to Mechanical instrumentation and Analytical instrumentation. It gives detailed information to the students about the measurement of variables related to velocity, acceleration, force, torque, shaft power, Ph. This subject is designed to implement whatever is studied industrial instrumentation theory subject including measuring force, velocity, displacement, distance, etc., using measuring instrumental setup and also to construct signal conditioning circuits and testing it.

Course Objective:

The objective of this course is to enable the student to,

- Acquire skill on handling mechanical comparator and electronic comparator.
- Acquire skill on measuring speed, distance and acceleration using stroboscope, ultrasonic meter and piezo electric accelerometer.
- Acquire skill on measuring force and torque using strain gauge, Hydraulic load cell and torque meter.
- Acquire skill measuring the pH values and percentage of oxygen of given samples using pH electrode and Oxygen analyzer.
- Acquire skill on measuring the absorbance and transmittance of sample using spectrometer.

Course Outcomes:

After successful completion of this course, the students should be able to,

CO1: Measure the deviation using mechanical and electronic comparator

CO2: Measure speed, distance and acceleration using stroboscope, Ultrasonic meter and piezo electric accelerometer

CO3: Measure force and torque using strain gauge, Hydraulic load cell and torque meter

CO4: Measure pH values and percentage of Oxygen of given samples using pH electrode and Oxygen Analyser.

CO5: Measure the absorbance and transmittance of sample using spectrometer.

Pre-requisites:

Industrial Instrumentation theory, Sensors and Transducers

1042235421	INDUSTRIAL INSTRUMENTATION PRACTICAL	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	-	-	-
CO2	3	2	1	1	-	-	-
CO3	2	3	3	2	-	-	-
CO4	2	3	2	2	-	-	-
CO5	2	3	2	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

1042235421	INDUSTRIAL INSTRUMENTATION PRACTICAL	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	15
B	Experimenting with Procedure	15
C	Observing Reading / Calculations / Graph	15
D	Result	5
TOTAL		50

1042235421	INDUSTRIAL INSTRUMENTATION PRACTICAL	L	T	P	C
Practical		0	0	4	2

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice.

The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	20
B	Experimenting with Procedure	30
C	Readings Observed	20
D	Calculations / Graph	10
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042235421	INDUSTRIAL INSTRUMENTATION PRACTICAL	L	T	P	C
Practical		0	0	4	2

Ex.No	Name of the Exercise	Hours
1	Find out the measurement of given component and compare with a standard component using mechanical comparator and slip rings	5
2	Construct and test an Electronic Comparator	5
3	Measurement of Angular speed using Stroboscope	5
4	Measurement of distance using Ultrasonic meter	5
5	Measurement of Acceleration using Piezo Electric Accelerometer	5
6	Measurement of force using Strain Gauge Load Cell	5
7	Measurement of force using Hydraulic Load Cell	5
8	Measurement of Torque of a rotating shaft using torsion meter	5
9	Measurement of pH value of various solutions using digital pH meter	5
10	Measurement of percentage of Oxygen of given sample using Oxygen analyzer	5
11	Measurement of Absorbance and Transmittance of test solutions using Spectrometers	5
12	Construct and test V to F and F to V Convertors	5
TOTAL HOURS		**60**

1042235421	INDUSTRIAL INSTRUMENTATION PRACTICAL	L	T	P	C
Practical		0	0	4	2

Equipment Required:

S.No	Item Description	Quantity Required
1	Dial Gauge	1
2	Stroboscope	1
3	Ultrasonic Distance meter	1
4	Piezo Electric accelerometer	1
5	Strain gauge load cell	1
6	Hydraulic load cell	1
7	Torsion meter	1
8	Digital PH meter	1
9	Oxygen Analyzer	1
10	Spectro meter	1
11	V to F and F to V Trainer	1
12	CRO	1

1042235422	P&ID using CAD Practical	L	T	P	C
Practical		0	0	4	2

Introduction:

P&IDs are essential in the engineering and design of piping systems and process plants. By diagramming the functional relationship of piping, instrumentation and equipment components, they illustrate the interaction of the process components used to control an entire process. P&IDs include equipment, physical sequences of process branches, valves, instrumentation reducers and control interlocks. they are also important to the maintenance of the equipment used and the ability to adjust the process that they represent. Diploma in instrumentation and control engineers must be familiar with P&I Drawings, and also they have to practice to draw P&I Diagrams. This practical subject gives hands on training to draw diagrams.

Course Objectives:

The objective of this course is to enable the student to

- To acquire skill on drawing P&ID for measuring Temperature, Pressure and level of Feedback control system.
- To acquire skill on drawing P&ID for Cascade control system and Feed forward control system.
- To acquire skill on drawing P&ID for Ratio control system and Split range control system.
- To acquire skill on drawing P&ID for On/Off Level, Flow and Pressure Control of Centrifugal Pump.
- To acquire skill on drawing P&ID for Boiler feed water pumping and heating system.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Draw the P&ID for temperature and pressure control of Feedback control system for chemical reactor and level control in tank

CO2: Draw the P&ID for Feed forward control system and Ratio control system.

CO3: Draw the P&ID for Ratio control system and Split range control system.

CO4: Draw the P&ID for On/Off control of Level, Flow and Pressure of Centrifugal Pump.

CO5: Draw P&ID for Boiler feed water pumping and heating system, flue gas dew point control, Lube oil cooler

Pre-requisites:

Process control Instrumentation theory

1042235422	P&ID using CAD Practical	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	-	-	-
CO2	3	2	1	1	-	-	-
CO3	2	3	3	2	-	-	-
CO4	2	3	2	2	-	-	-
CO5	2	3	2	2	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

1042235422	P&ID using CAD Practical	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	15
B	Experimenting with Procedure	15
C	Observing Reading / Calculations / Graph	15
D	Result	5
TOTAL		50

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice.

The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Experimental Setup Diagram	20
B	Experimenting with Procedure	30
C	Readings Observed	20
D	Calculations / Graph	10
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042235422	P&ID using CAD Practical	L	T	P	C
Practical		0	0	4	2

Ex.No	Name of the Exercise	Hours
1	Draw the P&ID of a Drum type Boiler with only measurement points.	6
2	Draw the P&ID of Feedback control system in a chemical reactor for the control of temperature and pressure.	6
3	Draw the P&ID of Feedback control system in a tank for the control of leveland inlet flow rate.	6
4	Draw the P&ID of Cascade control system in a steam heat exchanger andDistillation column.	6
5	Draw the P&ID of Feed forward control system in a stirred tank heater.	6
6	Draw the P&ID of a ratio control system for the control of two flow rates by ratio.	6
7	Draw the P&ID of Split range control scheme in a process	4
8	Draw the P&ID of On/Off Level, Flow and Pressure Control of CentrifugalPump.	4
9	Draw the P&ID for measurement of furnace draft in Boiler	4
10	Draw the P&ID of Boiler feed water pumping and heating system	4
11	Draw the P&ID of flue gas dew point control	2
12	Draw the P&ID of Lube oil cooler	2
TOTAL HOUR		**60**

1042235422	P&ID using CAD Practical	L	T	P	C
Practical		0	0	4	2

EQUIPMENTS / SOFTWARE REQUIRED

Sl.No	Name of the Equipments / Software	Quantity Required
1	Desktop / Laptop	10*
2	Laser Printer	01
3	UPS 5 KVA with One Hour Backup	01
4	CAD / CAD P&ID 2021 / EdrawMax Software (Multiuser)	01

*For 30 students batch

1042235423	Embedded System Design With ARDUINO Practical	L	T	P	C
Practical		0	0	4	2

Introduction:

The Arduino platform has become quite popular with people just starting out with electronics. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message and turn it into an output activating a motor, turning on an LED, publishing something online. Arduino is one of those Embedded System Devices (called as an Embedded Development Board), which got very famous in the maker's community due to its free and open source nature. Instrumentation Engineers must be familiar with embedded system development.

Course Objectives:

The objective of this course is to enable the student to

- Gain Knowledge on Embedded system Design using ARDUINO
- Acquire skill on working with ARDUINO BOARD to embed the Arduino program into the Board to build applications
- Gain Skill on Programming the ARDUINO using C code for different applications
- Gain Skill on interfacing the various sensor and Actuator modules with ARDUINO Board
- Gain Skill on building small applications using ARDUINO BOARD and ARDUINO IDE

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Work with ARDUINO BOARD to build embedded applications

CO2: Write C code to build small applications using ARDUINO board

CO3: Interface ARDUINO Board with various sensor modules and Actuator Modules

CO4: Design and Develop C coding for Different measurement applications

CO5: Design and Develop mini project for small applications using ARDUINO

Pre-requisite:

Sensors and Transducers Theory and Practical subject

1042235423	Embedded System Design With ARDUINO Practical	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	-	-	-
CO2	3	3	3	3	-	-	-
CO3	2	3	3	3	-	-	-
CO4	2	3	3	3	-	-	-
CO5	2	3	3	3	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

1042235423	**Embedded System Design With ARDUINO Practical**	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	**DESCRIPTION**	**MARKS**
A	Arduino Hardware Interfacing Diagram	15
B	Arduino Sketch	15
C	Editing / Execution	15
D	Result	5
TOTAL		50

1042235423	Embedded System Design With ARDUINO Practical	L	T	P	C
Practical		0	0	4	2

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice.

The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Arduino Hardware Interfacing Diagram	20
B	Arduino Sketch	30
C	Editing / Execution	20
D	Debugging	10
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042235423	**Embedded System Design With ARDUINO Practical**	L	T	P	C
Practical		0	0	4	2

Ex.No.	Name of the Exercise	Hours
1	Familiarization of ARDUINO board, ARDUINO IDE and ARDUINO sketch. Develop c program to blink LED in the ARDUINO board	5
2	Construct a circuit to interface 16 X 2 LCD to ARDUINO hardware. Write a C program to display your name in the LCD.	5
3	Construct circuit using ARDUINO hardware and develop C program to measure unknown resistance and test it	5
4	Construct circuit using ARDUINO hardware and develop C program to measure temperature using LM35 temperature sensor and test it.	5
5	Construct circuit using ARDUINO hardware and develop C program to measure light intensity using LDR and test it	5
6	Construct circuit using ARDUINO hardware and develop C program to measure distance using ultrasonic distance sensor and test it	5
7	Construct circuit using ARDUINO hardware and develop C program to measure angular displacement using potentiometer sensor and test it	5
8	Construct circuit using ARDUINO hardware and develop C program to measure humidity using Humidity sensor and test it	5
9	Construct circuit using ARDUINO hardware and develop C program to detect motion using PIR sensor and test it	5
10	Construct circuit using ARDUINO hardware and develop C program to control speed, step and direction of Bipolar stepper motor	5
11	Construct circuit using ARDUINO hardware and develop C program to control Servo motor for angular positioning	5
12	Construct circuit using ARDUINO hardware and develop C program to control DC motor.	5
TOTAL HOURS		**60**

1042235423	**Embedded System Design With ARDUINO Practical**	L	T	P	C
Practical		0	0	4	2

Equipment Required:

Sl.No.	Name of the Equipments / Software	Quantity Required
1	ARDUINO Development Kit	As req.
2	Switches, sensors, 16 X 2 LCD, LED's, POT, LDR , PIR sensor, LM35 temperature sensor, HC-SR04 ultra sonic sensor, Humidity sensor, Stepper motor, servo motor, DC motor and Bread board	As req.
3	Arduino IDE Open source Software	1

1042235424	INDUSTRIAL POWER ELECTRONICS PRACTICAL	L	T	P	C
Practical		0	0	4	2

Introduction:

The objective of this practical session is to introduce students to the fundamental concepts and applications of power electronics in industrial settings. This practical aims to provide hands-on experience with power electronic devices, circuits, and systems commonly used in various industrial applications. It's essential to ensure proper safety precautions are followed when working with high-power electronic devices and circuits.

Course Objectives:

The objective of this course is to enable the student to

- Acquire skill on constructing and testing MOSFET and SCR based power circuits.
- Gain skill on constructing and testing single phase Converter and Chopper circuits
- Acquire skill on constructing and testing Inverter circuits
- Gain skill on Constructing and testing the open loop speed control of single phase AC motor
- Acquire skill on simulating three phase half controlled and fully controlled converter

Course Outcomes:

On successful completion of this course, the student will be able to

CO1: Construct and test the VI characteristics of MOSFET and RC Firing circuit of SCR

CO2: Construct and test single phase Half Controlled Bridge converter, fully controlled Bridge converter circuit, DC chopper and Step up chopper

CO3: Construct and test the single phase parallel inverter circuit

CO4: Construct and test the open loop speed control of single phase AC motor

CO5: Simulate three phase half controlled and fully controlled converter

Pre-requisite:

Electronic devices and circuits, Industrial power electronics theory

1042235424	INDUSTRIAL POWER ELECTRONICS PRACTICAL	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	-	-	-
CO2	3	3	3	2	-	-	-
CO3	3	3	3	2	-	-	-
CO4	3	3	3	2	-	-	-
CO5	3	3	3	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

1042235424	INDUSTRIAL POWER ELECTRONICS PRACTICAL	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Circuit / Experimental Setup Diagram	15
B	Experimenting with Procedure	15
C	Observing Reading / Calculations / Graph	15
D	Result	5
TOTAL		50

1042235424	INDUSTRIAL POWER ELECTRONICS PRACTICAL	L	T	P	C
Practical		0	0	4	2

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice.

The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Circuit / Experimental Setup Diagram	20
B	Experimenting with Procedure	30
C	Readings Observed	20
D	Calculations / Graph	10
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042235424	INDUSTRIAL POWER ELECTRONICS PRACTICAL	L	T	P	C
Practical		0	0	4	2

Ex.No.	Name of the Experiment	Hours
1	Obtain the VI Characteristics of MOSFET.	5
2	Construct and test the RC firing circuit for SCR.	5
3	Construct and test a single phase Half Controlled Bridge converter with resistive load.	5
4	Construct and test a single phase Fully Controlled Bridge converter with resistive load.	5
5	Construct and test a PWM based DC Chopper using MOSFET / IGBT.	5
6	Construct and test a Step up Chopper.	5
7	Construct and test the SCR Commutation circuits.	5
8	Construct and test a single phase inverter.	5
9	Construct and test the single phase parallel inverter using MOSFET	5
10	Construct and test the open loop speed control of single phase AC motor.	5
11	Simulate the three phase half controlled converter with R load.	5
12	Simulate the three phase fully controlled converter with R load.	5
	TOTAL HOURS	**60**

1042235424	INDUSTRIAL POWER ELECTRONICS PRACTICAL	L	T	P	C
Practical		0	0	4	2

Equipment Required:

S No	Name of the Equipment / Software	Required No's
1.	Characteristics of MOSFET Trainer Kit	1
2.	RC Firing Circuit for SCR Trainer Kit	1
3.	Single Phase Half Controlled Bridge Converter with R load Trainer Kit	1
4.	Single Phase Fully Controlled Bridge Converter with R load Trainer Kit	1
5.	PWM based Step down DC Chopper using MOSFET / IGBT Trainer Kit	1
6.	SCR Commutation Circuit Trainer Kit	1
7.	Step up Chopper Trainer Kit	1
8.	Single Phase Inverter Trainer Kit	1
9.	Single Phase Parallel Inverter using MOSFET / IGBT Trainer Kit	1
10.	Open Loop Speed Control of Single phase AC motor Trainer Kit	1
11.	Simulation Software- PSpice/ MultiSIM / MATLAB	--
12.	20 MHz Dual Trace CRO with suitable probes	4

1042235425	Automated Pneumatic Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Introduction:

In Industry PLC plays predominant role in control applications. PLC based pneumatic instrumentation practical has several advantages, including enhanced control, automation, and monitoring capabilities. PLCs offer precise control over pneumatic systems, allowing for accurate adjustment of pressure, flow rates, and timing. PLCs can interface with various sensors such as pressure sensors, flow meters, and position sensors to provide real-time feedback on the pneumatic system's performance. PLC-based pneumatic instrumentation practical offers numerous benefits including precision control, flexibility, integration with sensors, fault diagnosis, sequential control, safety enhancements, data logging, and remote monitoring.

Course Objectives:

The objective of this course is to enable the student to

- Measure Temperature using any type of thermometer and Temperature Transmitter
- Measure pressure using U tube manometer and Transducers
- Measure Differential Pressure using DPT
- Measure Flow rate of Fluid flow using flow transducer
- Measure Level of a liquid in a tank using Level Transmitter

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Measure temperature using Liquid in glass and Bi metallic thermometer and Temperature Transmitter

CO2: Measure pressure using U tube manometer and Bourdon tube-LVDT setup

CO3: Measure Flow rate and Differential pressure using DPT

CO4: Measure Flow rate of Fluid flow using Electromagnetic flow meter

CO5: Measure Level of a Liquid in a tank using Level transmitter

Pre-requisite:

Sensors and Transducers Theory and Practical subject

1042235425	Automated Pneumatic Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	-	-	-
CO2	3	2	1	1	-	-	-
CO3	2	3	3	2	-	-	-
CO4	2	3	2	2	-	-	-
CO5	2	3	2	2	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

1042235425	Automated Pneumatic Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle / 50 % Exercises	Second Cycle / Another 50 % Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Experimental Setup / Hardware Diagram	15
B	Ladder Logic Diagram	15
C	Editing / Execution	15
D	Result	5
TOTAL		50

1042235425	Automated Pneumatic Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

CA 3: Practical document should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test and End Semester Examination with a bonafide certificate

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice.

The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.

This documentation can be carried out in a separate note book / file. The procedure and sketch should be written by the student manually.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the flying squad and DOTE official.

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

PART	DESCRIPTION	MARKS
A	Experimental Setup / Hardware Diagram	20
B	Ladder Logic Diagram	30
C	Editing / Execution Program	20
D	Result	10
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042235425	**Automated Pneumatic Instrumentation Practical**	L	T	P	C
Practical		0	0	4	2

Ex. No	Name of the Exercise	Hours
1	Conduct experiment to Operate single acting cylinder using PLC for fixed number of cycles using counter instruction and electrical switches	5
2	Conduct experiment to Operate single acting cylinder using PLC a) using on-delay Logic b) using off-delay logic	5
3	Double acting cylinder is used to perform machining operation. Pneumatic cylinder is advanced by pressing two push buttons simultaneously. If any one of the push button is released, cylinder comes back to start position. Implement it using PLC	5
4	Double acting cylinder is used to perform forward and return motion. Pneumatic cylinder is advanced by pressing push buttons PB1. Cylinder is returned by pressing push button PB2.Implement it using PLC	5
5	Double acting cylinder is used to perform forward and return automatically after reaching the extreme forward position. Pneumatic cylinder is advanced by pressing push buttons PB1 Implement it using PLC	5
6	Double acting cylinder is used to perform pressing operation. Cylinder has to move forward when PB1 button is pressed and return for set time of 20 seconds before it automatically returns to initial position. Limit switch S2 is used for end sensing of the forward motion of the cylinder. Implement it using PLC.	5
7	Conduct experiment to operate Double acting cylinder using PLC N cycles using counter and one set of electrical limit switches and one no. 5/2 solenoid valve.	5
8	Double acting cylinder is used to perform continuous to and fro motion. Cylinder has to move forward when PB1 button is pressed and once to and fro reciprocation starts it should continue till stop button PB2 is pressed. Limit switches are used for end position sensing. Implement it using PLC.	5
9	Double acting cylinder is used to perform to and fro operation. Cylinder has to move forward when PB1 button is pressed and continue to and fro motion till 10 cycles of operations is performed. Implement it using PLC	5
10	Conduct experiment to perform Sequential operation of 2 nos. of double acting cylinders using PLC for the sequence A+ B+ B- and A- using 2 nos. of 5/2 solenoid valves and 2 sets of electrical limit switches.	5
11	Conduct experiment to perform Sequential operation of 2 nos. of double acting cylinders using PLC for the sequence A+ B+ A- and B- using 2 nos. of 5/2 solenoid valves and 2 sets of electrical limit switches	5
12	Conduct experiment to operate Double acting cylinder using PLC Single cycle, Forward, Time delay and return	5
TOTAL HOUR		**60**

1042235425	Automated Pneumatic Instrumentation Practical	L	T	P	C
Practical		0	0	4	2

Web Reference:

https://instrumentationtools.com/plc-pneumatic-circuit-control/

Equipment Required:

Sl. No	Item Description	Range	Quantity Required
1.	Pneumatic Trainer kit with capable of interfaced with PLC	-	2
2.	FRL unit, Manifold valve, 5/2 Directional Valve,3/2 Directional valve, Single acting cylinder, Double acting cylinder mounted on the Pneumatic Trainer kit with necessary power supply arrangement	-	2
3.	PLC of any make with minimum 10 I/O		2

1042235540	Industrial Automation using PLC	L	T	P	C
Practicum		1	0	4	3

Introduction:

A diploma holder when employed in automated power station will be required to work with Programmable Logic Controllers. In industry, many manufacturing processes demand a sequence of operation, which are to be performed repetitively. Early automation systems were mechanical in design, timing and sequencing being effected by gears and cams. Slowly these design concepts were replaced by electrical drives which were controlled by relays and now by programmable logic controllers (PLCs). PLCs are widely used in all industries for efficient control operations. A diploma holder in industry is called upon to design, modify and troubleshoot such control circuits. Looking at the industrial applications of PLCs in the modern industry, this subject finds its usefulness in the present curriculum.

Course Objectives:

At the end of the course, the students will be able to

- Acquire knowledge on PLC hardware and to Implement Ladder Logic Program for simple applications
- Use the PLC for Time delay generation and Counting application
- Implement the control of sequential operation using PLC and to handle the Motor operations
- Implement the control operations required for the Industrial applications
- Implement the control operations required for commercial applications

Course Outcomes:

After successful completion of this course, the student will be able to

CO1: Perform the Latching operation with pushbutton switch inputs and Boolean Logic operations

CO2: Perform the On_Delay and Off_Delay timing operations and counting the events using PLC

CO3: Implement sequential operations required in industrial applications using Sequencer instructions of PLC and to run a Motor in forward and reverse direction

CO4: Control the Level of Liquid in a Tank and to control the conveyor belt operations using PLC

CO5: Control the Car parking system and to control the operation of Lift using PLC

Pre-requisites:

Digital Logic Theory, Digital electronic circuits, sensors and Transducers

1042235540	Industrial Automation using PLC	L	T	P	C
Practicum		1	0	4	3

CO-PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	-	-	-
CO2	3	3	3	2	-	-	-
CO3	3	3	3	2	-	-	-
CO4	3	3	3	2	-	-	-
CO5	3	3	3	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Teachers have to use different teaching method for easy to learn of students.
- To help the students to learn different types of instruments and their measurements.
- To Give Demo to the students by teachers using various multimedia.

1042235540	Industrial Automation using PLC	L	T	P	C
Practicum		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II Exercises	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments should be completed as per the portions above and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise/experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

The details of the documents should be prepared as per the instruction below.

The exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of next exercise. The detailed date of practices and its evaluations should be maintained in the logbook and should be submitted for verification.

1042235540	Industrial Automation using PLC	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	PLC Hardware Connection Diagram	10
B	Drawing Ladder Logic Diagram	15
C	Execution with Procedure	15
D	Result Observed	10
TOTAL		50
E	Record note	10
		60

CA 3: Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions	7 x 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

1042235540	Industrial Automation using PLC	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	PLC Hardware Connection Diagram	20
B	Ladder Logic Diagram	20
C	Execution with Procedure	20
D	Result Observed	20
E	Record Note	10
F	Viva Voce	10
TOTAL		100

1042235540	Industrial Automation using PLC	L	T	P	C
Practicum		1	0	4	3

Unit I	PLC Hardware and Ladder Logic programming	
PLC – Definition – Functional Block Diagram of PLC – Input Field Devices – Output Field Devices – Memory Organization Ladder Programming – Basic Ladder Logic Symbols - Relay Type Instructions: Normally Closed , Normally Opened Output coil - Logical Instructions: AND, OR, NAND, NOR, XOR, NOT		3
Ex.No.1: Design and Develop Ladder Logic Program to switch ON the pilot lamp when START Push button is pressed and lamp will be continuously ON even after the push button is released. Pilot lamp will be switched OFF when STOP button is pressed Ex.No.2: Design and Develop Ladder Logic Program to simulate the following Logic functions: NOT, AND, OR, NAND, NOR, XOR, XOR Logic. Ex.No.3: Design and Develop Ladder Logic Program to meet the following requirements When Switch 1 OR Switch 2 ON, Lamp ON When Switch 3 AND Switch 4 ON , Lamp OFF Ex.No.4: Design and Develop Ladder Logic program to meet the following requirements When Switch 1 ON, Lamp 1 and Lamp 2 ON When Switch 1 OFF, Lamp 1 OFF and Lamp 2 ON When Switch 2 ON , Lamp 2 OFF , Lamp 3 ON and Lamp 4 ON When Switch 2 OFF, Lamp 2 ON, Lamp 3 ON, Lamp 5 ON		12
Unit II	**PLC Timer and Counter programming through Ladder logic Diagram**	
Timer Instructions: On Delay Instruction - Off Delay Instruction - Retentive timer Instruction and Non-retentive Timer Instruction - Ladder Diagram timing application. **Counter Instructions**: Count-Up instruction - Count-Down Instruction, Reset (RST) - Ladder diagram for counting application		3

1042235540	Industrial Automation using PLC	L	T	P	C
Practicum		1	0	4	3

Ex.No.5:	**(i)** Develop and Implement Ladder Logic Diagram to switch ON the pilot lamp 10 second after the toggle switch is pressed. (ii) Develop and Implement Ladder Logic Diagram to switch OFF the pilot lamp 10 seconds after the toggle switch is pressed. (iii) Develop and Implement Ladder logic Diagram for cyclic ON & OFF of a Pilot Lamp	12
Ex.No.6:	Design and Develop Ladder Logic Diagram to count the event of toggling the switch And pilot lamp should be switched ON when the count value is 15.	
Unit III	**Branch and Sequencer Instructions**	
Branching Instructions: Jump to Label , Jump to Subroutine , Return , Subroutine , Master Control Reset (MCR) Shift & Sequence Instructions: Bit Shift Left, Bit Shift Right, Sequencer Output Sequencer Compare, Sequencer Load.		3
Ex.No.7:	Develop and implement a Ladder logic program for the sequence control of four outputs repetitively**.**	12
Ex.No.8:	Develop and implement a Ladder Logic program to run the motor in the forward direction when START_FORWARD switch is pressed and to run the motor in Reverse Direction When the START_REVERSE switch is pressed.	
Unit IV	**Data Manipulation , Mathematical and Compare Instructions**	
Data Compare Instructions: Equal (EQU) EQU, Less Than (LES), Less Than or Equal (LEQ), Not Equal (NEQ), Greater Than (GRT), Greater Than or Equal (GEQ)		3
Ex.No.9:	Develop and Implement Ladder Logic Diagram for the On/Off Level Control.	12
Ex.No.10:	Develop and implement a Ladder logic Diagram for conveyor control	
Unit V	**Applications of PLC**	
Data Manipulation Instructions: Move (MOV), Masked Move (MVM) Math Instructions: ADD, SUB, MUL, DIV, SQR		3
Ex.No.11:	Develop and Implement a Ladder logic Diagram for Car parking.	12
Ex.No.12:	Develop and Implement a Ladder Logic Diagram for Lift control	
TOTAL HOURS		**75**

1042235540	Industrial Automation using PLC	L	T	P	C
Practicum		1	0	4	3

Text Book for Reference:

1. Introduction to Programmable Logic Controllers by G. Dunning, Thomson / Delmar Learning, New Delhi (3rd edition)
2. Madhuchhanda Mitra ,Samarjit sen Gupta,"PLC and Industrial Automation and Introduction", Penram international Publishing (India) Pvt Ltd.
3. Programmable Logic Controllers by F.D. Petruzella, McGraw Hill India, New Delhi, 2003.

Web-based/Online Resources

- https://instrumentationtools.com/car-parking-system-plc-programming/
- https://instrumentationtools.com/plc-program-water-level-control/
- https://instrumentationtools.com/plc-program-conveyor-motor/
- https://instrumentationtools.com/elevator-plc-ladder-logic/

Equipment Required:

Sl.No.	Items Description	Quantity Required
1.	MODULE with Programmable Logic controller , Push Button/ Toggle switches, Pilot Lamp, provision to connect interface modules , Provision to connect with computer	As req.
2.	PC Pentium Dual core	As req.
3.	PC to PLC Interface cable	As req.
4.	ON- OFF Level control module to work with PLC	2
5.	Conveyor Control Module to work with PLC	2
6.	Lift control Module to work with PLC	2
7.	Car parking module to work with PLC	2

6000236111	Advanced Engineering Mathematics	L	T	P	C
Theory		3	0	0	3

Introduction

Mathematics is essential for engineering students to understand core engineering subjects. It provides the framework for engineers to solve problems in engineering domains. This course is designed to bridge the gap between diploma mathematics and B.E/B.Tech mathematics in matrix algebra, differential calculus, vector calculus, differential equations, and Laplace transforms.

Course Objectives

The objective of this course is to enable the students to

1. Understand the concepts of eigen-values and eigen-vectors of matrices.
2. Learn the notation of partial differentiation and determine the extremities of functions of two variables.
3. Acquire knowledge in vector calculus which is significantly used to solve engineering problems.
4. Formulate and solve differential equations.
5. Understand Laplace transformation and its engineering applications.

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Find eigenvalues and corresponding eigenvectors of a square matrix.

CO2: Apply the knowledge of partial differentiation to evaluate Jacobian and extremities of two variable functions.

CO3: Evaluate the gradient of a scalar field and the divergence and curl of vector fields.

CO4: Solve ordinary differential equations using various techniques.

CO5: Use Laplace transforms to solve first-order ordinary differential equations.

Pre-requisites

Matrices, Determinants, Differentiation, Integration and Vector Algebra.

6000236111	Advanced Engineering Mathematics	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	1	1	1	3
CO2	3	3	2	1	1	1	3
CO3	3	3	2	1	1	1	3
CO4	3	3	2	1	1	1	3
CO5	3	3	2	1	1	1	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- A theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-based.
- All demonstrations/Hands-on practices might be under a simulated environment.
- Use an inducto-deductive approach to achieve the desired learning objectives.
- Use open-ended questions to nurture the problem-solving and reasoning skills among students.
- Support and guide the students for self-study.
- State the need for mathematics with engineering studies and provide real-life examples.

6000236111	Advanced Engineering Mathematics	L	T	P	C
Theory		3	0	0	3

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1and CA2, Assessment test should be conducted for two units as below.

(5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

6000236111	Advanced Engineering Mathematics	L	T	P	C
Theory		3	0	0	3

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

6000236111	**Advanced Engineering Mathematics**	L	T	P	C
Theory		3	0	0	3

Unit I	**EIGENVALUES AND EIGENVECTORS**	
Characteristic equation – Eigen-values of 2×2 and 3×3 real matrices – Eigen-vectors of 2×2 real matrices – Properties of eigen-values (excluding proof) – Cayley-Hamilton theorem (excluding proof) – Simple problems.		7
Unit II	**FUNCTIONS OF SEVERAL VARIABLES**	
Partial derivatives of two variable and three variable functions (up to second order) – Homogeneous functions and Euler's theorem (excluding proof) – Jacobian matrix and determinant – Maxima and minima of functions of two variables – Simple problems.		7
Unit III	**VECTOR CALCULUS**	
Scalar field and Vector field – Vector differential operator – Gradient of a scalar field – Directional derivative – Divergence and curl of a vector field (excluding properties) – Solenoidal and irrotational vector fields – Simple problems.		7
Unit IV	**DIFFERENTIAL EQUATIONS**	
Differential equation – Formation – Order and degree – Solution of a differential equation – Equations of first order and first degree – Variable separable method – Leibnitz's Linear equations – Second order equations of the form $(aD^2 + bD + c)y = e^{nx}$ where a, b, c and n are constants and the auxiliary equation $(am^2 + bm + c = 0)$ has only real roots – Complementary function – Particular integral – General solution – Simple problems.		7
Unit V	**LAPLACE TRANSFORMS**	
Definition of Laplace transform – Laplace transforms of standard functions - Linearity and change of scale property (excluding proofs) – First shifting property – Laplace transforms of derivatives – Properties (excluding proofs) – Inverse Laplace transforms – Properties (excluding proofs) – Solving first order ordinary differential equation using Laplace transforms – Simple problems.		7
	Revision + Test	10
	TOTAL HOURS	45

6000236111	Advanced Engineering Mathematics	L	T	P	C
Theory		3	0	0	3

Suggested list of Students Activity,

- Demonstrate the applications of eigen-values in stability analysis, decouple of three-phase systems and vibration analysis.
- Demonstrate maxima and minima of two variable functions using GeoGebra graphing calculator.
- Demonstrate solenoidal vector field and irrotational vector field using engineering applications.
- Demonstrate the applications of differential equations in solving engineering problems.
- Presentation /Seminars by students.
- Quizzes.

Reference Books:

1. John Bird, Higher Engineering Mathematics, Routledge, 9th Edition, 2021.
2. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.
3. Arumugam, S., Thangapandi Isaac, A., & Somasundaram, A., Differential Equations and Applications, Yes Dee Publishing Pvt. Ltd., 2020.
4. Duraipandian, P., & Kayalal Pachaiyappa, Vector Analysis, S Chand and Company Limited, 2014.
5. Narayanan, S., & Manicavachagom Pillai T.K., Calculus Volume I and II, .Viswanathan Publishers Pvt. Ltd., 2007.

Web Reference

1. https://www.khanacademy.org/math/
2. https://www.mathportal.org/
3. https://openstax.org/subjects/math/
4. https://www.mathhelp.com/
5. https://www.geogebra.org/
6. https://www.desmos.com/
7. https://phet.colorado.edu/

6000236111	Advanced Engineering Mathematics	L	T	P	C
Theory		3	0	0	3

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hours. **Maximum Marks: 100**

Note: Answer Ten questions by selecting Two questions from each unit. Each question carries 10 marks.

Instruction to the question setters.

Each unit should have four questions. Each question carries 10 Marks. Each question may have two subdivisions only.

6000236112	Entrepreneurship	L	T	P	C
Theory		3	0	0	3

Introduction

Development of a diploma curriculum is a dynamic process responsive to the society and reflecting the needs and aspirations of its learners. Fast changing society deserves changes in educational curriculum particularly to establish relevance to emerging socio-economic environments; to ensure equity of opportunity and participation and finally promote concern for excellence. In this context the course on entrepreneurship and start ups aims at instilling and stimulating human urge for excellence by realizing individual potential for generating and putting to use the inputs relevant to social prosperity and thereby ensuring good means of living for every individual, providing jobs and developing the Indian economy.

Course Objectives

After completing this subject, the student will be able to

- Acquire entrepreneurial spirit and resourcefulness
- Familiarize Acquire knowledge about the business idea and product selection
- Analyze the banking and financial institutions
- Understand the pricing policy and cost analysis
- Get knowledge about the business plan preparation

Course Outcomes

CO1: Explain the process of entrepreneurship

CO2: Analyse the importance of generation of ideas and product selection

CO3: Familiarization of various financial and non financial schemes

CO4: Acquire various cost components to arrive pricing of the product

CO5: Learn the preparation of project feasibility report

Pre-requisites

Knowledge of basics of Engineering and Industrial engineering

6000236112	Entrepreneurship	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	3	1	3
CO2	-	-	-	-	3	3	3
CO3	-	-	-	1	-	3	2
CO4	-	1	3	3	2	3	2
CO5	-	2	3	3	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice- activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real- world scenarios when possible.

6000236112	Entrepreneurship	L	T	P	C
Theory		3	0	0	3

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1and CA2, Assessment test should be conducted for two units as below.

(5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

6000236112	Entrepreneurship	L	T	P	C
Theory		3	0	0	3

Unit I	Entrepreneurship – Introduction and Process	
Concept of entrepreneurship - Importance, Myths about Entrepreneurship, Pros and Cons of Entrepreneurship, Process of Entrepreneurship, , Competencies and characteristics of an entrepreneur -, Ethical Entrepreneurship, Entrepreneurial Values and Attitudes, Creativity, Innovation and entrepreneurship- Entrepreneurs - as problem solvers, Mindset of an employee and an entrepreneur, - Risk Taking-Concepts		7
Unit II	**Business Idea**	
Types of Business: Manufacturing, Trading and Services, Stakeholders: sellers, vendors and consumers and Competitors, E- commerce Business Models, business idea generation -Types of Resources - Human, Capital and Entrepreneurial tools and resources, etc.,- setting business goals- Patent, copyright and Intellectual property rights, Customer Relations and Vendor Management, -Business Ideas vs. Business Opportunities, Opportunity – SWOT ANALYSIS of a business idea - Business Failure – causes and remedies.- Types of business risks,		7
Unit III	**Banking**	
Size and capital based classification of business enterprises- Role of financial institutions, Role of Government policy, Entrepreneurial support systems, Incentive schemes for state government, and Incentive schemes for Central governments.		7
Unit IV	**Pricing and Cost Analysis**	
Types of Costs - Variable - Fixed- Operational Costs - Break Even Analysis - for single product or service, -financial Business Case Study, Understand the meaning and concept of the term Cash Inflow and Cash Outflow- Pricing- Calculate Per Unit Cost of a single product, , Understand the importance and preparation of Income Statement, Prepare a Cash Flow Projection- Factors affecting pricing.- GST.		7

6000236112	Entrepreneurship	L	T	P	C
Theory		3	0	0	3

Unit V	Business Plan Preparation	
Feasibility Report – Technical analysis, financial analysis- Market Research - Concept, Importance and Process- tools for market research- Market Sensing and Testing, Marketing and Sales strategy, Digital marketing, Branding - Business name, logo, tag line, Promotion strategy, Business Plan Preparation, -Concept and Importance, , Execution of Business Plan.		7
	Revision + Test	10
	TOTAL HOURS	45

Suggested list of Students Activity.

1. Students can explore app development or web design. They'll learn about technology, user experience, and marketing.
2. Hosting events, workshops, or conferences allows students to practice project management, networking, and marketing skills.
3. Encourage students to address social or environmental issues through innovative business solutions. This fosters empathy and creativity.
4. Part of entrepreneurship clubs or organizations provides networking opportunities, mentorship, and exposure to real-world challenges.
5. Competitions like business plan contests or pitch events allow students to showcase their ideas and receive feedback.
6. Students can create and sell handmade crafts, artwork, or other products. This teaches them about production, pricing, and customer relations.
7. Students can provide consulting services in areas they're knowledgeable about, such as social media marketing or financial planning.
8. Encourage students to create and manage their own small business or offer freelance services. This hands-on experience helps them understand various aspects of entrepreneurship.

6000236112	Entrepreneurship	L	T	P	C
Theory		3	0	0	3

Text and Reference Books:

1. G.K. Varshney, Fundamentals of Entrepreneurship, Sahitya Bhawan Publications, Agra., 2019.
2. H.Nandan, Fundamentals of Entrepreneurship, Prentice Hall India Learning Private Limited, Third Edition, 2013.
3. R.K. Singal, Entrepreneurship Development & Management, S K Kataria and Sons, 2013.

Web Reference:

- https://ocw.mit.edu/courses/15-390-new-enterprises-spring-2013/resources/lecture-1/
- https://onlinecourses.nptel.ac.in/noc20_ge08/preview

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hours. **Maximum Marks: 100**

Note: Answer Ten questions by selecting Two questions from each unit. Each question carries 10 marks.

Instruction to the question setters.

Each unit should have four questions. Each question carries 10 Marks. Each question may have two subdivisions only.

6000236113	Project Management	L	T	P	C
Theory		3	0	0	3

Introduction

Project management is the systematic application of knowledge, skills, tools, and techniques to project activities to meet specific project requirements. It involves planning, organizing, and managing resources to achieve project goals within defined scope, time, and budget constraints. Project management encompasses several key processes and phases, including initiation, planning, execution, monitoring and controlling, and closing. It is essential across various industries to ensure projects are completed successfully, efficiently, and effectively, aligning with organizational objectives and stakeholder expectations. Project managers play a crucial role in leading teams, managing risks, ensuring quality, and communicating with stakeholders to drive project success.

Course Objectives

After completing this subject, the student will be able,

- To understand the concept, characteristics and elements of projects.
- To understand the stages in Project Life Cycle.
- To appreciate the need for Project Portfolio Management System.
- To know the considerations in choosing appropriate project management structure.
- To understand the components of techno-economic feasibility studies.
- To know about the detailed project report
- To learn about project constraints.
- To understand the techniques of evaluation.
- To get insight into the Social Cost Benefit Analysis Method.
- To know how to construct project networks using PERT and CPM.
- To learn how to crash project networks
- To understand the meaning of project appraisal.
- To understand the meaning of project audits.
- To know the qualities of an effective project manager.
- To understand the stages in the Team Development model.

6000236113	Project Management	L	T	P	C
Theory		3	0	0	3

Course Outcomes

CO 1: Explain the principles of Project Management

CO 2: Create and manage project schedules.

CO 3: Create structure and manage the project commitments.

CO 4: Acquire to Gain enterprise support.

CO 5: Prepare a Detailed Project Report (DPR).

Pre-requisites

Basic Knowledge.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	-	3	1
CO2	3	-	-	-	1	3	1
CO3	3	-	-	1	1	3	1
CO4	3	-	-	-	1	3	1
CO5	3	-	-	1	1	3	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

6000236113	Project Management	L	T	P	C
Theory		3	0	0	3

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1and CA2, Assessment test should be conducted for two units as below.

(5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

6000236113	Project Management	L	T	P	C
Theory		3	0	0	3

Unit I	Project Management – An Overview, Project Portfolio Management System and Structure, Steps in Defining Project and Project Delays	
Project – Classification – Importance of Project Management – An Integrated Approach – Project Portfolio Management System – The Need – Choosing the appropriate Project Management Structure: Organizational considerations and project considerations – steps in defining the project – project Rollup – Process breakdown structure – Responsibility Matrices – External causes of delay and internal constraints.		7
Unit II	**Various Stages and Components of Project Feasibility Studies, Phases of a Project, Stages in Project Life Cycle and Project Constraints**	
Project feasibility studies - Opportunity studies, General opportunity studies, specific opportunity studies, pre-feasibility studies, functional studies or support studies, feasibility study – components of project feasibility studies – Managing Project resources flow – project planning to project completion: Pre-investment phase, Investment Phase and operational phase – Project Life Cycle – Project constraints.		7
Unit III	**Project Evaluation under Certainty and Uncertainty, Project Evaluation, Commercial and Social Cost Benefit Analysis**	
Project Evaluation under certainty - Net Present Value (Problems - Case Study), Benefit Cost Ratio, Internal Rate of Return, Urgency, Payback Period, ARR – Project Evaluation under uncertainty – Methodology for project evaluation – Commercial vs. National Profitability – Social Cost Benefit Analysis, Commercial or National Profitability, social or national profitability.		7

6000236113	Project Management	L	T	P	C
Theory		3	0	0	3

Unit IV	Developing Project Network using PERT and CPM, Project Appraisal and Control Process.	
Developing a Project Plan - Developing the Project Network – Constructing a Project Network (Problems) – PERT – CPM – Crashing of Project Network (Problems - Case Study) – Resource Leveling and Resource Allocation – how to avoid cost and time overruns – Steps in Project Appraisal Process – Project Control Process – Control Issues – Project Audits – the Project Audit Process – project closure – team, team member and project manager evaluations.		7
Unit V	**Project Managing Versus Leading of Project, Qualities of Project Manager and Managing Project Teams, Team Building Models and Performance Teams and Team Pitfalls.**	
Managing versus leading a project - managing project stakeholders – social network building (Including management by wandering around) – qualities of an effective project manager – managing project teams – Five Stage Team Development Model – Situational factors affecting team development – project team pitfalls.		7
	Revision + Test	10
	TOTAL HOURS	45

Suggested list of Students Activity,

Project Simulation and Role-Playing:

- Activity: Participate in simulated project scenarios where students take on different roles within a project team (e.g., project manager, team member, stakeholder).
- Purpose: This helps students understand the dynamics of project management, including leadership, communication, and team collaboration.

6000236113	Project Management	L	T	P	C
Theory		3	0	0	3

Case Study Analysis:

- Activity: Analyze real-world case studies of successful and failed projects.
- Purpose: This activity enables students to apply theoretical knowledge to practical situations, identify best practices, and learn from the challenges and solutions implemented in real projects.

Project Plan Development:

- Activity: Develop a comprehensive project plan for a hypothetical or real project, including scope, schedule, budget, risk management, and quality management plans.
- Purpose: This allows students to practice creating detailed and structured project plans, honing their skills in planning and organizing project activities.

Group Project:

- Activity: Work in teams to manage a project from initiation to closure, simulating a real project environment.
- Purpose: Group projects help students learn how to work collaboratively, manage group dynamics, and apply project management tools and techniques in a team setting.

Project Management Software Training:

- Activity: Gain hands-on experience with project management software such as Microsoft Project, Asana, or Trello.
- Purpose: This activity equips students with practical skills in using technology to plan, track, and manage project tasks and resources efficiently.

Reference Books:

1. Clifford F. Gray And Erik W. Larson, Project Management – The Managerial Process, Tata Mcgraw Hill.
2. Dragan Z. Milosevic, Project Management Toolbox: Tools And Techniques For The Practicing Project Manager,
3. Gopalakrishnan, P/ Ramamoorthy, V E, Textbook Of Project Management, Macmillan India. Ltd.
4. Harold Kerzner, Project Management: A Systems Approach To Planning, Scheduling, And Controlling, Eighth Edition, John Wiley & Sons
5. Jason Charvat, Project Management Methodologies: Selecting, Implementing, And Supporting Methodologies And Processes For Projects, John Wiley & Sons
6. Kevin Forsberg, Ph.D, Hal Mooz, Visualizing Project Management: A Model For Business And Technical Success, Second Edition, Pmp And Howard Cotterman, John Wiley & Sons.

6000236113	Project Management	L	T	P	C
Theory		3	0	0	3

Web Reference

https://youtu.be/pc9nvBsXsuM

NPTEL Courses

https://youtu.be/PqQqTAu_FiM

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hours. **Maximum Marks: 100**

Note: Answer Ten questions by selecting Two questions from each unit. Each question carries 10 marks.

Instruction to the question setters.

Each unit should have four questions. Each question carries 10 Marks. Each question may have two subdivisions only.

6000236114	Finance Fundamentals	L	T	P	C
Theory		3	0	0	3

Introduction

This course gives a deep insight into the finance fundamentals such as money management and the process of acquiring needed funds. It also encompasses the oversight, creation, and study of money, banking, credit, investments, assets, liabilities that make up financial systems and improves overall financial literacy.

Course Objectives

The objective of this course is to

1. Identify different ways to save money for future
2. Understand various techniques to raise capital
3. Get acquainted with the essential terminologies used in finance language
4. Get exposed to different types of budgeting
5. Instill the concept of costing and its impact on profitability

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Manage financial resources effectively to achieve personal goals

CO2: Explain the procedure for Business Funding

CO3: Exhibit financial literacy through the usage of different terminologies appropriate to the context

CO4: Differentiate the types of budgeting and allocate the resources

CO5: Apply the idea of marginal costing in decision making

Pre-requisites

Knowledge of basic mathematics

6000236114	Finance Fundamentals	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	1	-	2
CO2	3	-	-	-	1	-	2
CO3	3	-	-	-	1	-	2
CO4	3	-	-	-	1	-	2
CO5	3		-	-	1	-	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice- activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real- world scenarios when possible.

6000236114	Finance Fundamentals	L	T	P	C
Theory		3	0	0	3

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1and CA2, Assessment test should be conducted for two units as below.

(5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

6000236114	Finance Fundamentals	L	T	P	C
Theory		3	0	0	3

UNIT I	Personal Finance	
Personal Finance – Meaning, Objectives and advantages – Individual Perspective – Family Perspective – Time Value of Money – Personal Savings: Meaning, Different modes of Saving – Bank Deposit, Online Investments, Insurance, Stocks, Gold, Real Estate – Returns Vs Risk – Financial Discipline – Setting Alerts for commitments (With Real time Examples).		7
UNIT II	**Business Funding**	
Sources: Personal Savings – Borrowings - Venture Capital – Venture Capital Process – Commercial Banks – Government Grants and Scheme.		7
UNIT III	**Finance language**	
Capital – Drawing – Income – Expenditure – Revenue Vs Capital Items – Assets – Fixed Assets – Current Assets – Fictitious Assets – Liabilities – Long-term Liabilities – Current Liabilities – Internal Liabilities – External Liabilities – Shareholders fund: Equity Share capital, Preference Share Capital, Reserve & Surplus – Borrowings: Debentures, Bank Loan, Other Loan – Depreciation – Reserve Vs Provision.		7
UNIT IV	**Budgeting**	
Budgetary Control – Meaning – Preparation of various budgets – Purchase budget – Sales Budget – Production budget – Cash Budget – Flexible budgets. (With Problems)		7
UNIT V	**Marginal Costing**	
Marginal Costing – Meaning – Marginal Costing Vs Absorption Costing – Concepts of Variable Cost, Fixed Cost and Contribution – PV Ratio – Break Even Point – Margin of Safety – Key Factor – Application of Marginal Costing in decision making – Make or Buy – Shutdown or Continue – Exploring New Markets (With Problems)		7
	Revision + Test	10

6000236114	Finance Fundamentals	L	T	P	C
Theory		3	0	0	3

Suggested list of Students Activity,

Financial Statement Analysis:

- Activity: Analyze and interpret financial statements, including balance sheets, income statements, and cash flow statements of different companies.
- Purpose: This activity helps students understand the financial health and performance of organizations, developing skills in financial analysis and critical thinking.

Investment Portfolio Management:

- Activity: Create and manage a simulated investment portfolio, making decisions on asset allocation, stock selection, and diversification.
- Purpose: This allows students to apply theoretical concepts in a practical setting, learning how to evaluate investment opportunities and manage financial risk.

Case Study Analysis:

- Activity: Examine real-world case studies involving financial decisions made by companies, such as capital budgeting, mergers and acquisitions, and financial restructuring.
- Purpose: Case studies provide insights into the application of finance principles in business scenarios, enhancing problem-solving and decision-making skills.

Classroom Discussions and Debates:

- Activity: Participate in discussions and debates on current financial issues, market trends, and economic policies.
- Purpose: Engaging in discussions helps students stay informed about the latest developments in finance, develop their communication skills, and form well-rounded opinions on financial matters.

Reference Books:

1. Banking Theory, Law & Practice - Dr.L.Natarajan, Margham Publications.
2. Corporate Accounting by T.S.Reddy and Dr.A.Murthy, Margham Publications.
3. Management Accounting by T.S.Reddy and Dr.Y.Hariprasd Reddy, Margham Publications.
4. Cost Accounting by T.S.Reddy and Dr.Y.Hariprasd Reddy, Margham Publications.

6000236114	Finance Fundamentals	L	T	P	C
Theory		3	0	0	3

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hours. **Maximum Marks: 100**

Note: Answer Ten questions by selecting Two questions from each unit. Each question carries 10 marks.

Instruction to the question setters.

Each unit should have four questions. Each question carries 10 Marks. Each question may have two subdivisions only.

1042236115	Bio Medical Instrumentation	L	T	P	C
Theory		3	0	0	3

Introduction:

Bio medical engineering education is in the growing stage. But every year, there is a tremendous increase in the use of modern medical equipment in the hospital and health care industry therefore it is necessary for every student to understand the functioning of different medical equipment. This course is to enable the students to learn the basic principles of different bio medical instruments and clinical measurement, Bio-medical recorders, Therapeutic instruments, Biotelemetry and Modern imaging techniques instruments.

Course Objectives:

The objective of this course is to enable the students to

- Acquire Knowledge on the generation of Bio-potential and its measurement using various electrodes.
- Gain Knowledge on the working principles of operations of ECG recorder, EEG recorder and EMG recorder.
- Acquire Knowledge on the working principles of audio meter, pacemaker and ventilators.
- Gain knowledge about the importance of patient safety and various methods of accident prevention.
- Acquire knowledge on the basic principle of CT, MRI scanner and operation of various imaging techniques.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain about Bio - electric signals, electrodes and clinical measurement.

CO2: Explain the construction and working of Bio - medical recorders.

CO3: Explain the construction and working of Therapeutic instruments.

CO4: Explain the construction and working of Biotelemetry and patient safety systems.

CO5: Explain the construction and working of Modern imaging techniques instruments.

Pre-requisites:

Basics of Electronics & Instrumentation, Electronic devices and circuits, Analog and digital electronic circuits.

1042236115	Bio Medical Instrumentation	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	2	-	-	-
CO2	3	2	3	2	-	-	-
CO3	3	2	3	2	-	-	-
CO4	3	2	3	2	-	-	-
CO5	3	2	3	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers must use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different types of Diagnostic and Therapeutic equipment, Teachers should use PPT presentation of image and to show video of application of the Diagnostic and Therapeutic Equipment. Also, should explain examples from daily life, realistic situations, and visit hospitals and demonstrate the equipment.
- Students may be shown all the Diagnostic, Therapeutic, and operating theater equipment in the lab. The demonstration can make the subject exciting and foster in.
- The students have a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to use the diagnostic equipment to diagnose the disease in a human body.
- Teachers are advised to follow an inductive strategy to help the students to discover the working principle of various diagnostic and therapeutic instruments.

1042236115	Bio Medical Instrumentation	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042236115	Bio Medical Instrumentation	L	T	P	C
Theory		3	0	0	3

Unit I	PHYSIOLOGICAL & CLINICAL MEASUREMENTS	
	Bio Potential and Electrodes : Components of man instrument system – Bio-potential and their generation – resting & action potential. Electrodes -Micro- Skin Surface – Needle electrodes. **Clinical Measurements:** Measurement of blood pressure – Direct method- indirect Method – Blood flow meter - Electromagnetic blood flow meter- Ultrasonic blood flow meter. Measurement of blood pH – CO_2 method of respiration rate – Lung Volume – Heart rate	9
Unit II	**DIAGNOSTIC INSTRUMENTS**	
	Electro cardiograph: 12 Lead systems – ECG recorder – analysis of ECG waves. **Electro Encephalograph:** 10-20% lead System - EEG recorder- EEG wave types **Electro Myograph :** EMG Waves - EMG Recording unit - Measurement of conduction velocity. **Electro Retinograph :** ERG Recording Unit – ERG waves. **Audiometer :** Basic Audiometer Block diagram - Types	9
Unit III	**THERAPEUTIC INSTRUMENTS**	
	Cardiac pacemaker: Need for pacemaker – Classification – External pacemaker – Implantable pacemaker – Programmable pacemaker. **Cardiac Defibrillators:** Need for defibrillators – Types – AC defibrillators - DC Defibrillators. **Heart lung Machine**: Block Diagram - Oxygenators – Blood pumps. **Dialysis** : Hemo dialysis – peritoneal dialysis – Working	9
Unit IV	**BIO – TELEMETRY AND PATIENT SAFETY**	
	Bio – Telemetry: Introduction to Bio telemetry - Physiological parameter adaptable to bio telemetry - components of a bio telemetry system – Application of bio telemetry. **Patient Safety:** Physiological effects of electric current – Electrical Shock Hazards- Micro shock – Macro shock- Methods of accident Prevention against electric hazards – GFI – equi potential grounding system.	9
Unit V	**MODERN IMAGING TECHNIQUES**	
	Laser: Laser – Properties - principles - application of laser in medicine. Operation of Co_2 Laser & ND – YAG Laser. **X –Ray:** X-Ray apparatus – Block Diagram – operation - Angiography – CT Scanner. **Ultrasonic imaging Technique** : Echo cardiography – Working – Operating modes **Magnetic resonance imaging Technique** : MRI Scan Principles - Working	9
	TOTAL HOURS	45

1042236115	Bio Medical Instrumentation	L	T	P	C
Theory		3	0	0	3

Suggested List of Activities (upgraded):

- Students can view the video in YouTube on different kind of Medical instruments being used in hospitals
- Student can view the procedure of using the Medical instruments in the hospital to Patients in the video
- Students can visit hospital and can observe the different kind of Medical instruments being used in hospital for diagnosing and therapeutic purpose.
- Student can try to open the old medical instruments and see the inner parts and circuits and try to debug the problem.
- Students have to practice the design and construction of Medical electronics circuits
- Student can read Magazines related to Bio medical equipment in online or in offline
- Students have to practice to measure Blood pressure using Sphygmomanometer, can practice to take ECG, EEG with the concerned equipment.

Text Books for Reference:

1. Dr.M. Arumugam – Biomedical Instrumentation, Anuradha Publications, Chennai
2. Medicine and clinical Engineering, Jacobson and Webstar, Prentice-Hall
3. Introduction to Biomedical Instrumentation, Mandeep Singh, PHI Learning Pvt. Ltd, 2nd edition 2010

1042236115	Bio Medical Instrumentation	L	T	P	C
Theory		3	0	0	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
2.
3.
4.

II. 5.
6.
7.
8.

III. 9.
10.
11.
12.

IV. 13.
14.
15.
16.

V. 17.
18.
19.
20.

1042236116	Power Plant Instrumentation	L	T	P	C
Theory		3	0	0	3

Introduction:

The course is designed to familiarize the student with the functions and instrumentation available in a modern power generation plant. The student is first exposed to an in-depth analysis of the process of controlling the generation of electricity from traditional fuel sources. This is followed by a study of instrumentation and control aspects of alternative forms of electricity generation.

Course Objectives:

The objective of this course is to enable the students to

- Acquire knowledge on the overview of different methods of power generation.
- Gain Knowledge on the various measurements involved in power generation plants.
- Acquire knowledge on the working principles of different types of devices used for analysis.
- Gain knowledge on the working principle of different types of controls and control loops
- Acquire knowledge on the working principles of measurement of various turbine parameters like speed, vibration and temperature and their control.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the basic principles of power generation.

CO2: Explain measurements of various parameters in power plant.

CO3: Explain the various analyzers in power plants.

CO4: Explain about the turbine boiler control.

CO5: Explain about the turbine monitoring and control.

Pre-requisites:

Basics of Instrumentation, Sensors and transducers, Measurement of process variables, Process control Instrumentation.

1042236116	Power Plant Instrumentation	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	-	-	-	-
CO2	3	2	1	-	-	-	-
CO3	3	2	1	-	-	-	-
CO4	3	2	1	-	-	-	-
CO5	3	2	1	-	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different types of power generation methods and power plants. Teachers should use PPT presentation and to show video of power generation in different types of power plants. Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- Students may be shown models of different types of power plants. The demonstration of one particular power plant can make the subject exciting and foster in the students a scientific mind set.
- Teachers are advised to follow an inductive strategy to help the students to discover the working principle of various components, switches and relays.

1042236116	Power Plant Instrumentation	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042236116	Power Plant Instrumentation	L	T	P	C
Theory		3	0	0	3

Unit I	POWER GENERATION METHODS	
Introduction - Hydro Electric Power Plant – Classification of hydroelectric power plant – Components used in Hydro Electric power plant – Working - Thermal power plant – Circuits in thermal power plant – Components used in Thermal power plant – Working of thermal power plant – Solar power plant – working of solar power plant – Nuclear power plant – Components used in nuclear power plant – working of pressurized water reactor & boiling water reactor – Wind power plant – Basic components used in wind power plant – Working.		9
Unit II	**MEASUREMENTS IN POWER PLANTS**	
Airflow Measurements – Variable head flow meters – Hot wire Anemometer – Steam Flow Measurement – Steam temperature measurement – Drum level measurement – Dust measurements – Smoke Measurements – Radiation Detectors – Geiger Muller counter – scintillation counter – Pressure gauges		9
Unit III	**ANALYTICAL MEASUREMENT**	
Introduction – Oxygen Measurement in flue gas – CO_2 in flue gas – combustibles analyzer – infrared flue gas analyzers – chromatography – Air pollution monitoring instruments - Fuel analyzers – Coal calorimeter and gas calorimeter.		9
Unit IV	**CONTROL LOOPS IN BOILERS**	
Block diagram of boiler control systems - combustion control – air / fuel ratio control – single point positioning – parallel positioning - combustion control - coal / air ratio control - furnace draft control using feed forward and feedback control – Boiler drum level control - single , two and three element control – Boiler feed water pumping and heating systems – flue gas dew point control – soot blowing .		9

1042236116	Power Plant Instrumentation	L	T	P	C
Theory		3	0	0	3

Unit V	TURBINE MONITORING AND CONTROL	
Introduction – Speed, Vibration, Shell temperature monitoring and control – Lubrication system for Turbo Alternator – Block Diagram –Controls in lubrication systems – Lube oil pressure / Flow control – Lube oil temperature control – Lube oil tank level control – Turbo alternator cooling systems – Classification of cooling system – Open or once through system - closed system – air cooling system.		9
TOTAL HOURS		45

Suggested List of Activities (upgraded):

- Students can visit nearby power plant and inspect the different types of instrumentation employed in power plant
- Students can see the video in YouTube related to power generation methods and instrumentation used in power generation
- Students can play quiz game on different type of sensors, actuators employed in power plants and update the knowledge
- Students can read magazines on Power plant and update their knowledge on renewable energy methods and required instrumentation for it

Text Books for Reference:

1. Krishnaswamy .K and Ponnibala . M,Power plant instrumentation, PHI Learning PVT Ltd.,
2. P.Tamilmani , Power plant instrumentation , Sams Publishers, Chennai.
3. P.K.NAG , Power plant Engineering, Tata McGraw – Hill Education, Third Edition 2007

1042236116	Power Plant Instrumentation	L	T	P	C
Theory		3	0	0	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042236117	Industrial Process Control Instrumentation	L	T	P	C
Theory		3	0	0	3

Introduction:

The aim of introducing this subject is to make the students more conversant with the process terminology and all types of control involved in process industries. This subject covers the detailed instrumentation and control of Heat exchanger, Steam boiler, Distillation column, Dryer, Pump and Compressor. Also, it provides an idea about the instrumentation and control in Paper and Pulp industry and pharmaceutical industry briefly. This subject gives more confidence to the students to choose their career as Instrumentation engineers in process industries.

Course Objectives:

The objective of this course is to enable the students to

- Acquire knowledge on Heat transfer unit operations.
- Acquire knowledge on control of Heat and Mass transfer unit operations.
- Gain knowledge on Control of Pumps and compressors.
- Acquire knowledge of Instrumentation and control in Paper and pulp Industries.
- Gain Knowledge about process control in Pharmaceutical and Fermentation industries.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the different types of control of heat exchanger and boiler.

CO2: Analyze the various controls of Distillation Column & Dryers.

CO3: Examine the Control Methods of Pumps & Compressors.

CO4: Describe the Paper and Pulp Industry Control Systems.

CO5: Identify Control methods in Pharmaceutical and Fermentation Industry.

Pre-requisites:

Process Control Instrumentation

1042236117	Industrial Process Control Instrumentation	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	2	2	2
CO2	3	3	3	2	2	2	2
CO3	3	3	3	2	2	2	2
CO4	3	3	2	2	2	2	2
CO5	3	3	2	3	2	2	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different types of control of heat exchanger. Teachers should use PPT presentation of image, symbol of components and to show video of application of the control methods.
- Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- Students may be shown all the Control operations in the video demonstration. The demonstration can make exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to demonstrate working of Pumps.
- Teachers are advised to follow an inductive strategy to help the students to discover the working principle of Compressors.
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any?

1042236117	Industrial Process Control Instrumentation	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each. Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042236117	Industrial Process Control Instrumentation	L	T	P	C
Theory		3	0	0	3

Unit I	CONTROL OF HEAT TRANSFER UNIT OPERATIONS	
Control of Heat exchanger – Variables and Degrees of Freedom – Liquid-To-Liquid Heat Exchangers – Feedback Control – Steam Heated Exchanger – Feedback Control – Bypass Control – Cascade Control - Control of Steam Boiler – Boiler Equipment – In-line instruments of Drum type Boiler – Combustion Control.		9
Unit II	**CONTROL OF HEAT AND MASS TRANSFER UNIT OPERATIONS**	
Control of Distillation Column – Distillation Equipment – Variables and degrees of freedom – Pressure Control – Feed Control – Reboiler Control – Reflux Control - Control of Dryers – Principles – Control – Batch dryers – Atmospheric tray dryer – Batch Fluid bed dryer – Continuous dryers – Double drum dryer – Rotary dryer.		9
Unit III	**CONTROL OF PUMPS & COMPRESSORS**	
Control of Pumps –Pump control methods –Centrifugal Pump –On-Off Level Control –On-Off Flow Control – On-Off Pressure Control – Speed Variation – Rotary Pump – On-Off Control – Safety and Throttling Control – Reciprocating Pump – On-Off Control – Throttling Control. Control of Compressors – Capacity control methods of Compressors – Centrifugal Compressor –Surge Control – Anti surge Control – Rotary Compressor – Bypass and Suction Control – Reciprocating Compressor – On-Off Control – Constant Speed Capacity Control.		9
Unit IV	**CONTROL INSTRUMENTATION IN PAPER AND PULP INDUSTRY**	
Description of the Process – Basis weight measurement – Consistency Sensors – Typical Control Systems in the Paper industry – Blow down Tank Control – Digester Liquor Feed Pump Control – Brown Stock Washer Level Control – Stock Chest Level Control – Basis Weight Control of a Paper Machine – Valves in the Paper industry.		9
Unit V	**PROCESS CONTROL IN PHARMACEUTICAL AND FERMENTATION INDUSTRY**	
Description of the Process – Fermentation – Measurement Hardware in the Pharmaceutical industry – Flow, Level, Pressure measurement – Temperature measurement – Smoke detector – Analyzers in the Pharmaceutical industry – Fermentation Control System – pH Control – Temperature Control – Tablet Coating Control.		9
TOTAL HOURS		**45**

1042236117	Industrial Process Control Instrumentation	L	T	P	C
Theory		3	0	0	3

Suggested List of Students Activity (Ungraded)

- Check the web portal for Image and video of different types of heat transfer unit operations.
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce the control methods, image of different types of pumps and working principles.
- Students might be asked to find the various components in real life equipment.
- Students might be asked to see the demonstration video of various industry oriented processes.
- Students might work on the Industrial Process Control components using simulation software in the virtual laboratory web portal.

Text books for reference:

1. Bela G.Liptak, Instrumentation in Processing Industries, Second Edition, Chilton Book Co Publications, 2009
2. Gregory K. McMillan, P. Hunter Vegas, 'Process/Industrial Instruments and Controls Handbook', Sixth Edition, McGraw Hill Publication, 2019
3. Dale R. Patrick and Stephan W. Fardo, Industrial Process Control Systems, Second Edition, River Publications, 2021.

1042236117	Industrial Process Control Instrumentation	L	T	P	C
Theory		3	0	0	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042236211	Industrial Automation and Drives	L	T	P	C
Theory		3	0	0	3

Introduction:

Fundamental knowledge in the field of Industrial Automation and Drives are essential for Instrumentation Engineers. As most of the devices are electrical and electronics based, the student is required to develop a basic understanding of the concepts and related terms of automation, Pneumatics, Hydraulics, and Industrial Drives which is in this backdrop that this course has been designed. An Instrumentation Engineer must be familiar with the basics of Industrial Automation, Pneumatics and Hydraulics Systems, Components of Automation and Electrical Safety which is also be dealt in this subject.

Course Objectives:

The objective of this course is to enable the students to

- Acquire knowledge on different types of automation, various components and levels of Industrial automation.
- Gain Knowledge on Pneumatic System and various types of valves, speed Control of Pneumatic Circuits.
- Acquire knowledge on Hydraulic System and the various types of hydraulic accumulators, speed Control of Hydraulic Circuits.
- Illustrate the Parts, various types of Electric drives and construction working of Stepper motor and Servo motors.
- Identify the various circuit breaker, Sensors in Automation and Analyze the safety precaution in Industry.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the different types and Components of automation in Industry.

CO2: Analyze the different types of control valves in Pneumatics system.

CO3: Examine the Hydraulic systems and Speed Control Methods.

CO4: Describe the various types of drives and Special motors.

CO5: Identify the different circuit breakers, sensors, and Safety methods.

Pre-requisites:

Electrical circuits and machines & Instrumentation Fundamentals.

1042236211	Industrial Automation and Drives	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	-	-	-
CO2	3	2	2	2	-	-	-
CO3	3	2	2	2	-	-	-
CO4	3	2	2	2	-	-	-
CO5	3	2	2	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers must use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different types of automation. Teachers should use PPT presentation of image, symbol of components and to show video of application of the components.
- Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- Students may be shown all the Pneumatics and Hydraulics components, Electrical drives, and Sensor in the lab. The demonstration can make the subject exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to demonstrate the working of motors.
- Teachers are advised to follow inductive strategy to help the students to discover the working principle of Pneumatics and Hydraulics components, Electrical drives and Sensor.
- Do not let incidents work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any?

1042236211	Industrial Automation and Drives	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042236211	Industrial Automation and Drives	L	T	P	C
Theory		3	0	0	3

Unit I	BASICS OF INDUSTRIAL AUTOMATION	
Automation - Definition – Types of automation in Industry – Requirements of automation – Components of Industrial Automation- Industrial automation levels- Advantages and Disadvantages of automation-` Applications of Industrial Automation – List of various Latest Automation Technologies.		9
Unit II	**PNEUMATIC SYSTEMS**	
Pneumatic system - Introduction - Elements of Pneumatic power supply – FRL Unit - Pressure control valves - Pressure relief valve - Pressure reducing valve - Directional control valve (DCV) - Poppet and spool valve - 3/2 DCV - 4/3 DCV - 5/2 DCV - Valve symbols- working-Applications of pneumatic systems. Pneumatic circuits – Speed Control of a single acting cylinder and Double acting cylinder with meter in and meter out circuits.		9
Unit III	**HYDRAULIC SYSTEMS**	
Hydraulic system – Introduction–Elements of Hydraulic power supply – Hydraulic accumulators – Definition - Types – Weight of gravity type accumulator – Spring loaded type accumulator - Gas filled accumulator – Applications of Hydraulic systems- Comparison between hydraulic and Pneumatic Systems. Hydraulic circuits – Double acting cylinder with meter in and meter out circuits		9
Unit IV	**INDUSTRIAL DRIVES**	
Electric drive - Definition - Parts - Types - Individual - Group - Multi motor- Comparisons of Electric Drives - Block diagram of Variable Frequency Drive (VFD) Selection factors of motor- Stepper Motor-Types – VR stepper motor - Construction - Working Principle - Applications- Servo motor- Permanent magnet Servo motor- Brushless Servo motor-Construction –working- Applications.		9

1042236211	Industrial Automation and Drives	L	T	P	C
Theory		3	0	0	3

Unit V	AUTOMATION COMPONENTS AND ELETRICAL SAFETY	
	Automation Components: Sensors- Temperature Sensor - Proximity Sensor- Pressure Sensor- Level Sensor - Infrared Sensor **Electrical safety**: Circuit breakers- Miniature Circuit Breaker (MCB)- Earth Leakage Circuit Breaker (ELCB) - Earthing – Need for Earthing-Types of earthing - Electric shock- first aid, precautions - causes of accident and their preventive measures.	9
	TOTAL HOURS	**45**

Suggested List of Students Activity (Ungraded)

- Check the web portal for Image and video of different types of Automation, Pneumatics Components, Sensors and Electric drives.
- Periodical quizzes should be conducted on a a weekly/fortnightly basis to reinforce the valve symbols, image of different types of motors and working principles
- Students might be asked to find the various components in real life equipment, circuits.
- Students might be asked to see the demonstration video of various electrical drives.
- Students might work the automation components using simulation software in the virtual laboratory web portal.

Text Books for Reference:

1. R.Srinivasan, Hydraulics and Pneumatic control, Second edition, McGraw Hill Education, 2008.
2. R.Srinivasan, Special Electrical Machines, Second edition, Lakshmi Publication, 2018.
3. G.K.Dubey, Fundamentals of Electrical Drives, Second edition , Narosa Publishing House Pvt LTD, 2010

Website Reference:

1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://www.electricaltechnology.org/2015/09/what-is-industrial-automation.html
3. https://themechanicalengineering.com/pneumatic-system

1042236211	Industrial Automation and Drives	L	T	P	C
Theory		3	0	0	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

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1042236212	Instrumentation in Paper and Cement Industries	L	T	P	C
Theory		3	0	0	3

Introduction:

The aim of introducing this subject is to make the students more conversant with the process terminology and all types control involved in process industries. This subject covers the detailed instrumentation and control of Heat exchanger, Steam boiler, Distillation column, Dryer, Pump and Compressor. Also it provides an idea about the instrumentation and control in Paper and Pulp industry and Pharmaceutical industry briefly. This subject gives more confident to the students to select their career as Instrumentation engineers in process industries.

Course Objectives:

On completion of the following units of syllabus, the students must be able to

- To acquire the knowledge about control of Heat Exchanger
- To acquire the knowledge about control of the Heat and Mass transfer unit operations
- To gain knowledge about the control of Pumps and Compressors
- To acquire knowledge on Paper manufacturing process and Instrumentation in paper Industries
- To gain knowledge on Cement manufacturing process and Instrumentation in Cement Industries

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain the control of heat Exchanger and Steam boiler

CO2: Explain the control of Heat and Mass transfer operations in Distillation column and Dryers

CO3: Explain the process of control of pumps and compressors

CO4: Explain the paper manufacturing process and various instrumentation principles involved in control of paper manufacturing process.

CO5: Explain the various stages of cement manufacturing process and Instrumentation techniques in cement manufacturing process

Pre-requisites:

Basics of Instrumentation & Measurement of Process Variables

1042236212	Instrumentation in Paper and Cement Industries	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	3	-	-	-
CO2	3	2	3	3	-	-	-
CO3	3	2	3	3	-	-	-
CO4	3	2	3	3	-	-	-
CO5	3	2	3	3	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different equipment used in paper and cement industries, paper manufacturing process, cement manufacturing process, Teachers should use PPT presentation and video presentation of above process and instrumentation. Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- Teachers are advised to follow inductive strategy to help the students to discover the process of manufacturing paper and cement.

1042236212	Instrumentation in Paper and Cement Industries	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042236212	Instrumentation in Paper and Cement Industries	L	T	P	C
Theory		3	0	0	3

Unit I	CONTROL OF HEAT TRANSFER UNIT OPERATIONS	
Control of Heat exchanger – Variables and Degrees of Freedom – Liquid-To-Liquid Heat Exchangers – Feedback Control – Steam Heated Exchanger – Feedback Control – Bypass Control – Cascade Control. Control of Steam Boiler – Boiler Equipment – In-line instruments of Drum type Boiler – Combustion Control.		7
Unit II	**CONTROL OF HEAT AND MASS TRANSFER UNIT OPERATIONS**	
Control of Distillation Column – Distillation Equipment – Variables and degrees of freedom – Pressure Control – Feed Control – Reboiler Control – Reflux Control. Control of Dryers – Principles – Batch dryers – Atmospheric tray dryer – Batch Fluid bed dryer – Continuous dryers – Double drum dryer – Rotary dryer.		7
Unit III	**CONTROL OF PUMPS AND COMPRESSORS**	
Control of Pumps – Pump control methods – Centrifugal Pump – On-Off Level Control – On-Off Flow Control – On-Off Pressure Control – Speed Variation – Rotary Pump – On-Off Control – Reciprocating Pump – On-Off Control. Control of Compressors – Centrifugal Compressor –Surge Control – Anti surge Control – Rotary Compressor – Bypass and Suction Control – Reciprocating Compressor – On-Off Control		9
Unit IV	**INSTRUMENTATION IN PAPER INDUSTRY**	
Paper Manufacturing Process – Raw Materials – Pulping Process – Paper Making Process – Converting. Instrumentation in Paper Industry: Measurement of Basis Weight - Density – Specific Gravity – Flow – Level of Liquids and Solids – Pressure – Temperature – Consistency – Moisture – pH – Oxidation – Reduction Potential – Graphic Displays and Alarms. Typical Controls in Paper Industry: Blow Tank Controls – Digester Liquor Feed pump Controls – Brown Stock Washer Level Control – Stock Chest Level Control – Basic Weight Control – Dissolving Tank Density Control – Condensate Conductivity Control.		11

1042236212	Instrumentation in Paper and Cement Industries	L	T	P	C
Theory		3	0	0	3

Unit V	INSTRUMENTATION IN CEMENT INDUSTRY	
Cement – Types: Hydraulic and Non-Hydraulic – Cement Manufacturing Process – Quarrying and Crushing – Raw Material Grinding – Wet Processes – Dry Processes – Kiln, Pre-heater and Precalciner – Clinker Cooling and Grinding – Clinker Storage and Cement Grinding – Packing. Instrumentation in Cement Industry – Level Sensors – Vibration Sensors – Mechanical Switches – Pneumatic Valves – Weight Measurement: Load Cells - Motion Sensors – Analyzers: Non- Dispersive Infrared Detectors – Infrared Detectors – PGNAA – Carbon Sulfur Detectors – Coal Sulfur Detectors – pH Sensor.		11
TOTAL HOURS		**45**

Suggested List of Students Activity (Ungraded)

- Check the web portal for Image and video of Paper and cement manufacturing process.
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce the knowledge on manufacturing process of paper and cement and equipment involved in the process.
- Students might be asked to see the video of Instrumentation in paper cement industries.

Text Books for Reference:

- Bela G Liptak, Instrumenation Engineers Handbook – Process Control (3/e).
- Bela G Liptak, Instrumentation in Processing Industries
- Andrews and William, Applied Instrumentation in Process Industries
- Douglas M Considine, Gregory K Mcmillan, Process / Industrial Instruments and Controls Handbook (5/e), McGraw Hill
- Dale R Patrick and Stephan W Fardo, Industrial Process Control Systems, Vikas Publishing House.

1042236212	Instrumentation in Paper and Cement Industries	L	T	P	C
Theory		3	0	0	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042236213	Computer Control of Process	L	T	P	C
Theory		3	0	0	3

Introduction:

Computer controlled Process is a prominent course to make the students aware about the need of computers in a Process control system. This course is intended to develop the basic understanding about Data Acquisition system and the working principle of Digital Control Systems. The Student will acquire knowledge in HART Communication Protocols and Field Bus architecture. The student will also become familiar with theSCADA System architecture, its components and various Industrial applications of SCADA. SCADAis used in Process control systems in almost every Instrumentation industry.

Course Objectives:

The objective of this course is to enable the students to

- Acquire knowledge on the need for Data acquisition system and Data acquisition techniques in PC based Data acquisition and control.
- Gain Knowledge on the need of Computer in control systems and the working principle of various digital control systems.
- Acquire knowledge on HART Communication Protocols and Field Bus architecture.
- Gain Knowledge on SCADA System architecture and its components.
- Gain knowledge on the SCADA Protocols and the Industrial applications of SCADA.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Explain the principle of operation of Data acquisition system andthe Data Acquisition techniques in computer-based Process Control.

CO2: Explain the Digital Control interfacing and principle of various digital control systems.

CO3: Explain the HART Protocols, Communication modes, and field bus architecture.

CO4: Explain the principle of SCADA System architecture and its components.

CO5: Explain the SCADA Protocols and the Industrial applications of SCADA.

Pre-requisites:

Sensors and Transducers, Measurement of process variables and Process Control Instrumentation.

1042236213	Computer Control of Process	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	-	-	-
CO2	3	2	2	3	-	-	-
CO3	3	2	2	2	-	-	-
CO4	3	2	2	2	-	-	-
CO5	3	2	3	2	-	-	-

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

Instructional Strategy:

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn PC Based Data Acquisition System and its control. Teachers should use PPT presentation to show video of Computer based control in a process. Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to show the principle of Digital Control Systems.
- Teachers are advised to follow inductive strategy to help the students to know the SCADA System architecture and its Industrial Applications.

1042236213	Computer Control of Process	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042236213	Computer Control of Process	L	T	P	C
Theory		3	0	0	3

Unit I	DATA ACQUISITION SYSTEM	
Data Acquisition System: Definition- need for data acquisition systems - Sampling theorem – Sampling and digitising – Aliasing – Sample and hold circuit–Interfacing ADC and DAC with Microprocessor - Multiplexer - Multiplexed channel operation – Microprocessor based data acquisition systems- PC-Based data acquisition and control.		9
Unit II	**DIGITAL CONTROL SYSTEMS**	
Need of computer in a control system - Functional block diagram of a computer control system- Direct digital control-Digital control interfacing- D igital temperature control system – Digital liquid level Control system-Digital flow control system Digital position control system with stepping motors and their control.		9
Unit III	**HART AND FIELD BUS**	
Highway Addressable Remote Transducer (HART) –Definition - Introduction – HART Communication Protocol – Communication Modes – HART Commands – HART Applications. Field Bus-Introduction - General field bus Architecture- Basic requirements of Field bus standard- Field Bus topology- Interoperability and Inter changeability.		9
Unit IV	**SCADA SYSTEMS**	
Evolution of SCADA – Definition - SCADA system Architecture- Communication requirements-Properties of SCADA system-Features-Advantages – Disadvantages-Remote terminal units - Interface Units -Human Machine Interface Units(HMI) - Data Logger- Intelligent Electronic Devices(IDE)- SCADA Server- Control System - Control Panel.		
Unit V	**INDUSTRIAL APPLICATIONS OF SCADA**	
SCADA - Hardware and software, System Master station, SCADA Protocols - SCADA systems in operation and control of interconnected power system - Power System Automation- Substation SCADA System- Petroleum Refining Process- Water Purification System- Chemical Plant.		9
TOTAL HOURS		**45**

1042236213	Computer Control of Process	L	T	P	C
Theory		3	0	0	3

Suggested List of Students Activity (Ungraded)

- Check the web portal to study the Data Acquisition techniques, Digital Control techniques, HART and Field bus.
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce the need of computer in Process Control System.
- Students might be asked to see the demonstration video of SCADA architecture and its Industrial applications

Text Books for Reference:

1. M.Chidambaram, Computer Control of Processes, Naroza Publishing House Pvt. Ltd., 2006
2. Krishna Kant, Computer Based Industrial Control, PHI,2007
3. Stuart A. Boyer , SCADA: Supervisory Control and Data Acquisition Systems, 4th Edition, ISA Press, 2010

Website link for Reference:

http://www.digimat.in/nptel/courses/video/108108099/L30.html

1042236213	Computer Control of Process	L	T	P	C
Theory		3	0	0	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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II. 5.
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V. 17.
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20.

1042236214	Industrial Robotics	L	T	P	C
Theory		3	0	0	3

Introduction:

Industrial robotics refers to the use of robots in manufacturing and industrial processes to automate tasks traditionally performed by human workers. These robots are specifically designed to carry out repetitive, dangerous, or precise tasks with a high level of accuracy and efficiency. Industrial robotics continues to evolve rapidly, driven by advancements in technology such as artificial intelligence, machine learning, and sensor technology. As robots become more sophisticated and versatile, they are expected to play an increasingly important role in shaping the future of manufacturing and industrial automation.

Course Objectives:

The objective of this course is to enable the students to

- Understand different components of robot
- Compare various types of Robot
- Study the working of various robot controller
- Study the various types of End Effectors
- Understand the working of sensors Vision system.
- Study the Robot Programming and Robot programming Languages.
- Appreciate the application of Robots in Industries.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Ability to understand basic concepts of Robotics.

CO2: To understand the Robot controller and drive systems used in robots.

CO3: Ability to know about the basics and functions of End Effectors, Sensors and vision system.

CO4: Understand the Robot Programming and Robot programming Languages

CO5: Acquire Knowledge it various applicators of Robots.

Pre-requisites:

Basic knowledge of Robots, Robot controller, End Effectors, Sensors, Robot programming and Applications of Robots.

1042236214	Industrial Robotics	L	T	P	C
Theory		3	0	0	3

CO/PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-			
CO2	3	2	-	-			
CO3	3	-	2	2			
CO4	3	-	2	2			
CO5	3	-	2	2			

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

Instructional Strategy

- It is advised that teachers have to use different teaching methods to stimulate the interest of students in learning.
- To help students to learn different types of sensors and transducers. Teachers should use PPT presentation to show video of application of the various types of sensors and transducers. Also, should explain examples from daily life, realistic situations, and real-world engineering and technological applications.
- Students may be shown all the available sensors in the lab. The demonstration can make the subject exciting and foster in the students a scientific mind set. Student activities should be planned on all the topics.
- Demonstration method may be used with step-by-step procedure to show the working of different types of sensors and transducers.
- Teachers are advised to follow inductive strategy to help the students to know the working principle of special sensors.
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any

1042236214	Industrial Robotics	L	T	P	C
Theory		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
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Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

CA1 and CA2: Assessment written test should be conducted for 50 Marks for two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042236214	Industrial Robotics	L	T	P	C
Theory		3	0	0	3

Unit I	FUNDAMENTALS OF ROBOT TECHNOLOGY	
Introduction – Definition - Robot Anatomy - Basic configuration of Robotics - Robot Components – Manipulator, End Effectors, Drive system, Controller and Sensors. Mechanical arm – Degree of freedom – Links and joints – Construction of Links- Types of joints. Classification of Robots - Cartesian- Cylindrical- spherical- horizontal articulated (SCARA) - vertical articulated - Work envelope - Work Volume – Comparison of Work envelope and Work volume. Introduction to PUMA Robot.		9

Unit II	ROBOT CONTROLLER AND DRIVE SYSTEMS	
Robot Controller- Configuration - Four types of controls – Open loop and closed loop controller –servo systems - Speed of response and stability **Drive system:** Pneumatic drives – Hydraulic drives – Electrical drives – Stepper motor- DC Servo motor – working - Salient features – Applications and comparison of drives. **Feedback Devices:** Potentiometers - Optical encoders - Resolvers - DC Tachometer.		9

Unit III	END EFFECTORS, SENSORS, AND VISION SYSTEMS	
End Effectors: Grippers and tools – Mechanical Grippers- Magnetic Grippers- Vacuum Grippers - Adhesive Grippers. **Sensors:** Requirements of Sensors –Types of sensors- Tactile sensors- Touch sensors- Proximity sensors -Range Sensors- Force sensors- Photo electric sensors. **Machine Vision System:** Sensing and digitizing image data – Signal conversion – Image storage – Lighting techniques – Robotic Applications – Robot operation aids – teach pendant - Manual data input (MDI) and computer control.		9

Unit IV	ROBOT PROGRAMMING	
Robot Programming – Lead Through methods and textual Robot Languages – Motion specification – motion Interpolation – Basic Robot Languages – Generation of Robot programming Languages- Robot Language structure - On- Line and Off- Line Programming – Basic Robot commands		9

1042236214	Industrial Robotics	L	T	P	C
Theory		3	0	0	3

Unit V	INDUSTRIAL APPLICATIONS OF ROBOTS	
Robot Application in manufacturing – material handling – Material transfer – pick and place operations – palletizing and de-palletizing - Press loading and unloading – Die casting – Machine tool loading and unloading – Spot welding – Arc welding – Spray painting – Assembly finishing – Automatic Guided vehicle system.		9
TOTAL HOURS		**45**

Suggested List of Students Activity (Ungraded)

- Check the web portal to study different types of Robot and sensors.
- Periodical quizzes should be conducted on a weekly/fortnightly basis to reinforce the different types of Robot and their working principles.
- Students might be asked to see the demonstration video of various Robots.

Text Books for Reference:

1. Deb S. R. and Deb S., "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd, 2010
2. A.K.Gupta, S.K.Arora, Industrial Automation and Robotics, Laxmi Publications (P) Ltd, 2013
3. RK Mittal, IJ Nagrath, Robotics and Control, Tata McGraw Hill Education Pvt, 1st July 2018

Website Reference:

Lecture Notes:

1. https://www.academia.edu/38824957/Robotics_by_rk_mittal
2. file:///C:/Users/sunda/Downloads/OER000000209%20(1).pdf

Video Lectures

1. https://youtu.be/CQVgM9OivV8
2. https://youtu.be/0s5m-AsXcpM?si=GA-dKE9DKOQ1rTOD&t=581
3. https://youtu.be/p7GOXb3Kc6I?si=IoiTCzGfjmBQZu8x&t=190
4. https://youtu.be/8mOHS8M1Pmc?si=cV8CO-H8M4NUeqBa&t=27

1042236214	Industrial Robotics	L	T	P	C
Theory		3	0	0	3

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Sample:

I. 1.
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1042236351	Internship	Periods	C
Project		550	12

Introduction

Internships in educational institutions are designed to provide students with practical experience in their field of study and to bridge the gap between academic knowledge and professional practice.

Objectives

After completing Internship, Interns will be able to,

- Apply the theoretical knowledge and skill during performance of the tasks assigned in internship.
- Demonstrate soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship.
- Document the Use case on the assigned Task.
- Enable interns to apply theoretical knowledge gained in the classroom to real-world practical applications.
- Provide hands-on experience in the industrial practices.
- Develop essential skills such as communication, organization, teamwork, and problem-solving.
- Enhance specific skills related to the intern's area of focus.
- Offer a realistic understanding of the daily operations and responsibilities.
- Provide opportunities to work under the guidance of experienced supervisors and administrators.
- Allow interns to explore different career paths.
- Help interns make informed decisions about their future career goals based on first hand experience.
- Facilitate the establishment of professional relationships with supervisor, administrators, and other professionals in the field.

1042236351	Internship	Periods	C
Project		550	12

- Provide access to a network of contacts that can be beneficial for future job opportunities and professional growth.
- Foster personal growth by challenging interns to step out of their comfort zones and take on new responsibilities.
- Build confidence and self-efficacy through successful completion of internship tasks and projects.
- Give insight into the policies, regulations, and administrative practices.
- Allow interns to observe and understand the implementation of standards and policies in practice.
- Provide opportunities for constructive feedback from supervisors and mentors, aiding in the intern's professional development.
- Enable self-assessment and reflection on strengths, areas for improvement, and career aspirations.
- Encourage sensitivity to the needs and backgrounds of different groups, promoting inclusive and equitable industrial practices.

Course Outcomes

CO 1: Demonstrate improved skills.

CO 2: Exhibit increased professional behavior.

CO 3: Apply theoretical knowledge and principles in real-world practices.

CO 4: Develop and utilize assessment tools to evaluate the learning and practices.

CO 5: Engage in reflective practice to continually improve their learning and professional growth.

1042236351	Internship	Periods	C
Project		550	12

Facilitating the Interns by an Internship Provider.

Orient intern in the new workplace. Give interns an overview of the organization, Explain the intern's duties and introduce him or her to co-workers.

Develop an internship job description with clear deliverables and timeline.

Allow the interns in meetings and provide information, resources, and opportunities for professional development.

The interns have never done this kind of work before, they want to know that their work is measuring up to organizational expectations, hence provide professional guidance and mentoring to the intern.

Daily progress report of Intern is to be evaluated by industry supervisor. examine what the intern has produced and make suggestions. Weekly supervision meetings can help to monitor the intern's work.

Duties Responsibilities of the Faculty Mentor

To facilitate the placement of students for the internship

To liaison between the college and the internship provider

To assist the Industrial Training Supervisor during assessment

Instructions to the Interns

- Students shall report to the internship provider on the 1st day as per the internship schedule.
- Intern is expected to learn about the organization, its structure, product range, market performance, working philosophy etc.
- The interns shall work on live projects assigned by the internship provider.
- The Intern shall record all the activities in the daily log book and get the signature of the concerned training supervisor.
- Intern shall have 100% attendance during internship programme. In case of unavoidable circumstances students may avail leave with prior permission from the concerned training supervisor of the respective internship provider. However, the maximum leave

1042236351	Internship	Periods	C
Project		550	12

permitted during internship shall be as per company norms where they are working and intern shall report the leave sanctioned details to their college faculty mentor.

- The interns shall abide all the Rules and Regulations of internship provider
- Intern shall follow all the safety Regulations of internship provider.
- On completion of the internship, the intern shall report to the college and submit the internship certificate mentioning duration of internship, evaluation of interns by internship provider, Student's Diary and Comprehensive Training Report.

Attendance Certification

Every month students have to get their attendance certified by the industrial supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the institution supervisor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

Training Reports

The students have to prepare two types of reports: Weekly reports in the form of a diary to be submitted to the concerned staff in-charge of the institution. This will be reviewed while awarding Internal

Industrial Training Diary

Students are required to maintain the record of day-to-day work done. Such a record is called Industrial training Diary. Students have to write this report regularly. All days for the week should be accounted for clearly giving attendance particulars (Presence, absence, Leave, Holidays etc.). The concern of the Industrial supervisor is to periodically check these progress reports.

Comprehensive Training Report

In addition to the diary, students are required to submit a comprehensive report on training with details of the organisation where the training was undergone after attestation by the supervisors. The comprehensive report should incorporate study of plant/product/process/construction along with intensive in-depth study on any one of the topics such as processes, methods, tooling,

1042236351	Internship	Periods	C
Project		550	12

construction and equipment, highlighting aspects of quality, productivity and system. The comprehensive report should be completed in the last week of Industrial training.

Any data, drawings etc. should be incorporated with the consent of the Organisation.

Scheme of Evaluation

Internal Assessment

Students should be assessed for 50 Marks by industry supervisor and polytechnic faculty mentor during 8th Week and 15th Week. The total marks (50 + 50) scored shall be converted to 40 marks for the Internal Assessment.

Sl. No.	Description	Marks
A	Punctuality and regularity. (Attendance)	10
B	Level / proficiency of practical skills acquired. Initiative in learning / working at site	10
C	Ability to solve practical problems. Sense of responsibility	10
D	Self expression / communication skills. Interpersonal skills / Human Relation.	10
E	Report and Presentation.	10
Total		50

1042236351	**Internship**	Periods	C
Project		550	12

End Semester Examination - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of internship period (Dec - May). The marks scored will be converted to 60 marks for the End Semester Examination.

Sl. No.	Description	Marks
A	Daily Activity Report.	20
B	Comprehensive report on Internship, Relevant Internship Certificate from the concerned department.	30
C	Presentation by the student at the end of the Internship.	30
D	Viva Voce	20
Total		100

1040236353	Fellowship	Periods	C
Project		550	12

Introduction

The Fellowship in the Diploma in Engineering program is designed to provide aspiring engineers with a comprehensive educational experience that combines theoretical knowledge with practical skills. This fellowship aims to cultivate a new generation of proficient and innovative engineers who are equipped to meet the challenges of a rapidly evolving technological landscape.

Participants in this fellowship will benefit from a robust curriculum that covers core engineering principles, advanced technical training, and hands-on projects. The program emphasizes interdisciplinary learning, encouraging fellows to explore various branches of engineering, from mechanical and civil to electrical, electronics & communication and computer engineering. This approach ensures that graduates possess a versatile skill set, ready to adapt to diverse career opportunities in the engineering sector.

In addition to academics, the fellowship offers numerous opportunities for professional development. Fellows will engage with industry experts through seminars, workshops, and internships, gaining valuable insights into real-world applications of their studies. Collaborative projects and research initiatives foster a culture of innovation, critical thinking, and problem-solving, essential attributes for any successful engineer.

By offering this fellowship, participants become part of a vibrant community of learners and professionals dedicated to advancing the field of engineering. The program is committed to supporting the growth and development of each fellow, providing them with the tools and resources needed to excel both academically and professionally.

The Fellowship in the Diploma in Engineering is more than just an educational endeavor; it is a transformative journey that equips aspiring engineers with the knowledge, skills, and experiences necessary to make significant contributions to society and the engineering profession.

1040236353	Fellowship	Periods	C
Project		550	12

Objectives

After completing students will be able to,

- Provide fellows with a solid foundation in core engineering principles and advanced technical knowledge across various engineering disciplines.
- Equip fellows with hands-on experience through laboratory work, projects, and internships, ensuring they can apply theoretical knowledge to real-world scenarios.
- Promote interdisciplinary understanding by encouraging exploration and integration of different engineering fields, fostering versatility and adaptability in fellows.
- Encourage innovation and creativity through research projects and collaborative initiatives, enabling fellows to develop new solutions to engineering challenges.
- Facilitate professional growth through workshops, seminars, and interactions with industry experts, preparing fellows for successful careers in engineering.
- Develop critical thinking and problem-solving skills, essential for tackling complex engineering problems and making informed decisions.
- Strengthen connections between academia and industry by providing opportunities for internships, industry visits, and guest lectures from professionals.
- Foster leadership qualities and teamwork skills through group projects and collaborative activities, preparing fellows for leadership roles in their future careers.
- Instill a sense of ethical responsibility and awareness of the social impact of engineering practices, encouraging fellows to contribute positively to society.
- Promote a culture of lifelong learning, encouraging fellows to continually update their knowledge and skills in response to technological advancements and industry trends.
- Prepare fellows to work in a global engineering environment by exposing them to international best practices, standards, and cross-cultural experiences.

1040236353	Fellowship	Periods	C
Project		550	12

Course Outcomes

CO 1: Demonstrate a strong understanding of core engineering principles and possess the technical skills necessary to design, analyze, and implement engineering solutions across various disciplines.

CO 2: Apply theoretical knowledge to practical scenarios, effectively solving engineering problems through hands-on projects, laboratory work, and internships.

CO 3: Exhibit the ability to conduct research, develop innovative solutions, and contribute to advancements in engineering through critical thinking and creative approaches to complex challenges.

CO 4: Understand and adhere to professional and ethical standards in engineering practice, demonstrating responsibility, integrity, and a commitment to sustainable and socially responsible engineering.

CO 5: Enhance strong communication skills, both written and verbal, and be capable of working effectively in teams, demonstrating leadership and collaborative abilities in diverse and multidisciplinary environments.

Important points to consider to select the fellowship project.

Selecting the right fellowship project is crucial for maximizing the educational and professional benefits of a Diploma in Engineering program.

- **Relevance to Future Plans**: Choose a project that aligns with your long-term career aspirations and interests. This alignment will ensure that the skills and knowledge you gain will be directly applicable to your desired career path.
- **Industry Relevance**: Consider the current and future relevance of the project within the industry. Opt for projects that address contemporary challenges or emerging trends in engineering.
- **Access to Facilities**: Ensure that the necessary facilities, equipment, and materials are available to successfully complete the project. Lack of resources can hinder the progress and quality of your work.
- **Mentorship and Guidance**: Select a project that offers strong mentorship and support from experienced faculty members or industry professionals. Effective guidance is crucial for navigating complex problems and achieving project objectives.
- **Project Scope**: Assess the scope of the project to ensure it is neither too broad nor too narrow. A well-defined project scope helps in setting clear objectives and achievable milestones.

1040236353	Fellowship	Periods	C
Project		550	12

- **Feasibility**: Evaluate the feasibility of completing the project within the given timeframe and with the available resources. Consider potential challenges and ensure you have a realistic plan to address them.
- **Technical Skills**: Choose a project that allows you to develop and enhance important technical skills relevant to your field of study. Practical experience in using specific tools, technologies, or methodologies can be highly beneficial.
- **Soft Skills**: Consider projects that also offer opportunities to develop soft skills such as teamwork, communication, problem-solving, and project management.
- **Innovative Thinking**: Select a project that encourages creativity and innovative problem-solving. Projects that push the boundaries of traditional engineering approaches can be particularly rewarding.
- **Societal Impact**: Consider the potential impact of your project on society or the engineering community. Projects that address significant challenges or contribute to social good can be highly fulfilling and make a meaningful difference.

Guidelines to select Fellowship

- Ensure the program is accredited by a recognized accrediting body and has a strong reputation for quality education in engineering.
- Ensure it covers core engineering principles that align with your interests and career goals.
- Investigate the qualifications and experience of the faculty mentor. Look for programs with faculty who have strong academic backgrounds, industry experience, and active involvement in research.
- Check if the program provides adequate hands-on training opportunities, such as laboratory work, workshops, and access to modern engineering facilities and equipment.
- Assess the program's connections with industry. Strong partnerships with companies can lead to valuable internship opportunities, industry projects, and exposure to real-world engineering challenges.
- Explore the availability of research opportunities. Participation in research projects can enhance your learning experience and open doors to innovative career paths.
- Look for programs that offer professional development resources, such as workshops, seminars, and networking events with industry professionals and alumni.

1040236353	Fellowship	Periods	C
Project		550	12

- Ensure the program provides robust support services, including academic advising, career counseling, mentorship programs, and assistance with job placement after graduation.
- Consider the cost of the program and available financial aid options, such as scholarships, grants, and fellowships. Evaluate the return on investment in terms of career prospects and potential earnings.
- Research the success of the program's alumni. High employment rates and successful careers of past graduates can indicate the program's effectiveness in preparing students for the engineering field.

Duties Responsibilities of the Faculty Mentor

Each student should have a faculty mentor for the Institute.

- Get the approval from the Chairman Board of Examinations with the recommendations of the HOD/Principal for the topics.
- Provide comprehensive academic advising to help fellows select appropriate specializations, and research projects that align with their interests and career goals.
- Guide fellows through their research projects, offering expertise and feedback to ensure rigorous methodology, innovative approaches, and meaningful contributions to the field.
- Assist fellows in developing technical and professional skills through hands-on projects, laboratory work, and practical applications of theoretical knowledge.
- Offer career advice and support, helping fellows explore potential career paths, prepare for job searches, and connect with industry professionals and opportunities.
- Provide personal mentorship, fostering a supportive relationship that encourages growth, resilience, and a positive academic experience.
- Facilitate connections between fellows and industry professionals, alumni, and other relevant networks to enhance their professional opportunities and industry exposure.
- Ensure fellows have access to necessary resources, including research materials, lab equipment, software, and academic literature.
- Regularly monitor and evaluate the progress of fellows, providing constructive feedback and guidance to help them stay on track and achieve their goals.
- Instill and uphold high ethical and professional standards, encouraging fellows to practice integrity and responsibility in their work.

1040236353	Fellowship	Periods	C
Project		550	12

- Assist with administrative tasks related to the fellowship program, such as preparing progress reports, writing recommendation letters, and facilitating grant applications.
- Organize and participate in workshops, seminars, and other educational events that enhance the learning experience and professional development of fellows.
- Address any issues or conflicts that arise, providing mediation and support to ensure a positive and productive academic environment.

Instructions to the Fellowship Scholar

- Regularly meet with your faculty mentor for guidance on academic progress, research projects, and career planning. Be proactive in seeking advice and support from your mentor.
- Develop strong organizational skills. Use planners, calendars, and task management tools to keep track of assignments, project deadlines, and study schedules. Prioritize tasks to manage your time efficiently.
- Take advantage of opportunities to participate in research projects and hands-on activities. These experiences are crucial for applying your theoretical knowledge and gaining practical skills.
- Focus on improving essential professional skills such as communication, teamwork, problem-solving, and leadership. Participate in workshops and seminars that enhance these competencies.
- Actively seek networking opportunities through industry events, seminars, and meetings. Establish connections with peers, alumni, and professionals in your field to build a strong professional network.
- Seek internships, co-op programs, or part-time jobs related to your field of study. Real-world experience is invaluable for understanding industry practices and enhancing your employability.
- Uphold high ethical standards in all your academic and professional activities. Practice integrity, honesty, and responsibility. Adhere to the ethical guidelines and standards set by your institution and the engineering profession.
- Adopt a mindset of lifelong learning. Stay updated with the latest developments and trends in engineering by reading industry journals, attending conferences, and taking additional courses.

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Project		550	12

Documents to be submitted by the student to offer fellowship.

- **Completed Application Form**: This is typically the standard form provided by the institution or fellowship program that includes personal information, educational background, and other relevant details.
- **Detailed CV/Resume**: A comprehensive document outlining your educational background, knowledge experience, interest in research experience, publications, presentations, awards, and other relevant achievements if any.
- **Personal Statement**: A document explaining your motivation for applying to the fellowship, your career goals, how the fellowship aligns with those goals, and what you intend to achieve through the program.
- **Recommendation Letters**: Letters from faculty mentor, employer, or professionals who can attest to your academic abilities, professional skills, and suitability for the fellowship.
- **Proposal/Description**: A detailed proposal or description of the fellowship project or study you plan to undertake during the fellowship. This should include objectives, methodology, expected outcomes, and significance of the project.
- **Enrollment Verification**: Documentation verifying your current acceptance status in the academic institution or industry where the fellowship will be conducted.
- **Funding Information**: Details about any other sources of funding or financial aid you are receiving, if applicable. Some fellowships may also require a budget proposal for the intended use of the fellowship funds.
- **Samples of Work**: Copies of the relevant work that demonstrates your capabilities and accomplishments in your field.
- **Endorsement Letter**: A letter from your current academic institution endorsing your application for the fellowship, if required.
- **Ethical Approval Documents**: If your research involves human subjects or animals, you may need to submit proof of ethical approval from the relevant ethics committee.
- **Additional Documents**: Any other documents requested by the fellowship program required by the institution.

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Attendance Certification

Every month students have to get their attendance certified by the supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the faculty mentor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

Rubrics for Fellowship. Review I & II.

Sl. No.	Topics	Description
1	Alignment with Objectives	Assess how well the project aligns with the stated objectives and requirements. Determine if the student has addressed the key aspects outlined in the project guidelines.
2	Depth of Research:	Evaluate the depth and thoroughness of the literature review. Assess the student's ability to identify and address gaps in existing research.
3	Clarity of Objectives:	Check if the student has clearly defined and articulated the objectives of the project. Ensure that the objectives are specific, measurable, achievable, relevant, and time-bound (SMART).
4	Methodology and Data Collection:	Evaluate the appropriateness and justification of the research methodology. Assess the methods used for data collection and their relevance to the research questions.
5	Analysis and Interpretation:	Examine the quality of data analysis techniques used. Assess the student's ability to interpret results and draw meaningful conclusions.
6	Project Management:	Evaluate the project management aspects, including adherence to timelines and milestones. Assess the student's ability to plan and execute the project effectively.

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7	Documentation and Reporting:	Check the quality of documentation, including code, experimental details, and any other relevant materials. Evaluate the clarity, structure, and coherence of the final report.
8	Originality and Creativity:	Assess the level of originality and creativity demonstrated in the project. Determine if the student has brought a unique perspective or solution to the research problem.
9	Critical Thinking:	Evaluate the student's critical thinking skills in analyzing information and forming conclusions. Assess the ability to evaluate alternative solutions and make informed decisions.
10	Problem-Solving Skills:	Evaluate the student's ability to identify and solve problems encountered during the project. Assess adaptability and resilience in the face of challenges.

INTERNAL MARKS - 40 Marks

As per the rubrics each topic should be considered for the Review I and Review II. Equal weightage should be given for all the topics. It should be assessed by a faculty mentor and the industrial professional or research guide.

Review 1 shall be conducted after 8th week and Review 2 shall be conducted after 14th week in the semester. Average marks scored in the reviews shall be considered for the internal assessment of 30 Marks.

Scheme of Evaluation

PART	DESCRIPTION	MARKS
A	Assessment as per the rubrics.	30
B	Attendance	10
Total		**40**

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END SEMESTER EXAMINATION - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of fellowship. The marks scored will be converted to 60 marks for the End Semester Examination.

Sl. No.	Description	Marks
A	Daily Activity Report.	20
B	Comprehensive report of the Fellowship Work.	30
C	Presentation by the student.	30
D	Viva Voce	20
Total		100

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Project		550	12

Introduction

Every student must do one major project in the Final year of their program. Students can do their major project in Industry or R&D Lab or in-house or a combination of any two for the partial fulfillment for the award of Diploma in Engineering.

For the project works, the Department will constitute a three-member faculty committee to monitor the progress of the project and conduct reviews regularly.

If the projects are done in-house, the students must obtain the bonafide certificate for project work from the Project supervisor and Head of the Department, at the end of the semester. Students who have not obtained the bonafide certificate are not permitted to appear for the Project Viva Voce examination.

For the projects carried out in Industry, the students must submit a separate certificate from Industry apart from the regular bonafide certificate mentioned above. For Industry related projects there must be one internal faculty advisor / Supervisor from Industry (External), this is in addition to the regular faculty supervision.

The final examination for project work will be evaluated based on the final report submitted by the project group **of not exceeding four students**, and the viva voce by an external examiner.

Objectives

Academic project work plays a crucial role in the education of Diploma in Engineering students, as it helps them apply theoretical knowledge to practical situations and prepares them for real-world engineering challenges.

- **Integration of Knowledge**: Consolidate and integrate theoretical knowledge acquired in coursework to solve practical engineering problems.
- **Skill Development**: Enhance technical skills related to the specific field of engineering through hands-on experience and application.
- **Problem-Solving Abilities**: Develop critical thinking and problem-solving abilities by addressing complex engineering issues within a defined scope.
- **Project Management**: Gain experience in project planning, execution, and management, including setting objectives, timelines, and resource allocation.
- **Teamwork and Collaboration**: Foster teamwork and collaboration by working in multidisciplinary teams to achieve project goals and objectives.

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- **Research Skills**: Acquire research skills by conducting literature reviews, gathering relevant data, and applying research methodologies to investigate engineering problems.
- **Innovation and Creativity**: Encourage innovation and creativity in proposing and developing engineering solutions that may be novel or improve upon existing methods.
- **Communication Skills**: Improve communication skills, both oral and written, by presenting project findings, writing technical reports, and effectively conveying ideas to stakeholders.
- **Ethical Considerations**: Consider ethical implications related to engineering practices, including safety, environmental impact, and societal concerns.
- **Professional Development**: Prepare for future professional roles by demonstrating professionalism, initiative, and responsibility throughout the project lifecycle.

Course Outcomes

CO 1: Demonstrate the ability to apply theoretical concepts and principles learned in coursework to solve practical engineering problems encountered during the project.

CO 2: Develop and enhance technical skills specific to the field of engineering relevant to the project, such as design, analysis, simulation, construction, testing, and implementation.

CO 3: Apply critical thinking and problem-solving skills to identify, analyze, and propose solutions to engineering challenges encountered throughout the project lifecycle.

CO 4: Acquire project management skills by effectively planning, organizing, and executing project tasks within defined timelines and resource constraints.

CO 5: Improve communication skills through the preparation and delivery of project reports, presentations, and documentation that effectively convey technical information to stakeholders.

Important points to consider to select the In-house project.

- Selecting a project work in Diploma Engineering is a significant decision that can greatly influence your learning experience and future career prospects.
- Choose a project that aligns with your career aspirations and interests within the field of engineering. Consider how the project can contribute to your professional development and future opportunities.
- Ensure the project aligns with your coursework and specialization within the Diploma program. It should complement and build upon the knowledge and skills you have acquired in your studies.

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- Evaluate the scope of the project to ensure it is manageable within the given timeframe, resources, and constraints. Avoid projects that are overly ambitious or impractical to complete effectively.
- Assess the availability of resources needed to conduct the project, such as equipment, materials, laboratory facilities, and access to relevant software or tools. Lack of resources can hinder project progress.
- Select a project that genuinely interests and motivates you. A project that captures your curiosity and passion will keep you engaged and committed throughout the project duration.
- Consider the availability and expertise of faculty advisors or industry mentors who can provide guidance and support throughout the project. Effective mentorship is crucial for success.
- Clearly define the learning objectives and expected outcomes of the project. Ensure that the project will help you achieve specific learning goals related to technical skills, problem-solving, and professional development.
- Look for opportunities to propose innovative solutions or explore new methodologies within your project. Projects that encourage creativity can set you apart and enhance your learning experience.
- Consider ethical implications related to the project, such as safety protocols, environmental impact, and compliance with ethical guidelines in research and engineering practices.
- Evaluate whether the project offers opportunities for collaboration with peers, experts from other disciplines, or industry partners. Interdisciplinary projects can broaden your perspective and enhance your teamwork skills.
- Consider the potential impact of your project on society or the engineering community. Projects that address significant challenges or contribute to social good can be highly fulfilling and make a meaningful difference.

By carefully considering these points, Diploma Engineering students can make informed decisions when selecting project work that not only enhances their academic learning but also prepares them for successful careers in engineering.

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Duties Responsibilities of the internal faculty advisor.

Each group should have an internal faculty advisor assigned by the HOD/Principal.

- The in-house project should be approved by the project monitoring committee constituted by the Chairman Board of Examinations.
- The in-house project should be selected in the fifth semester itself. Each in-house project shall have a maximum of four students in the project group.
- Provide comprehensive academic advising to help in the selection of appropriate in-house project that align with their interests and career goals.
- Offer expertise and feedback to ensure rigorous methodology, innovative approaches, and meaningful contributions to the field.
- Assist in developing technical and professional skills through hands-on projects, laboratory work, and practical applications of theoretical knowledge.
- Provide personal mentorship, fostering a supportive relationship that encourages growth, resilience, and a positive academic experience.
- Facilitate connections between students and industry professionals, alumni, and other relevant networks to enhance their professional opportunities and industry exposure.
- Ensure students have access to necessary resources, including research materials, lab equipment, software, and academic literature.
- Regularly monitor and evaluate the progress of the in-house project, providing constructive feedback and guidance to help them stay on track and achieve their goals.
- Instill and uphold high ethical and professional standards, encouraging students to practice integrity and responsibility in their work.
- Assist in preparing progress reports, writing recommendation letters, and facilitating grant applications.
- Organize and participate in workshops, seminars, and other educational events that enhance the learning experience and professional development .
- Address any issues or conflicts that arise, providing mediation and support to ensure a positive and productive academic environment.

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Instructions to the students.

- Regularly meet with your internal faculty advisor for guidance on academic progress, research projects, and career planning. Be proactive in seeking advice and support from your faculty advisor.
- Use planners, calendars, and task management tools to keep track of assignments, project deadlines, and study schedules. Prioritize tasks to manage your time efficiently.
- Take advantage of opportunities to participate in in-house projects and hands-on activities. These experiences are crucial for applying your theoretical knowledge and gaining practical skills.
- Focus on improving essential professional skills such as communication, teamwork, problem-solving, and leadership. Participate in workshops and seminars that enhance these competencies.
- Actively seek networking opportunities through industry events, seminars, and meetings. Establish connections with peers, alumni, and professionals in your field to build a strong professional network.
- Seek internships, co-op programs, or part-time jobs related to your field of study. Real-world experience is invaluable for understanding industry practices and enhancing your employability.
- Uphold high ethical standards in all your academic and professional activities. Practice integrity, honesty, and responsibility. Adhere to the ethical guidelines and standards set by your institution and the engineering profession.
- Adopt a mindset of lifelong learning. Stay updated with the latest developments and trends in engineering by reading industry journals, attending conferences, and taking additional courses.

Documents to be submitted by the student for an in-house project.

Submit a printed report of your in-house project work along with the fabrication model / analysis report for the End Semester Examination.

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Project		550	12

Rubrics for In-House Project Work

Sl. No.	Topics	Description
1	Objectives	Clearly defined and specific objectives outlined. Objectives align with the project's scope and purpose.
2	Literature Review	Thorough review of relevant literature. Identification of gaps and justification for the project's contribution.
3	Research Design and Methodology	Clear explanation of the research design. Appropriateness and justification of chosen research methods.
4	Project Management	Adherence to project timeline and milestones. Effective organization and planning evident in the project execution.
5	Documentation	Comprehensive documentation of project details. Clarity and completeness in recording methods, results, and challenges.
6	Presentation Skills	Clear and articulate communication of project findings. Effective use of visuals, if applicable.
7	Analysis and Interpretation	In-depth analysis of data. Clear interpretation of results in the context of research questions.
8	Problem-Solving	Demonstrated ability to identify and address challenges encountered during the project. Innovative solutions considered where applicable.
9	Professionalism and Compliance	Adherence to ethical standards in research. Compliance with project guidelines and requirements.
10	Quality of Work	Overall quality and contribution of the project to the field. Demonstrated effort to produce high-quality work.

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SCHEME OF EVALUATION

The mark allocation for Internal and End Semester Viva Voce are as below.

Internal Marks (40 Marks)*		
Review 1 (10 Marks)	Review 2 (15 Marks)	Review 3 (15 marks)
Committee: 5 Marks. Supervisor: 5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks

Note: * The rubrics should be followed for the evaluation of the internal marks during reviews.

END SEMESTER EXAMINATION - Project Exam

The performance of each student in the project group would be evaluated in a viva voce examination conducted by a committee consisting of an external examiner and the project supervisor and an internal examiner.

End Semester (100)#			
Record (20 Marks)	Presentation (20 Marks)	Viva Voce (20 Marks)	Model / Analysis Report (40 Marks)
External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 20 Internal: 10 Supervisor: 10

 # The marks scored will be converted to 60 Marks.