AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY
(IOIT)

ADDING VALUE TO ENGINEERING

An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with "A+" Grade | NBA - 5 UG Programmes

ACADEMIC COURSE STRUCTURE

Second Year B. Tech Instrumentation Engineering

PROGRAM IN INSTRUMENTATION ENGINEERING

B.TECH 4 YEAR UG COURSE
(2025 Pattern)

AISSMS INSTITUTE OF INFORMATION TECHNOLOGY
Kennedy Road, Near RTO,
Pune – 411 001, Maharashtra State, India
Email: principal@aissmsioit.org,
Website: https://www.aissmsioit.org

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BOS–INSTRUMENTATION ENGINEERING
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PUNE–1.

Institute Vision & Mission

Vision:

To be recognized amongst top 10 private engineering colleges in Maharashtra by the year 2026 by rendering value added education through academic excellence, research, entrepreneurial attitude, and global exposure.

Mission :

- To enable placement of 150 plus students in the 7 lacs plus category & ensure 100% placement of all final year students.
- To connect with 10 plus international universities, professional bodies, and organizations to provide global exposure students
- To create conducive environment for career growth, prosperity, and happiness of 100% staff.
- To be amongst top 5 private colleges in Pune in terms of admission cut off

Quality Policy

We commit ourselves to provide quality education & enhance our students quality through continuous improvement in our teaching and learning processes.

Department Vision & Mission

Vision:

To be recognized as one of the best instrumentation engineering programs by developing globally competent engineers, researchers and entrepreneurs to solve real life problems through skill-based education.

Mission:

M1:To promote learning for skill-based education and emerging technologies to make students globally competent.

M2:To create conducive environment for research, innovations and entrepreneurship.

Program Educational Objectives:

Graduates will

1. solve real life problems by applying the knowledge of instrumentation technology.
2. pursue higher education or be researcher or be entrepreneur.
3. contribute as a socially responsible citizen for the development of nation.
4. for the development of nation.

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Program Outcomes(POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. [Engineering knowledge]
2. Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. [Problem analysis]
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. [Design/development of solutions]
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. [Conduct investigations of complex problems]
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. [Modern tool usage]
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. [The engineer and society]
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. [Environment and sustainability]
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. [Ethics]
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. [Individual and team work]
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. [Communication]
11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. [Project management and finance]
12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. [Life-long learning]

Program Specific Outcomes(PSOs)

1. Graduates will be able to apply their knowledge of measurement and control to solve the problems related to environment, safety, health and agriculture sectors.

2. Graduates will be able to demonstrate their skills on Programmable logic controller, LabView, Distributed control system and Internet of thing.

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Instrumentation Engineering– Second Year B.Tech (Semester–III)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination Scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	IOHSM301	Democracy, Election & Governance@@	02	---	---	02	---	---	25	---	25	50
2	INPCC302	Data Science	03	---	---	03	40#	60**	---	---	---	100
3	INPCC303	Electrical Measurement And Instrumentation	03	---	---	03	40#	60*	---	---	---	100
4	INPCC304	Sensors and Transducers	03	---	---	03	40#	60*	---	---	---	100
5	INPCC305	Analog & Digital Techniques	03	--	---	03	40#	60*	---	---	---	100
6	INOEC306	MOOC (Automation in Manufacturing)	03	---	--	03	40$	60ss	---	---	---	100
7	INPCC307	Data Science Lab	---	---	02	01	---	---	25	---	---	25
8	INPCC308	Electrical Measurement and Instrumentation Lab	--	--	02	01	--	--	--	--	25	25
9	INPCC309	Sensors and Transducers Lab	---	---	02	01	---	---	---	50	---	50
10	INPCC310	Analog & Digital Techniques Lab	---	---	02	01	---	---	--	50	--	50
11	IOHSM3AC	Audit Course Vedic Mathematics	01	--	--	01	--	--	25	--	--	25
Total			**18**	**00**	**08**	**22**	**200**	**300**	**75**	**100**	**50**	**725**
Instrumentation Engineering- Minor in Sensor and Control Technology												
1	INMNR301	Sensors and Transducers	03	--	--	03	---	75	---	--	--	75
2	INMNR302	Sensors and Transducers Lab	--	--	02	01	--	--	25	---	---	25
			21	**00**	**10**	**26**	**200**	**375**	**100**	**100**	**50**	**825**
Computer Engineering -Minor in Software Development												
1	COMNR301	Object Oriented Programming	03	--	--	03	---	75*	---	--	--	75
2	COMNR302	Object Oriented Programming Laboratory	--	--	02	01	--	--	25	---	---	25
Information Technology- Minor in Software Development Technologies												
1	ITMNR301	Data Structure and Algorithms	3	--	--	3	--	75*	--	--	--	75
2	ITMNR302	Data Structure and Algorithms Lab	--	--	2	1	--	--	25	--	--	25
Artificial Intelligence and Data Science - Minor in Foundation of Artificial Intelligence												
1	ADMNR301	Python Programming for Data Science	3	--	--	3	--	75*	--	--	--	75
2	ADMNR302	Python Programming for Data Science Laboratory	--	--	2	1	--	--	25	--	--	25

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Electrical Engineering- Minor in Industrial Electrical Engineering												
1	ELMNR301	Electrical Measurements	3	-	-	3	-	75*	-	-	-	75
2	ELMNR302	Electrical Measurements Lab	-	-	2	1	-	-	25	-	-	25
Electronics and Telecommunication- Minor in Microelectronics and Embedded Systems												
1	ETMNR301	Analog Electronic Circuits	3	-	-	3	-	75*	-	-	-	75
2	ETMNR302	Analog Electronic Circuits Lab	-	-	2	1	-	-	25	-	-	25
Institute Level- Minor in Innovation, Entrepreneurial and Venture Development												
1	IOMNR301	UDYAME	3	-	-	3	-	75*	-	-	-	75
2	IOMNR302	UDYAME Lab	-	-	2	1	-	-	25	-	-	25

*	**End Semester Examination (ESE)** based on subjective questions.
**	**Practical or Activity based Evaluation.**
#	**In Semester Evaluation 1** based on Subjective Examination.
	In Semester Evaluation 2 based on Presentation / Group Discussion / Laboratory Work / Course Project / Home Assignment / Comprehensive Viva Voce/ Blog Writing / Case Study / Survey / GATE based MCQ examination/ Numerical based Subjective Examination.
$	**For MOOCs:** Assignments marks will be converted on the scale of 40 marks.
$$	**For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.
@@	To earn the credits, passing is mandatory in both the examination heads.

MOOC: Automation in Manufacturing :https://onlinecourses.nptel.ac.in/noc23_me105/preview

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Instrumentation Engineering–Second Year B.Tech (Semester–IV)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	INHSM401	Industrial Organization and Management@@	02	---	---	02	---	---	25	---	25	50
2	INPCC402	Control System	03	---	---	03	40#	60*	---	---	---	100
3	INPCC403	Embedded System Design	03	---	---	03	40#	60**	---	---	---	100
4	INPCC404	Process Control Loop Components	03	---	---	03	40#	60*	---	---	---	100
5	INPCC405	Machine Learning	03	--	---	03	40#	60*	--	---	---	100
6	INVSE406	PLC Programming @@	01	---	04	03	--	--	50	50	---	100
7	INPCC407	Embedded System Design Lab	---	---	02	01	---	---	25	--	---	25
8	INPCC408	Process Control Loop Components Lab	---	---	02	01	---	---	---	50	---	50
9	INPCC409	Machine Learning Lab	--	---	02	01	---	---	--	---	25	25
10	INELC410	Project Based Learning Lab	--	--	02	01	--	--	50	--	--	50
11	IOHSM4AC	Audit Course Sustainable Development Goals	01	--	--	01	--	--	25	--	--	25
12	IOLLC4L1	Lifelong LearningSkills-1	--	--	--	01	--	--	25	--	--	25
13	IOLLC4L2	Lifelong LearningSkills-2	--	--	--	01	--	--	25	--	--	25
Total			**16**	**00**	**12**	**24**	**160**	**240**	**225**	**100**	**50**	**775**
Instrumentation Engineering- Minor in Sensor and Control Technology												
11	INMNR401	Process Control Loop Components	03	--	--	03	---	75##	---	--	--	75
12	INMNR402	Process Control Loop Components Lab	--	--	02	01	--	--	25	---	---	25
Grand Total			**19**	**00**	**14**	**28**	**160**	**315**	**250**	**100**	**50**	**875**
Computer Engineering -Minor in Software Development												
1	COMNR401	Software Engineering and Modeling	3	-	-	3	-	75##	-	-	-	75
2	COMNR402	Software Engineering and Modeling Laboratory	-	-	2	1	-	-	25	-	-	25
Information Technology -Minor in Software Development Technologies												
1	ITMNR401	Object Oriented Programming	03	--	--	03	---	75##	---	--	--	75
2	ITMNR402	Object Oriented Programming Lab	--	--	02	01	--	--	25	---	---	25

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Artificial Intelligence and Data Science- Minor in Foundation of Artificial Intelligence												
1	ADMNR401	Artificial Intelligence	03	--	--	03	---	75##	---	--	--	75
2	ADMNR402	Artificial Intelligence Laboratory	--	--	02	01	--	--	25	---	---	25
Electronics and Telecommunication- Minor in Microelectronics and Embedded Systems												
1	ETMNR401	Integrated circuits	03	--	--	03	---	75##	---	--	--	75
2	ETMNR402	Integrated circuits Lab	--	--	02	01	--	--	25	---	---	25
Electrical Engineering- Minor in Industrial Electrical Engineering												
1	ELMNR401	DC and Induction Machines	03	--	--	03	---	75##	---	--	--	75
2	ELMNR402	DC and Induction Machines Lab	--	--	02	01	--	--	25	---	---	25
Institute Level- Minor in Innovation, Entrepreneurial and Venture Development												
1	IOMNR401	Design Thinking and Innovation	03	--	--	03	---	75##	---	--	--	75
2	IOMNR402	Design Thinking and Innovation Lab	--	--	02	01	--	--	25	---	---	25

*	**End Semester Examination (ESE)** based on subjective questions.
**	**Practical or Activity based Evaluation.**
#	**In Semester Evaluation 1** based on Subjective Examination.
	In Semester Evaluation 2 based on Presentation / Group Discussion / Laboratory Work / Course Project / Home Assignment / Comprehensive Viva Voce/ Blog Writing / Case Study / Survey / GATE based MCQ examination/ Numerical based Subjective Examination.
##	**End Semester Examination (ESE) based on objective questions.**
$	**For MOOCs: Assignments marks will be converted on the scale of 40 marks.**
$$	**For MOOCs: Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.**
@@	To earn the credits, passing is mandatory in both the examination heads.

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Second Year B. Tech Instrumentation Engineering Democracy Election and Governance			
Course Code:	**IOHSM301**	**Credit**	2
Contact Hours:	1 Hrs/week (L)	**Type of Course:**	Term work Oral
Examination Scheme	Term work 25Marks	Oral 25Marks	

Pre-requisites: Nil

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term work	Internal	25
2.	Oral	External	25

Course Objectives	
1	To introduce the students meaning of democracy and the role of the governance.
2	To help the understand the various approaches to the study of democracy and governance.

Course Outcomes: Students will be able to	
301.1	Know the meaning of democracy and the role of the governance in life
301.2	Understand the various approaches to the democracy and governance

Topicscovered:

UNIT 1. DEMOCRACY-FOUNDATION AND DIMENSIONS(5 hrs)

a. Constitution of India
b. Evolution of Democracy-Different Models
c. Dimensions of Democracy-Social, Economic, and Political

UNIT II: DECENTRALIZATION(5 hrs)

a. Indian tradition of decentralization
b. History of panchayat Rajinstitution in the lost independence period
c. 73rdand74thamendments
d. Challenges of caste, gender, class, democracy and ethnicity

UNIT-III: GOVERNANCE (5 hrs.)

a. Meaning and concepts
b. Government and governance
c. Inclusion and exclusion

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Text Books:

1. Banerjee-Dube,I.(2014).*AhistoryofmodernIndia*.CambridgeUniversityPress.
2. Basu,D.D.(1982).*IntroductiontotheConstitutionofIndia*.PrenticeHallofIndia.
3. Bhargava,R.(2008).*Politicaltheory:Anintroduction*.PearsonEducationIndia.
4. Bhargava, R., Vanaik, A. (2010) *Understanding Contemporary India: Critical Perspective* .New Delhi: Orient Blackswan.
5. Chandhoke. N., Proyadardhi. P, (ed) (2009), *'Contemporary India: Economy, Society, Politics'*, Pearson India Education Services Pvt. Ltd, ISBN 978-81-317-1929-9.
6. Chandra,B.(1999).*EssaysoncontemporaryIndia*.Har-AnandPublications.
7. Chaterjee,P.(1997).Stateand Politics in India.
8. Dasgupta. S.,(ed)(2011),*'Political Sociology'*, Dorling Kindersley (India)Pvt. Ltd., Licensees of Pearson Education in south Asia. ISBN: 978-317-6027-7.
9. Deshpande,S.(2003).ContemporaryIndia:ASociologicalView,NewDelhi:VikingPublicatio n.
10. Guha,R.(2007).India After Gandhi: The History of the World's Largest. *Democracy, Harper Collins Publishers, NewYork.*
11. Guha, R.(2013). *Gandhi before India*.Penguin UK.
12. Jayal.N.G. (2001). *Democracy in India.* NewDelhi: Oxford University Press.
13. Kohli,A.(1990).*Democracyanddiscontent:India'sgrowingcrisisofgovernability*.Cambridge UniversityPress.
14. Kohli,A.,Breman,J.,&Hawthorn,G.P.(Eds.).(2001).*ThesuccessofIndia'sdemocracy*(Vol.6).C ambridgeUniversityPress.
15. Kothari ,R.(1989). *State against democracy: In search of humane governance.* Apex Pr.
16. Kothari, R. (1970).*Politics in India*. New Delhi: Orient Blackswan.
17. Kothari, R.(1995).*Caste in Indian politics.* Orient Blackswan.
18. Sarkar,S.(2001).*Indiandemocracy:thehistoricalinheritance.theSucc*edition

मराठी संदर्भ ग्रंथ:

१. राही श्रुती गणेश., आवटे श्रीरंजन, (२०१९), *'आपलं आयकार्ड'*, सुहास पळशीकर द युनिक अकॅडमी पब्लिकेशनप्रा.लि.,.

२. व्होरा राजेंद्र., पळशीकर, सुहास.(२०१४). *भारतीय लोकशाही अर्थ आणि व्यवहार.* पुणे : डायमंड प्रकाशन.

३. सुमंत, यशवंत.(२०१८). *प्रा. यशवंत सुमंत यांची तीन भाषणे.* पुणे : युनिक अँकॅडमी पब्लिकेशन्स प्रा.लि

४. भोळे. भा.ल. (२०१५). *भारतीय गणराज्याचे शासन आणि राजकारण.* नागपूर: पिंपळापुरे बुक प्रकाशन

५. कसबे. रावसाहेब. (२०१०)डॉ. आंबेडकर आणि भारतीय राज्यघटना. पुणे: सुगावा प्रकाशन

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Second Year B. Tech Instrumentation Engineering Data Science			
Course Code:	**INPCC302**	**Credit**	**03**
Contact Hours:	03Hrs/week(L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation40 Marks	End-sem. Examination 60Marks	Activity Based Examination

Pre-requisites: Data structure, linear algebra, statistics.

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To describe data science processes, applications.
2	To explain statistical methods for data analysis.
3	To describe data science packages.
4	To demonstrate exploratory data analysis and data visualization.

Course Outcomes: Students will be able to	
302.2	Demonstrate statistics for data analysis.
302.3	Describe data science packages.
302.4	Demonstrate data cleaning methods.
302.5	Create data visualization desktop.

Topics covered:

Unit I: Introduction to Data Science (6hrs)

Data science definition, Introduction to Artificial Intelligence, Machine Learning and Deep Learning. Data science process: Data science life cycle, Different steps, Data Science Software Tools, Programming Languages for Data Science, Applications of Data Science, Job roles in Data Science.

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Unit II :Data Sampling and Statistics for Data Analysis (6hrs) Types of data, Data Collection and Sampling methods, Statistics: Descriptive Statistics: Measurement of central tendency (Mean, median and mode), measurement of spread (Range, IQR, variance, standard deviation) , correlation, covariance and Inferential Statistics (Probability, Hypothesis testing)
Unit III: Data Science Packages(6hrs) Numpy: Array Operation, Indexing/slicing, mathematical operations, Matrix operations, String operation. Pandas: Basic pandas operation on data frame, append, loc and iloc, missing values, merge, concat, control loops. Matplotlib: Histogram, Line chart, bar chart, pie chart, scatter plot, subplot, imshow. Seaborn, Sklearn: used for Machine learning. Scipy: used for scientific purpose.
Unit IV: Exploratory Data Analysis /Data Cleaning (6hrs) Identification of variables and data types, Univariate, bivariate, multivariate analysis, Missing value treatment (Mean /median/mode methods), Outlier treatment (Percentile, Std dev, IQR, Boxplot, Z score)
Unit V: Variable and Feature Transformation(6hrs) Categorical to Numerical: One hot encoding, dummies, Label encoding, Feature Selection, Feature Rescaling (Normalization and Standardization), Feature Transformation(Log, exponential, square)
Unit VI: Introduction to Data Visualization Tools: Power BI(6hrs) Introduction to Power BI, Understanding the Power BI ecosystem (Desktop, Service, Mobile), Features of Power BI, Power BI Desktop, importing data from different sources, Basic charts, Data visualization.

Text Books:

1. Python for data analysis by O'Reilly
2. Data Visualization in python by Daniel Nelson
3. Mastering Python for Data Science by Samir Madhavan
4. Introduction to Data Science by Igual, Segui, Springer, 2017

References Books:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing, and Presenting Data by
   John Wiley & Sons
2. Python for Data Analysis by W McKinney
3. Think Stats: Probability and Statistics for Programmers by Allen B. Downey
4. Elements of Statistical Learning by Hastie, Tibshirani, Friedman, Springer, 2011
5. The art of Data Science by Matsui, Peng, 2016
6. Data Science from Scratch by Grus, Google Books, 2015

E- Books / E- Learning References:

Python for data science: https://nptel.ac.in/courses/106106212

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Second Year B. Tech Instrumentation Engineering Electrical Measurements and Instrumentation			
Course Code:	**INPCC303**	**Credit**	**3**
Contact Hours:	3Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	Insem. Evaluation 40Marks	End-sem. Examination 60 Marks	

Pre-requisites:

- Basic knowledge of electrical engineering, laws, components, thevenin's theorem.

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem.Evaluation	Internal	40
2.	EndSemester Examination	External	60

Course Objectives	
1	To introduce static and dynamic performance characteristics of instruments.
2	To provide basic understanding of design of multi range ammeter and voltmeter
3	To explain the construction and working of instruments.
4	To introduce the application of analog and digital instruments.

Course Outcomes: Students will be able to	
303.1	Define static and dynamic characteristics to indicate the performance of instruments.
303.2	Calculate the values of resistances for design of multi range ammeter, voltmeter and ohmmeter
303.3	Determine the magnitude and frequency of given signal by CRO using Y-t, lissajous and Z-modulation techniques.
303.4	Compute the resistance, inductance and capacitance by DC and AC bridges and use it as signal conditioning circuit for resistive, inductive and capacitive transducers.
303.5	Explain types of ADCs and DACs to be used in digital instrumentation systems.
303.6	Explain types of graphical recorders and application in measurement

UNIT I:Fundamentals Of Measurement (7 hrs)

Need of Instrumentation, General Measurement System, Classification of Instruments, Static and Dynamic characteristics of instruments, Error: limiting error, Types of Errors. Loading effect: Input impedance and admittance of load & output impedance and admittance of source, loading effects of series and shunt connected instruments,

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Calibration: Definition,calibration report & certification, traceability, and traceability chart.
UNIT II: Analog Indicating Instruments (8hrs) PMMC, Galvanometer, Moving Iron instrument, RMS and True RMS concept, Extension of range of ammeter, design of multi range ammeter, conversion of ammeter to voltmeter, extension of range of voltmeter, design of multi range voltmeter, series and shunt type ohmmeter, Single phase wattmeter: construction and
UNIT III: Oscilloscope (6 hrs) General purpose oscilloscope Block Diagram, Cathode Ray Tube, front panel controls, Oscilloscope Probes 1:1 and 10:1, Dual trace CRO, ALT and CHOP modes, measurement of electrical parameters like voltage, current, frequency and phase, frequency measurement by Lissajous pattern and Z-modulation. Digital Storage Oscilloscope block diagram, sampling rate, bandwidth, roll mode.
UNIT IV: Bridges (7hrs) **DC bridges:** Wheatstone bridge construction and general balance condition, errors in bridge circuits, bridge sensitivity, Kelvin bridge, Kelvin double bridge, applications of DC bridges. **AC bridges:** Quality factor (Q) and dissipation factor(D), General equations for bridge balance, detectors for AC bridges, Maxwell's bridges, Hay bridge, Schering bridge, Wienbridge, applications of AC bridges.
UNIT V: Digital Instruments (8 hrs) Block diagram of digital instrument, Need of ADC, ADC specifications, selection criteria of ADC, Need of DAC, DAC specifications, selection criteria of DAC, Advantages and disadvantages of Digital instruments over Analog instruments, Accuracy of digital instruments, resolution of digital instrument, Displays: 7-segment display $\left(3\frac{1}{2},\ 3\frac{3}{4}\right)$, LCD, digital instruments like Digital Multimeter, Digital energy meter, Digital Clamp meter.
UNIT VI: Graphical Recording Instruments (6hrs) Definition of recorder, classification of recorder, marking mechanisms, tracing curves, Basic Strip chart recorder, Types of Strip chart recorder, XY Recorder, Application of recorders

Text Books:

1. Sawhney A. K, "Electrical and Electronics Measurements and Instruments" Dhanpat Rai & Co. 02nd Ed
2. W. D. Cooper & A. D. Helfrick, "Electronic Instrumentation and Measurement Techniques" PHI, 4th e/d, 1987
3. DavidA.Bell," Electronic Instrumentation and Measurements", PHI, 2e/d

Reference Books:

1. Anand M. M. S., "Electronic Instruments and Instrumentation Technology", PHI, 2004, 02nd Ed.
2. Kalsi H. S.," Electronic Instrumentation", TMH, 2nd or 3rd e/d, 2004/2010.
3. R. Subburaj, "Calibration the Foundation for ISO 9000 and TQM".
4. Bouwens A. J., "Digital Instrumentation", McGraw-Hill, second edition.

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Second Year B. Tech Instrumentation Engineering Sensors and Transducers			
Course Code:	**INPCC304**	**Credit**	**3**
Contact Hours:	3Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40Marks	Endsem.Examination 60Marks	

Pre-requisites: Basic knowledge of Electrical& Electronics Engineering

Course assessment methods/tools:

Sr.No.	Courseassessmentmethods/tools	External/Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To make students familiar with Sensors & its applications.
2	To discuss constructions and working principle of different types of sensors and transducers.
3	To make students aware about the construction, operation various features of sensors and transducers.
4	To familiar with different measuring instruments and the methods of measurement
5	To impart skills to evaluate the performance of methods of measurement and the use of different transducers.

Course Outcomes: Students will be able to	
304.1	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
304.2	Understand correctly the expected performance of various sensors
304.3	List and locate different type of sensors used in real life applications and paraphrase their importance
304.4	Outline and Use the concepts in common methods for converting a physical parameter into an electrical quantity.
304.5	Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light
304.6	Develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system

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Topics covered:
Unit I: Displacement And Speed Measurement (6hrs.) Need of sensors and transducers, transducers definition, classification, performance characteristics and selection criteria. **Displacement Measurement:** resistive-potentiometers, inductive-LVDT and RVDT ,capacitive, piezoelectric, ultrasonic and proximity sensors. **Speed Measurement:** Tachometer, Magnetic pickups, Encoders, Photoelectric pickups.
Unit II: Force And Torque & Vibration Measurement(6hrs.) **Force transducer:** Basic methods of force measurement, Elastic force transducer, Load cell, LVDT, Piezo electric transducer. **Torque Transducer:** Strain gauge torque measurement , inductive and magnetostrictive torque measurement **Vibration Measurement:** Piezoelectric, Seismic
Unit III: Pressure Measurement(6hrs.) Pressure scales and standards, Types of Pressure: Gauge pressure, Absolute pressure, Differential pressure, Vacuum pressure **Types of Pressure sensor:** Dead weight tester, vacuum pressure sensor, Bourdon tube , Manometers **Elastic Pressure sensor:** Bellows, bourdon tubes, diaphragm.
Unit IV: Temperature measurement (6hrs.) Temperature scales, classification, **Thermometer**- types of thermometer, filled system thermometer, **RTD**-Material used, types 2 wire,3 wire & 4 wire, application of RTD, **Thermistor** –Material used, type (NTC , PTC) and it's application. **Thermocouples**- Material used, Types(A,B,C,D,E,J,K,R,S,T), laws of thermocouples, cold junction compensation method. **Semiconductor temperature sensors**- Diode & IC temperature sensor LM35.
Unit V: Flow Measurement(6hrs.) Units, Classification of flow: Newtonian and non-Newtonian fluids, Reynolds's number, laminar and turbulent flows, velocity profile, Bernoulli's equation for incompressible flow, head type flow meters (orifice, venture meter and pitot tube), variable area type, turbine, electromagnetic , ultrasonic, vortex shedding, anemometers , mass flow meter: Coriolis flow meter.
Unit VI: Level And Miscellaneous Measurement (6hrs.) **Level Measurement:** Dipstick displacer, float, Bubblers method, Diaphragm level detector, laser level sensor, time domain reflectometry, ultrasonic level detector. **Viscosity:** Saybolt, Searle's rotating cylinder, Cone and plate, Falling and rolling ball, Rotameter. **Density:** Chain-balanced float type, Hydrometer (Buoyancy type), Hydrostatic Head (Air bubbler). **Humidity:** resistive and capacitive type sensors **Miscellaneous Sensors:** pH sensors, Conductivity sensors.

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Text Books:

1. Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill, 2nd Ed.
2. Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi, 2nd Ed.
3. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co, 2nd Ed.
4. Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt. Ltd, 07th Ed.

References

1. Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
2. Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
3. Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 02nd Ed.
4. Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers, 02nd Ed.

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Second Year B. Tech Instrumentation Engineering Analog and Digital Techniques			
Course Code:	**INPCC305**	**Credit**	**3**
Contact Hours:	3Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	Insem. Evaluation 40Marks	End-sem. Examination 60Marks	

Pre-requisites:

- Basic Electronics Engineering.

Course assessment methods/tools:

Sr.No.	Courseassessmentmethods/tools	External/Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To explain the concept of basic characteristics, open loop & close loop configuration of operational amplifier (op-amp).
2	To describe the design aspect of different circuits using op-amp, timer and voltage regulator.
3	To discuss the functionality and applications of various digital circuits.
4	To enable students to design combinational and sequential digital circuits.

Course Outcomes: Students will be able to	
305.1	Apply the knowledge of operational amplifier (op-amp) IC characteristics for IC selection, in various applications.
305.2	Design and implement analog circuits using general purpose and special purpose ICs.
305.3	Explain combinational and sequential logic circuits.
305.4	Design and test digital circuits.

Topics covered:

UNITI: Fundamentals of operational amplifier (6hrs.)

Characteristics of operational amplifier, Comparative study of different amplifiers (OP07, LF353, LM324). Introduction to open and closed Loop configurations of op-amp,Non-inverting amplifier, Inverting amplifier, Differential amplifier with feedback, Instrumentation amplifier: Equation of close loop gain, input impedance, output impedance and bandwidth.

UNITII: Op-amp applications (6hrs.)

Linear applications: Voltage summing and weighting circuit, Equation solving with op-amp, Practical Integrator, Practical differentiator, Current to voltage converter with zero and span adjustment circuit, Voltage to current converter with zero and span adjustment circuit

Non-linear applications: Comparator, Schmitt trigger, Barkhausen stability criteria, Wein bridge oscillator

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UNITIII: Special purpose ICs (6hrs.) **Timers:** Astable, Monostable, and Bistable multivibrators using LM555.Voltage regulators: Performance parameters (line regulation, load regulation, ripple rejection), **Fixed voltage regulators** (IC78xx, IC79xx)
UNITIV:Combinational Logic (6hrs.) **Logic circuit minimization techniques**: Laws of Boolean Expression De-Morgan's Theorem, SOP form, POS form, Minimization of SOP and POS forms, K-Maps. **Combinational Logic Circuits**: Multiplexer, De-multiplexer,Full adder , Full Substractor.
UNITV-Sequential Logic (6hrs.) Flip-flop: SR, JK, MSJK, D, T types of flip flop, Truth tables. Conversion from one type to another type of Flip Flop.
UNITVI-Counters (6hrs.) Asynchronous counters, Synchronous counters: Binary, Johnson counter, Shift register, Types of Shift Register Sequence Generator.
Syllabus contents required for competitive exams (GATE): Unit I, II, IV,V,VI

Text Books:

1. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education India, 2002.
2. Ramakant Gaikwad, "Operational Amplifiers" PHI, 3 rd Edition, 1992.
3. D. Roy Choudhury, "Linear Integrated Circuits" New Age International, 4th Edition.
4. Floyd "Digital Principles", Pearson Education, 11th Edition.
5. Gothman, "Digital Electronics", 2nd Edition, PHI.
6. M. Morris Mano,' Digital Design', Pearson Education, 03rd Edition.

Reference Books:

1. Paul Horowitz, Winfield Hill, "The Art of Electronics", 2 nd Edition, Cambridge University press, 2008.
2. Leach, Malvino, Saha; Digital Principles and Applications, 7th Edition, McGraw Hill.
3. R. P. Jain; Modern Digital Electronics, 4th Edition, McGraw Hill.

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Second Year B. Tech Instrumentation Engineering Automation in Manufacturing			
Course Code:	**INOEC306**	**Credit**	**03**
Contact Hours:	03Hrs/week(L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40Marks	End-sem. Examination 60Marks	

Pre-requisites: Knowledge of basic electronics and electrical engineering.

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1.	MOOC Assignments	External	40
2.	EndSemester Examination	External	60

Course Objectives	
1	Learn the Hydraulic systems in manufacturing industry
2	Explore the Pneumatic system functioning in manufacturing system

Course Outcomes: Students will be able to	
306.1	Illustrate the various hydraulic system in manufacturing processes.
306.2	Describe the various components in pneumatic system

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Topics covered:

Week 1: Introduction: Importance of automation in the manufacturing industry. Use of mechatronics..Systems required.
Week 2: Design of an automated system: Building blocks of an automated system, working principle and examples.
Week 3: Fabrication: Fabrication or selection of various components of an automated system. Specifications of various elements. Use of design data books and catalogues.
Week 4: Sensors: study of various sensors required in a typical automated system for manufacturing. Construction and principle of operation of sensors.
Week 5: Microprocessor Technology: signal conditioning and data acquisition, use of microprocessor or micro controllers. Configurations. Working.
Week 6: Drives: electrical drives – types, selection criteria, construction and operating principle.
Week 7: Mechanisms: Ball screws, linear motion bearings, cams, systems controlled by camshafts.
Week 8: Mechanisms: Electronic cams, indexing mechanisms, tool magazines, and transfer systems.
Week 9: Hydraulic systems: hydraulic power pack, pumps, valves.
Week 10: Hydraulic systems: designing of hydraulic circuits.
Week 11: Pneumatic systems: configurations, compressors, valves, distribution and conditioning.
Week 12: CNC technology: basic elements, interpolators and programming.

MOOC: Automation in Manufacturing

:https://onlinecourses.nptel.ac.in/noc23_me105/preview

Books and references

1. HMT Ltd. Mechatronics, Tata McGraw-Hill, New Delhi, 1988.
2. Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore,1999.
3. Regtien, P. P. L., Sensors for mechatronics, Elesevier, USA,2012.
4. Tonshoff, H.K. and I. Inasaki, Sensors in manufacturing,Wiley-VCH, 2001.
5. Gaonkar, R. S., Microprocessor architecture, programming,and applications with the 8085, Penram International Publishing (India), Delhi, 2000.
6. Bradley, D. A., Dawson D., Burd, N. C. and Loader A. J.,Mechatronics: Electronics in products and processes, CRC Press, Florida, USA, 2010.
7. Rothbart, H. A., CAM Design Handbook, McGraw-Hill, 2004.• Norton, R. L., Cam Design and Manufacturing Handbook,Industrial press Inc, 2002.
8. Mechatronics, HMT, Tata McGraw-Hill Education, 1998.
9. Groover, M. P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall, 2001.
10. Parr, A. A., Hydraulics and pneumatics, Elsevier, 1999.
11. Smid, P., CNC Programming Handbook, IndustrualPress,New York, USA, 2008.
12. Rao, P. N., CAD/CAM Principles and Applications, Tata McGraw Hill, New Delhi, 2010.

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BOS–INSTRUMENTATION ENGINEERING
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Second Year B. Tech Instrumentation Engineering Data Science Lab			
Course Code:	**INPCC307**	**Credit**	**1**
Contact Hours:	2Hrs/week(P)	**Type of Course:**	Practical
Examination Scheme	Term work 25Marks		

Pre-requisites:

- Basic Python programming knowledge.

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term work	Internal	25

Course Objectives	
1	To explain statistical methods for data analysis.
2	To demonstrate exploratory data analysis and data visualization.

Course Outcomes: Students will be able to	
307.1	Demonstrate statistics for data analysis.
307.2	Demonstrate data science packages.
307.3	Demonstrate data cleaning methods.
307.4	Create data visualization desktop.

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List of Experiments:

Students are required to perform all experiments from the given list.

1. Statistical analysis of dataset
2. Students performance analysis. Dataset: StudentsPerformance.csv
3. Missing value treatment of dataset. Dataset: Toyota.csv
4. Correlation analysis of dataset. Dataset: Toyota.csv
5. Data preparation:
   Download heart dataset from following link.
   https://www.kaggle.com/zhaoyingzhu/heartcsv

Perform following operation on given dataset.

   a) Find Shape of Data
   b) Find Missing Values
   c) Find data type of each column
   d) Finding out Zero's
   e) Find Mean age of patients

6. Data visualization: Plot frequency distribution of fuel type using bar plot.
   Dataset: Toyota.csv
7. Create 'price class for cars' having three categories: Low, Medium and High using control loops. Dataset: Toyota.csv
8. Power BI dashboard
9. File operation
10. VLAB: Word analysis (NLP)

Text Books:

1. Python for data analysis by O'Reilly
2. Data Visualization in python by Daniel Nelson
3. Mastering Python for Data Science by Samir Madhavan
4. Introduction to Data Science by Igual, Segui, Springer, 2017

References Books:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing, and Presenting Data by
2. John Wiley & Sons
3. Python for Data Analysis by W McKinney
4. Think Stats: Probability and Statistics for Programmers by Allen B. Downey
5. Elements of Statistical Learning by Hastie, Tibshirani, Friedman, Springer, 2011
6. The art of Data Science by Matsui, Peng, 2016
7. Data Science from Scratch by Grus, Google Books, 2015

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Second Year B. Tech Instrumentation Engineering Electrical Measurements and Instrumentation Lab			
Course Code:	**INPCC308**	**Credit**	**1**
Contact Hours:	2Hrs/week (L)	**Type of Course:**	Practical
Examination Scheme	Oral examination 25 Marks		

Pre-requisites:

- Basicknowledge of electrical engineering, laws, components, thevenin's theorem.

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1.	Oral examination	External	25

Course Objectives	
1	To introduce the different analog and digital instruments for measurement and procedure of measurement.
2	To explain the methodology of design of multirange ammeter, voltmeter and ohmmeter.

Course Outcomes: Students will be able to	
308.1	Calculate the values of resistances for design of multirange ammeter, voltmeter and ohmmeter
308.2	Determine the magnitude and frequency of given signal by CRO using Y-t, lissajous and Z-modulation techniques.
308.3	compute the resistance, inductance and capacitance by DC and AC bridges and use it as signal conditioning circuit for resistive, inductive and capacitive transducers.
308.4	demonstrate the application of ADCs and DACs tobe used in digital instrumentation systems.
308.5	Explain the parts, applications and difference between analog indicating instruments and graphical recorders

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List of Experiments:

1. Calibrate analog pressure gauge and prepare a calibration report.
2. Design multirange ammeter and voltmeter for minimum 3 different ranges.
3. Design series and shunt type ohmmeter.
4. Measurement of power using single phase wattmeter.
5. Measurement of voltage, current, time period, frequency and phase of sinusoidal wave using CRO
6. Measurement of unknown frequency by Z-modulation technique using CRO
7. Measurement of unknown resistance by wheatston's bridge.
8. Measure respective parameter by AC bridge (anyone AC bridge from syllabus).
9. To measure response time of a relay using DSO
10. To measure energy using single phase digital energy meter
11. Study and implementation of Analog to digital conversion using IC 0809
12. Study and implementation of Digital to Analog conversion using IC 0808
13. VALB: Design digital temperature measurement system using thermocouple/RTD
14. VLAB: Study of y-t or X-Y recorder

Text Books:

1. Sawhney A. K, "Electrical and Electronics Measurements and Instruments" Dhanpat Rai & Co. 02nd Ed
2. W. D. Cooper & A. D. Helfrick, "Electronic Instrumentation and Measurement Techniques" PHI, 4th e/d, 1987
3. DavidA Bell," Electronic Instrumentation and Measurements", PHI, 2e/d

Reference Books:

1. Anand M. M. S., "Electronic Instruments and Instrumentation Technology", PHI, 2004, 02nd Ed.
2. Kalsi H. S.," Electronic Instrumentation", TMH, 2nd or 3rd e/d, 2004/2010.
3. R. Subburaj, "Calibration the Foundation for ISO 9000 and TQM".
4. Bouwens A. J., "Digital Instrumentation", McGraw-Hill, second edition.

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Second Year B. Tech Instrumentation Engineering Sensor and Transducers Lab			
Course Code:	**INPCC309**	**Credit**	**1**
Contact Hours:	2Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Practical 50Marks		

Pre-requisites:

- Basic knowledge of Electrical & Electronics Engineering

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External/Internal	Marks
1.	Practical	Internal	50

Course Objectives	
1	To explain different characteristics techniques of Transducers
2	To describe various performance of flow measurements.
3	To explain selection of methods for level measurement.
4	To make students aware about the simulation operation of various features of sensors
5	To familiar with different temperature measuring instruments and methods
6	To impart skills on the performance of arduino and labview methods of measurement

Course Outcomes: Students will be able to	
309.1	Test various characteristics operations of LVDT and Load cell.
309.2	Understand different applications of flow measurement.
309.3	Develop program code by selection of proper data structure using python language.
309.4	Solve through software simulation on various characteristics of sensor.
309.5	Identify the proper methods and instrument for temperature measurement
309.6	Understand the working on different open source and virtual instrument platform

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List of Experiments:

Students are expected to perform any 8 experiments ;

1. Determine the characteristics of LVDT.
2. Study the characteristics of Load cell..
3Compare performance of Orifice and Venture for flow measurement..
4. Evaluate performance characteristics of air purge method for level measurement.
5. Simulate the performance of a chemical sensor.
6. Characterization of RTD (PT100) for temperature measurement.
7. Characterize the temperature sensor (Thermocouple)
8. Calibration of pressure gauge using dead weight pressure tester.
9. Compare performance of encoder and tachometer for speed measurement.
10. Measurement of temperature and humidity using Arduino..
11. Water level measurement using Arduino..
12. Study on Temperature Measurement using Lab View.
13. Measurement of level in a tank using capacitive type level probe
14 VLAB: Design an orifice plate for a typical application
15 VLAB: Study of Impulse Current Generator

Text Books:

1. Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill, 2nd Ed.
2. Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi, 2nd Ed.
3. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co, 2nd Ed.
4. Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt.Ltd, 07th Ed.

References

1. Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
2. Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
3. Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani,Tata McGraw-Hill Publishing Company Ltd., New Delhi, 02nd Ed.
4. Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers, 02nd Ed.

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Second Year B. Tech Instrumentation Engineering Analog and Digital Techniques Lab			
Course Code:	**INPCC310**	**Credit**	**1**
Contact Hours:	2Hrs/week (P)	**TypeofCourse:**	Practical
Examination Scheme	Practical – 50 Marks		

Pre-requisites:

- Basic Electronics Engineering Lab

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1	Practical	External	50

Course Objectives	
1	To describe the design and implementation aspect of different analog circuits using op-amp, timer and voltage regulator ICs.
2	To describe various variable reduction techniques.
3	To explain the designing and testing of combinational and sequential digital circuits.

Course Outcomes: Students will be able to	
310.1	Apply the knowledge of characteristics of operational amplifier (op-amp) IC to select IC as per application.
310.2	Design and implement analog circuits using op-amp, IC555.
310.3	Apply various variable reduction techniques in the design of digital logic circuits.
310.4	Design and test digital circuits

List of Experiments:

(Any 4 from 1 to 7)

1. Bandwidth measurement of inverting and non- inverting amplifier.
2. Measurement and comparison of characteristics CMRR, slew rate, output offset voltage etc. using different op-amp ICs.
3. Design and implement differentiator. Plot the frequency response.
4. Design and implement wien bridge oscillator.
5. Design and implement comparator, zero crossing detector and schmitt trigger. Draw hysteresis plot.
6. Design and implement astable and monostable multivibrator using LM 555.
7. Design and implement fixed voltage regulator using 78xx.

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(Any 4 from 8 to 16)

8. Verification of Truth Table of various logic gates and study input and output characteristics of TTL logic family.
9. Design and Implement full adder using logic gates.
10. Design and Implementsubstractor using logic gates.
11. Study of Flip –Flop ICs.
12. Conversion of flip –flop from one to other.
13. Implementation of counter of different Mod numbers.
14. Design of Sequential counter using type T and Type D design.
15. Design of Non sequential counter using type T and Type D design
16. VLAB: Design Ring & Johnson counters using shift register IC 7495.
17. VLAB: Demultiplexer using Universal Logic Gates.

Text Books:

1. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education India, 2002.
2. Ramakant Gaikwad, "Operational Amplifiers" PHI, 3 rd Edition, 1992.
3. D. Roy Choudhury, "Linear Integrated Circuits" New Age International, 4th Edition.
4. Floyd "Digital Principles", Pearson Education, 11th Edition.
5. Gothman, "Digital Electronics", 2nd Edition, PHI.
6. M. Morris Mano,' Digital Design', Pearson Education, 03rd Edition.

Reference Books:

1. Paul Horowitz, Winfield Hill, "The Art of Electronics", 2 nd Edition, Cambridge University press, 2008.
2. Leach, Malvino, Saha; Digital Principles and Applications, 7th Edition, McGraw Hill.
3. R. P. Jain; Modern Digital Electronics, 4th Edition, McGraw Hill.

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Second Year B. Tech Instrumentation Engineering Vedic Mathematics			
Course Code:	**IOHSM3AC**	**Credit**	**01**
Contact Hours:	01Hrs/week(L)	**Type of Course:**	Lecture
Examination Scheme	Term work 25 Marks		

- **Pre-requisites: Vedic Sutras, Vedic Sub Sutras**

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1.	Termwork	Internal	25

Course Objectives	
1	To develop the understanding of Techniques/Sutras to solve mathematical arithmetic's in easy and faster way and use these techniques to varies Competitive Examinations.
2	To Improve speed and efficiency to solve even the most complex Mathematical problems
3	To remove the phobia about mathematics in the minds of Students
4	To help students to have better command over mathematical concepts and boost up their self- confidence level towards the subject

Course Outcomes: Students will be able to	
3AC.1	Apply Vedic Mathematics techniques to Perform quickly and accurately mathematical calculations like multiplication, division, squares, cubes, LCM, HCF.
3AC .2	Apply Vedic Mathematics techniques to solve Linear Equations, Quadratic Equations, Factorization of a Cubic Polynomial.
3AC.3	Apply Vedic Mathematics techniques to Perform calculations in Coordinate Geometry, Differentiation, Integration and Trigonometry without relying heavily on calculators or written methods.

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Topics covered:

Module I:- Basic Level(4 Hrs)
Introduction of Vedic Mathematics, Multiplication, Square, Cube, Divisibility Test , Highest Common Factor of Polynomials, Multiplication of Polynomials, Division of Polynomials,.

Module II: Intermediate Level(4Hrs)
Linear Equations, Quadratic Equations, Factorization of a Cubic Polynomial, Magic squares, Dates and Calendar.

Module III: Advance Level (4Hrs)
Determinant, Coordinate Geometry, Differentiation, Integration, Trigonometry.

Textbooks:

1. Advanced Vedic Mathematics, Rajesh Kumar Thakur.
2. Vedic Mathematics Made Easy , DhavalBathia
3. VEDIC MATHEMATICS For Students: LEVEL – 1 OF 5 SERIES, by Nava Vision

Reference Books:

1. Sri Bharatikrishna Tirthaji,"Vedic Mathematics", Published by Motilal Banarsidass, 1965.ISBN 81-208-0163-6.
2. Williams K.R. "Discover Vedic Mathematics" Vedic Mathematics Research Group, 1984.ISBN 1-869932-01-3.
3. Wiliams K.R. and M.Gaskell "The Cosmic Calculator". Motilal Banarsidass ,2002.ISBN 81-208-1871-7.
4. Nicholas A.P., Williams,J. Pickles."Vertically and Crosswise". Inspiration books, 1984.ISBN 1-902517-03-2

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Second Year B. Tech Instrumentation Engineering Industrial Organization and Management			
Course Code:	INHSM401	**Credit**	2
Contact Hours:	2 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	Termwork 25Marks	Oral Examination 25Marks	

Pre-requisites: Knowledge of Organization structure, Types and Management

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term work	Internal	25
2.	Oral Examination	External	25

Course Objectives	
1	To relate and the basic concept of industrial organization and management for instrumentation Project.
2	To learn and know the use of various standards in Industries to improve the quality .
3	To learn and understand the production planning and scheduling activities involved in industries.
4	To learn the procurement activities and vendor documents.
5	To get the knowledge of Finance and capital management.
6	To understand different ethics like business and professional and knowledge of e-business.

Course Outcomes: Students will be able to	
401.1	Evaluate the role and responsibilities organization.
401.2	Apply the documents / activities required for the quality.
401.3	Identify the tools of Planning and scheduling .
401.4	Classify the standards required for industry development .
401.5	Classify the different types of budget & implement the balance sheet.
401.6	Interpret the information related to business and professional ethics.

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Topics covered:
Unit I: Basic Of Management & Strategic Industrial Management (4hrs) Introduction, Definition of management, characteristics of management, functions of management - Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making. Strategic planning, types of business strategy, Business environment, SWOT analysis, Developing competitive advantage profile and Environmental, Threat and opportunity Profile.
Unit II: Quality , Health , Environment & Safety (4hrs) Quality Circles/Forums, Quality Objectives, use of Statistical Process control, Introduction to ISO 9000 and Role of R & D, Industry Institute Interaction, types of quality – quality of design, conformance and performance, phases of quality management .factors causing pollution, effect of pollution on human health, Air pollution control, sources of pollution water pollution and control, solid waste management Environmental norms: ISO 14000.
Unit III: Production Planning , Inventory Control (4 hrs) Manufacturing Excellence, Outsourcing, Production planning techniques, Purchase and Inventory Management, inventory control using Economic Order Quantity, Minimum Order Quantity, Ordering Level, store keeping, Finished goods, semi finished goods, raw material handling and storage, Value Addition, Supply Chain concepts and management for leveraging profit.
Unit IV: Human Resources Management (4hrs) Manpower planning, Human Resources: exploiting true potential, Staff training and development, Motivation, Selection and training of manpower, Appraisal and increments management, Leadership skills, Delegation and development for growth. Objectives and Job Descriptions/ Role Summary.
Unit V:Financial Management(4hrs) Capital Structure, Fixed & Working Capital, Sources of finance, Assets management, Introduction to capital budgeting, Methods of capital budgeting: Budget definition and concept, objective of budget, type of budget, preparation of budget, Balance Sheet, function of money market and capital Market...
Unit VI: Professional Ethics and e-Business (4 hrs) Concept of Ethics, ethics and morals, business ethics, Professional ethics. Need for professional and business ethics. Introduction to Management Information System (MIS), Enterprise Resource Planning Systems (ERP), e-business and strategies.

Text Books:

1. Industrial organization and Engineering Economic- T. R. Banga and S. C. Sharma, Khanna Publication.
2. Industrial Engineering and Management- O.P. Khanna, Dhanpat Rai Publication.
3. P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd, New Delhi.
4. L. C. Shamba , Savitri Jhamb , Industrial Management – I , Everest Publishing House Management in Engineering – Gail Freeman-Bell and James Balkwill (PHI).

Reference Books:

1. M.Y. Khan and P. K. Jain, "Financial Management", Tata McGraw Hill, New Delhi
2. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw-Hill International Editions
3. Management in Engineering- Gail Freeman- Bell and James Balkwill (PHI)

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Second Year B. Tech Instrumentation Engineering Control System			
Course Code:	**INPCC402**	**Credit**	03
Contact Hours:	Hrs/week(L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40Marks	End-sem. Examination 60Marks	

- **Pre-requisites:** Concepts of Mathematics and Electrical Engineering

Course assessment methods/tools:

Sr.No.	Course assessment methods/tools	External /Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End-Semester Examination	External	60

Course Objectives	
1	Understand the fundamental concepts of control systems
2	Develop proficiency in Laplace transform and its inverse
3	Mastering the modeling techniques involves the ability to represent systems in canonical forms, enabling a deeper understanding and analysis of their behavior.
4	Analyze the LTI system in time domain and frequency domain

Course Outcomes: Students will be able to	
402.1	Apply knowledge of control system concepts
402.2	Analyze and solve differential equations
402.3	Model and analyze systems
402.4	Design and interpret block diagrams and signal flow graphs
402.5	Evaluate time domain characteristics
402.6	Assess stability and relative stability

Topics covered:

Unit I: Introduction to Control Systems(6hrs)

Introduction to control systems, Concepts of control systems, Classification of systems (Linear and Non-linear, Time-invariant and Time-variant, Static and Dynamic, Causal and Non-causal, Open loop and closed loop),Laplace transform and Inverse Laplace transform with properties. Solving differential equations

Unit II: Modeling of Systems (6hrs)

Representation of Electrical, Mechanical, and Electromechanical systems with differential equations. Concept of transfer function Properties of transfer function, Representation of

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transfer functions for Electrical and Mechanical systems with force to voltage and force to current analogies
Unit III: Block Diagram and Signal Flow Graph(6hrs) System in canonical form Introduction to block diagram and block diagram reduction rules Introduction to Signal flow graph and terminologies used Conversion of block diagrams to signal flow graph Mason's gain formula
Unit IV: Time Domain Analysis of Control Systems (6hrs) Standard test signals First order and second order systems and their response Time domain specifications of first order and second order systems Derivations of time domain specifications Static error constants (kp, kv, ka) and steady-state error (ess)
UnitV: Stability Analysis (6hrs) Concept of Stability in s domain Classification of Stability (BIBO stability and asymptotic stability)Stability analysis by Hurwitz criterion and Routh array Concept of relative stability and its analysis using Routh array Root locus: Definition, construction rules, determination of system gain at any point on the root locus (from magnitude condition and by graphical method).
Unit VI: Frequency Domain Analysis(6hrs) Fundamentals of frequency response Polar Plots and Bode plot. Determination of transfer functions from asymptotic Bode plot and Polar plot.

Text Books:

1. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 05th Ed.
2. B. S. Manke, "Linear Control Systems", Khanna Publishers, New Delhi, 02nd Ed.
3. A. K. Jairath, "Problems and Solutions of Control Systems", CBS Publishes, New Delhi, 06th Ed.
4. S. K. Bhattacharya, "Control System Engineering", Pearson India, 02nd Ed.

Reference Books:

1. K. Ogata, "Modern Control Engineering", PHI, New Delhi, 06th Ed..
2. Norman S. Nise, "Control System Engineering", John Wiley and Sons, 07th Ed.
3. B. C. Kuo, "Automatic Control Systems", PHI, New Delhi, 07th Ed

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Second Year B. Tech Instrumentation Engineering Embedded System Design			
Course Code:	**INPCC403**	**Credit**	**03**
Contact Hours:	3Hrs/week(L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	Activity Based Examination

- **Pre-requisites:** Digital Electronics, Basic Electronics Engineering, Operating System.

Course assessment methods/tools:

Sr.No.	Course assessment methods /tools	External / Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	EndSemester Examination	External	60

Course Objectives	
1	Tostudythearchitectureandinstructionssetin8051Microcontroller.
2	To write the code sign assembly and embedded C programming.
3	To interfacing the various I/O peripherals to the8051microcontroller.
4	To write codes in machine learning and embedded system
5	To study the implementation of embedded systems in advance tools.

Course Outcomes: Students will be able to	
403.1	Explain the architecture of 8051 microcontroller.
403.2	Illustrate the execution of instructions in assembly and embedded c programming language.
403.3	Demonstrate the timers and serial communication programs.
403.4	Model the various interfacing peripherals to the 8051 microcontroller.
403.5	Develop a project based on Raspberry Pi Platform and Arduino.
403.6	Learn how to create a model in Matlab Simulink.

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Topics covered:
Unit I: Introduction to Microcontroller 8051 (6hrs.) ArchitectureofMicrocontroller8051,GeneralPurposeandSpecialPurposeRegisters,Memoryorganization, Stack Operations, Addressing Modes, Interrupts.
Unit II: Instructions sets in Microcontroller 8051(6hrs) Data Transfer, Arithmetic, Logical, Branching , Looping, Counting, Sorting, Indexing, Conditional programming, Assembler Directives , Machine Cycle. Software development cycle: editor, assembler, cross-compiler, linker, compiler.
Unit III: Timers and serial communication(6 hrs) Programming on Timers& Counters, Pulse width modulation, Serial communication programming.
Unit IV: Interfacing I/O devices. (10 hrs) Pushbutton, Matrix keypad, LED, 7-segment LED display, LCD displays. Interface Analog Devices: ADC, LM35, Thermocouple, DAC. Stepper motor and DC motor interfacing.
Unit V: Embedded Python Programming (6 hrs) Embedded Device Interfacing with Python Programming Language on Raspberry Pi Platform and Arduino (LabView).
Unit VI: Simulink Embedded Coder (4hrs) Selecting Targets, Optimizing and Packaging Code, Executing and Verifying Code.

Text Books:

1. The 8051 Microcontroller Architecture, Programming and Applications by Kenneth J. Ayala, Penram International Publications
2. "The8051MicrocontrollerandEmbeddedSystems–usingassemblyandC",MuhammadAliMazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
3. "Microcontrollers:Architecture,Programming,InterfacingandSystemDesign",RajKamal,Pearson Education, 2005

References Books:

1. EmbeddedSystemDesign–FrankVahid,TonyGivargis,JohnWiley.YDanielLiang,
2. Programmingandcustomizingthe8051microcontroller,PredkoMichael,McGrawHill

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Second Year B.TEech Instrumentation Engineering Process Control Loop Components			
Course Code:	**INPCC404**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites:

- Basic knowledge of sensors//transducers, control system, Linear Integrated Circuits.

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To introduce basic fundamentals of automation.
2	To explain construction and working of transmitter, controller and control valve of process control loop.
3	To demonstrate the application of PID controller for pressure control loop and tuning methods.

Course Outcomes: Students will be able to	
404.1	Draw temperature, pressure, flow and level process control loop using standard components symbols by studying process characteristics and list process variables associated with loop.
404.2	Demonstrate the application of DPT for flow and level measurement.
404.3	Apply suitable control law to regulate the controlled variable at its set point value
404.4	Calculate PID parameters' tuning values by applying Z-N open loop and closed loop method to satisfy 1/4 th decay ratio tuning criteria
404.5	Determine control valve coefficient and control valve size for different control valve characteristics.
404.6	Explain causes of cavitation and flashing in different types of valves, its effects and remedies.

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Topic Covered
UNIT I: FUNDAMENTALS OF PROCESS CONTROL (08 Hrs) Components of process control loop, Examples of process loops like temperature, flow, level, pressure etc., concept of process variables, Signal line symbols, instrument symbols as per location, concept of field area and control room area, standard signals and its need, concept of live and dead zero. Process Characteristics: Process equation, capacity, self – regulation, control lag, process lag, distance/velocity lag (dead time).
UNIT II: TRANSMITTER (06 Hrs) Need of transmitter, two and four wire transmitters, features of transmitter. Electronic Capacitive Differential Pressure Transmitter: installation (impulse pipe and manifold), calibration setup, application of DPT for level and flow measurement, zero elevation and suppression. SMART: Comparison with conventional transmitter, block schematic, specifications.
UNIT III: CONTROLLER PRINCIPLES (06 Hrs) Control system parameters: Error, variable range, cycling, direct/reverse action. Discontinuous: two position, multi-position and floating control modes. Continuous: Proportional, integral, derivative, proportional-integral, proportional-derivative, proportional- integral-derivative (PID) control modes, reset windup, rate before reset, bump less transfer.
UNIT IV: TUNING OF PID CONTROLLER (04 Hrs) Tuning of controller: Different criteria like Quarter amplitude decay ratio, Integral time performance indices. Tuning Methods: Process reaction curve (open loop), Ziegler Nichols (closed loop)
UNIT V: CONTROL VALVES PART-I (06 Hrs) Converters: Current to pressure converter, pressure to current converter. Necessity of final control elements, Control valve parts, Actuators (Pneumatic, Electric, Hydraulic and handwheel), Control valve classification. Control valve terminology: Rangeability, turndown, viscosity index, valve capacity, AO, AC, fail-safe actions. Control valve characteristics: Inherent and installed. Control valve sizing coefficient CV.
UNIT VI: CONTROL VALVE PART-II (06 Hrs) **Linear valve:** Globe valve (GV): constructions, working, advantages, disadvantages and applications, Single seated GV, double seated GV, 3-way GV, Gate valve, angle valve. **Rotary valve**: Butterfly valve, Ball valve Positioner: Need, effect on performance of control valve Cavitation, flashing and noise, their effects and remedies

Text Books:

1. C. D. Johnson, "Process control and Instrument technology" Tata McGraw Hill, Publications, 08th Ed.
2. N.A. Anderson, Boca Ratan, " Instrumentation for Process measurement and control, Radnor Pennsylvania, CRC Press, 03rd Ed.

Reference Books:

1. B. G. Liptak, "Process Control, Instrument Engineering Hand book CRC Press, 03rd Ed.
2. Tuning of industrial control systems, ISA.
3. Control valve Handbook ISA

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Second Year B.Tech Instrumentation Engineering Machine Learning			
Course Code:	**INPCC405**	**Credit**	**03**
Contact Hours:	03 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites: Data science, basics of statistics.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To explain fundamental concepts of Machine Learning and its types, applications.
2	Introduction to supervised and unsupervised machine learning techniques.
3	To explain evaluation of machine learning models and generalize it.

Course Outcomes: Students will be able to	
405.1	Describe different types of machine leaning and its life cycle.
405.2	Differentiate various regression techniques and evaluate their performance.
405.3	Illustrate probabilistic machine learning algorithms.
405.4	Compare different types of classification models and their relevant application.
405.5	Explain the tree-based machine learning algorithms.
405.6	Apply unsupervised machine learning clustering algorithm.

Topics covered:

Unit I: Introduction to Machine Learning (06)

Need for Machine Learning, What is Machine Learning, Definition, Machine Learning Life cycle, Types of Machine Learning: Supervised Learning, Unsupervised Learning, Semi-Supervised Learning, Reinforcement Learning., Job Roles in Machine Learning, Applications of Machine Learning

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Unit II: Supervised Learning: Regression Analysis (06) Assumption of Regression, Simple Linear Regression, Multiple Linear Regressions, ordinary least square method, best fit line, MSE, MAE, R-Square, model performance evaluation
Unit III: Supervised Machine Learning: Probability Analysis (06) Introduction to Logistic Regression, Probability, Odd Ratio, Sigmoid/Logic function , Introduction to KNN: Lazy Learner, Distance Metrics (Euclidean, Manhattan, Hamming, Minkowski) and evaluation of KNN Model Introduction to Naïve Bayes: Conditional Probability, Bayes Theorem, Naïve Bayes.
Unit IV: Support Vector Machine (06) Introduction to SVM, Support Vectors, Margin, Hyper plane, Hard Margin and soft Margin, Linear separable data and nonlinear separable data, Introduction to various SVM Kernel to handle non-linear data – RBF, Gaussian, Polynomial, Sigmoid. Performance evaluation metrics-Confusion Matrix, Accuracy, Precision, Recall, ROC Curves, F-Measure
Unit V: Supervised Machine Learning: Classification Analysis (06) Introduction to Decision Tree: Concepts and Terminologies: Root node, leaf node, decision node, branches/edges, Tree split criteria, Impurity Measures: Gini index, entropy, Information gain, and pruning. Introduction to Random Forest: Ensemble Learning of decision tree, over fitting and under fitting, Regularization, Evaluation Metrics, Model Hyper parameter tuning
Unit VI: Unsupervised Machine Learning: Clustering (06) Clustering definition, Clustering types, Introduction to K Means Clustering, Centroid calculation, Distance measures, Elbow method, Silhouette method, Model evaluation.

Text Books:

1. Machine Learning For Absolute Beginners by Oliver Theobald
2. Python Machine Learning by Sebastian Raschka and Vahid Mirjalili
3. Understanding Machine Learning by Shai Shalev-Shwartz and Shai Ben-David
4. Ethem Alpaydin, Introduction to Machine Learning, PHI 2nd Edition-2013 2.
5. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
6. Tom M. Mitchell, Machine Learning, 1997, McGraw-Hill, First Edition

References Books:

1. Introduction to Machine Learning with Python by Andreas C. Müller, Sarah Guido
2. Machine Learning For Dummies by John Paul Mueller and Luca Massaron
3. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies by John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy
4. C. M. Bishop: Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
5. Ian H Witten, Eibe Frank, Mark A Hall: Data Mining, Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition
6. Kevin P Murphy: Machine Learning – A Probabilistic Perspective, MIT Press, August 2012.
7. Shalev-Shwartz S., Ben-David S., Understanding Machine Learning: From Theory to Algorithms, CUP, 2014

E- Books / E- Learning References:

1. Introduction to Machine Learning: https://nptel.ac.in/courses/106/106/106106139/
2. Machine Learning: https://nptel.ac.in/courses/106/106/106106202/
3. Machine Learning – Offered by Stanford Online - https://www.coursera.org/learn/machine-learning

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Second Year B.Tech Instrumentation Engineering PLC Programming			
Course Code:	INVSE406	**Credit**	**03**
Contact Hours:	1 Hrs/week (Th) 4 Hrs/week (P)	**Type of Course:**	Theory & Practical
Examination Scheme	Term Work 50 Marks	Practical 50 Marks	

Pre-requisites: Analog and Digital Techniques

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work	Internal	50
2.	Practical	External	50

Course Objectives	
1	To introduce the basics of industrial automation and PLC.
2	To explain ladder programming using basic PLC instructions.
3	To explain ladder programming using advanced PLC instructions.

Course Outcomes: Students will be able to	
406.1	Understand the fundamentals of industrial automation, PLC.
406.2	Explain PLC architecture and input-output modules.
406.3	Compare programming languages of PLC.
406.4	Deyelop ladder program using basic PLC instructions for industrial processes
406.5	Develop ladder program for performing comparison operations.
406.6	Develop ladder program using math operators for industrial processes.

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Topics covered:

Unit I: Fundamentals of Industrial Automation(2 hrs):
Need & Role of Automation, Evolution of Automation, Introduction to PLC, Types of PLC, Different Manufactures of PLCs and their revolution.

Unit II: PLC architecture (2 hrs):
PLC Architecture, DI-DO-AI-AO Modules.

Unit III: PLC Programming languages(2 hrs):
Programming Languages: Introduction to PLC Programming Languages as per IEC 61131-3:
Ladder Programming (LD), Function Block Diagram (FBD), Instruction List (IL), Structured
Text (ST) & Sequential Function Chart (SFC).

Unit IV: Basic PLC Programming(2 hrs):
Ladder programming for logic gates & Boolean algebra.
Timers & Counters instruction, Applications of Timers & Counters.

Unit V: Advanced PLC Programming: Comparison operations(2 hrs):
Equal, Not-equal to, Less than, Greater than, Less than or
equal to, Greater than or equal to, Limit test, Mask Compare equal to, Compare expression.

Unit VI: Advanced PLC Programming: Math operations(2 hrs):
ADD, SUB, MUL, DIV, SQR, NEG, AND, OR, NOR, EX-OR, NOT, CLEAR.
Move, Jump & Label, Sequencer instructions.

List of Experiments:

Students are required to perform following experiments:

1. Introduction to Programmable Logic Controller architecture
2. Introduction to Ladder Programming, develop and simulate Logic gates
3. Develop and simulate Boolean equations
4. Develop ladder logic for DOL starter
5. Develop and Simulate Ladder program for timer operations.
6. Develop and Simulate Ladder program for timer applications
7. Develop and Simulate Ladder program for counter operations.
8. Develop and Simulate Ladder program for counter applications.
9. Develop any one instrumentation application using timer and counter.
10. Develop and simulate comparison equations.
11. Develop and simulate math operations.
12. Develop and simulate ladder logic for level control.
13. Develop and simulate ladder logic for sequencer operation.
14. Develop and simulate ladder logic for opening and closing of shutter using PLC
15. Develop and simulate ladder logic for container filling process using PLC
16. Develop and simulate ladder logic for simultaneous output interlock using PLC
17. Motor forward and reverse direction control using PLC
18. VLAB:Maximum Simultaneous Operations Limiter using PLC

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Text Books:

1. Programmable Logic Controllers: Principles & Applications by John W. Webb, Ronald A. Reis, Prentice Hall of India, 5th ed.
2. Introduction to Programmable Logic Controllers by Gary Dunning, Delmar Thomson Learning, 3rd ed.

Reference Books:

1. Programmable Logic Controller by Frank D Petruzella, McGraw-Hill Education, 5th ed.
2. Programmable Logic Controllers by W. Bolton, Elsevier Newness publication, 4th ed.
3. Programmable Controller by T. A. Huges, ISA publication, 2nd ed.

E-learning references:

Allen Bradley PLC Training:
https://www.youtube.com/playlist?list=PLI78ZBihrkE3nnGIj2WmHb_GoWjFlfFIu

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Second Year B.Tech Instrumentation Engineering Embedded System Design Lab			
Course Code:	**INPCC407**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Termwork examination 25 Marks		

Pre-requisites:

- Digital Electronics, Basic Electronics Engineering, Operating System..

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Termwork	Internal	25

Course Objectives	
1	To study the architecture and instructions set in 8051 Microcontroller.
2	To write the codes in assembly and embedded C programing.
3	To interfacing the various I/O peripherals to the 8051 microcontroller.
4	To write codes in machine learning and embedded system
5	To study the implementation of embedded systems in advance tools.

Course Outcomes: Students will be able to	
407.1	Explain the architecture of 8051 microcontroller.
407.2	Illustrate the execution of instructions in assembly and embedded c programming language.
407.3	Demonstrate the timers and serial communication programs.
407.4	Model the various interfacing peripherals to the 8051 microcontroller.
407.5	Develop a project based on Raspberry Pi Platform and Arduino.
407.6	Learn how to create a model in Matlab Simulink.

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List of Experiments:

Students are required to perform minimum 10 program experiments from the given list.

1. Write programs based on various addressing modes and assembler directives.
2. Write programs based on Arithmetic and Logical Instructions in Assembly and Embedded C.
3. Write programs based on Branch Instructions in Assembly and Embedded C.
4. Write program on various code conversion.
5. Write programs based on Looping, Counting, and Indexing concept in Assembly and Embedded C.
6. Write programs to introduce delay using timers.
7. Write programs to turn ON/OFF LED using interrupt.
8. Write programs to generate various waveforms.
9. Write programs to interface 4x4 matrix keypad.
10. Write programs to interface LCD.
11. Write programs to interface 7 segment display.
12. VLAB:Simulink design for embedded c coder.

Text Books:

1. The 8051 Microcontroller Architecture, Programming and Applications by Kenneth J. Ayala, Penram International Publications
2. "The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
3. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005

References Books:

1. Embedded System Design – Frank Vahid, Tony Givargis, John Wiley. Y Daniel Liang, "

Programming and customizing the 8051 microcontroller, Predko Michael, McGrawHill, International edition

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Second Year B.Tech Instrumentation Engineering
Process Control Loop Components Lab

Course Code:	**INPCC408**	**Credit**	**1**
Contact Hours:	2 Hrs/week (L)	**Type of Course:**	Practical
Examination Scheme	Practical examination 50 Marks		

Pre-requisites:

- Basic knowledge of sensors//transducers, control system, Linear Integrated Circuits.

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Practical examination	External	50

Course Objectives

1	To explain the process control loop, component symbols and process variables.
2	To introduce workings and applications of the transmitter, controller, converter and final control element.

Course Outcomes: Students will be able to

408.1	demonstrate the application of DPT for Flow and level measurement.
408.2	explain the procedure of calibration of DPT and converters.
408.3	implement the circuit for on-off controller.
408.4	describe effects of control actions for pressure control loop.
408.5	demonstrate the Z-N closed loop tuning method to tune PID parameters
408.6	describe quick opening, linear and equal percentage control valve characteristics.

List of Experiments: Students are required to perform minimum 08 experiments from the given list.

1. Measurement of flow rate with DPT.
2. Measurement of level using DPT.
3. Calibrate Differential pressure transmitter.
4. Calibrate I to P converter and plot its input-output response.
5. Calibrate P to I converter and plot its input-output response.
6. Implement the On-Off controller circuit.
7. Verify the effect of different proportional controller gain for pressure control loop.
8. Verify the effect of proportional- integral controller for pressure control loop.
9. Tune the controller for temperature/pressure control loop using Z-N closed loop method.
10. Tune the controller for level/flow control loop using Z-N closed loop method.
11. VLAB:Study various parts of control valve and plot the quick opening, linear and equal percentage type installed characteristics.

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Text Books:

1. Sawhney A. K, "Electrical and Electronics Measurements and Instruments" Dhanpat Rai & Co. 02nd Ed
2. W. D. Cooper & A. D. Helfrick, "Electronic Instrumentation and Measurement Techniques" PHI, 4th e/d, 1987
3. David A.Bell," Electronic Instrumentation and Measurements", PHI, 2e/d

Reference Books:

1. Anand M. M. S., "Electronic Instruments and Instrumentation Technology", PHI, 2004, 02nd Ed.
2. Kalsi H. S., " Electronic Instrumentation", TMH, 2nd or 3rd e/d, 2004/2010.
3. R. Subburaj, "Calibration the Foundation for ISO 9000 and TQM".
4. Bouwens A. J., "Digital Instrumentation", McGraw-Hill, second edition.

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Second Year B.Tech Instrumentation Engineering Machine Learning Lab			
Course Code:	**INPCC409**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Oral 25 Marks		

Pre-requisites:

- Python programming language.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Oral	External	25

Course Objectives	
1	To explain the fundamental elements of machine learning for classification, regression, clustering.
2	To apply and evaluate the performance of a different machine learning models.

Course Outcomes: Students will be able to	
409.1	Implement different supervised and unsupervised machine learning algorithms.
409.2	Evaluate performance of machine learning algorithms for real-world applications.

List of Experiments:

Students are required to perform all experiments from the given list.

1. Dataset: https://www.kaggle.com/datasets/venky73/temperatures-of-india/data
   This data consists of temperatures of INDIA averaging the temperatures of all places month wise. Temperature values are recorded in CELSIUS.
   a. Apply Linear Regression using suitable library function and predict the Month-wise temperature.
   b. Assess the performance of regression models using MSE, MAE and R-Square metrics
   c. Visualize simple regression model.
2. To implement KNN algorithm to predict whether user will purchase the product or not.
   Dataset: User_data.csv
3. Predict the onset of diabetes based on diagnostic measures using SVM algorithm.
   Dataset: https://www.kaggle.com/datasets/uciml/pima-indians-diabetes-database/
   The objective of the dataset is to diagnostically predict whether or not a patient has diabetes, based on certain diagnostic measurements included in the dataset.

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List of Experiments:

4. To build a machine learning model classifier using Decision tree to predict whether a student will get admission or not.
   Dataset: https://www.kaggle.com/mohansacharya/graduate-admissions
   Apply Machine Learning Algorithm and Evaluate Model.
5. Home price prediction using machine learning.
   Dataset: https://www.kaggle.com/datasets/kunwarakash/chennai-housing-sales-price/data
6. Iris flower species prediction using Machine Learning.
   Dataset: IRIS.csv
7. Breast cancer prediction analysis using Machine Learning
   Dataset: https://www.kaggle.com/datasets/yasserh/breast-cancer-dataset/data
8. Heart disease prediction using machine learning techniques. Compare the performance of models.
   Dataset: https://www.kaggle.com/datasets/arezaei81/heartcsv
9. Apply K means clustering algorithms (based on Spending Score) to find the group of customers and evaluate model.
   Dataset: https://www.kaggle.com/shwetabh123/mall-customers
10. VLAB: Word tokenization (NLP)

Text Books:

1. Machine Learning For Absolute Beginners by Oliver Theobald
2. Python Machine Learning by Sebastian Raschka and Vahid Mirjalili
3. Understanding Machine Learning by Shai Shalev-Shwartz and Shai Ben-David
4. Ethem Alpaydin, Introduction to Machine Learning, PHI 2nd Edition-2013 2.
5. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
6. Tom M. Mitchell, Machine Learning, 1997, McGraw-Hill, First Edition

References Books:

1. Introduction to Machine Learning with Python by Andreas C. Müller, Sarah Guido
2. Machine Learning For Dummies by John Paul Mueller and Luca Massaron
3. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies by John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy
4. C. M. Bishop: Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
5. Ian H Witten, Eibe Frank, Mark A Hall: Data Mining, Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition
6. Kevin P Murphy: Machine Learning – A Probabilistic Perspective, MIT Press, August 2012.
7. Shalev-Shwartz S., Ben-David S., Understanding Machine Learning: From Theory to Algorithms, CUP, 2014

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Second Year B.Tech Instrumentation Engineering Project Based Learning			
Course Code:	**INELC410**	**Credit**	1
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Term Work 50 Marks		

Pre-requisites:

- Analog and Digital Techniques, Sensor and Transducer

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work	Internal	50

Course Objectives	
1	To work on different issues in society
2	To design the prototype
3	To develop a software based work.

Course Outcomes: Students will be able to	
410.1	Use different electronic components and sensors/transducers to provide practical solution to real life problems.
410.2	Design/model/simulate/and fabricate a prototype
410.3	Designing and implementation of mini project which includes measurement of parameter signal processing, controlling, debugging related to objectives defined in the problem statement.
410.4	Prepare the project report

List of Experiments:

Phase 1:

1. Elaborating the significance of the subject in view of New NEP 2023 to the students
2. Topic Selection: To discuss the shortlisted topic(s) for the batch
3. Group Formation: Proposal of shortlisted idea and identification of like-minded students (*up to 6 members*) as a team
4. Rubrics: Teacher/Mentor will introduce students to the various rules and SOP under which evaluation of the project is to be done.

Phase 2:

1. Proposal of various probable solutions/approaches to the problem
2. Brain storming on the probable solutions
3. Selection of a feasible solution
4. Bill of Materials (BOM)
5. Assigning the tasks and roles starting with literature survey

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Phase 3:
1. Review of Literature Survey: Identification of Gaps
2. Formulation of Problem Statement
3. Defining Objectives, Materials and Methods
4. Proposal of Budget
5. Designing PERT Chart [*program evaluation and review technique*]

Phase 4:
1. Probable Design, Drawing, Simulation and Design Of Experiment

Phase 5:
1. Review of progress till week 4
2. Presentation to review panel
3. Suggestions by the panel and instructions to incorporate the changes if any.

Phase 6:
1. Identification of materials/ supporting software/ hardware/ components
2. Proposal of budget, if any

Phase 7:
1. Implementation of Experiment
2. Programming / Fabrication / Poster / Model

Phase 8:
1. Testing of experimental design (Fabrication/Program/Poster) to satisfy the aims and objectives followed by analysis and identification of changes to be made in line with aims and objectives

Phase 9:
1. Testing of experimental design (Fabrication/Program/Poster) to satisfy the aims and objectives followed by analysis and identification of changes to be made in line with aims and objectives
2. Compilation of observations
3. Reporting of results and discussions over the results

Phase 10:
1. Verification of results with reference to proposed expected outcome and providing logical explanation citing evidences to support the results obtained
2. Discussion of results and philosophy behind logical explanation citing reported results and evidences, if any.
3. Reporting the findings to compile report with the help of literature referred
4. In case of novelty of results; developing scientific mechanism and logical reasoning to establish validity of the results

Phase 11:
1. Review of progress till date
2. Presentation of results in the form of report
3. Validation of report and certification of authenticity for the study done
4. Promoting students to exhibit model based on implementable solution of study undertaken OR publicise results of the study undertaken in the form of Journal Paper: Review/Short Report OR magazine article/blog OR Poster/Paper in Conference
5. Participation of students in intercollegiate competition(s)

Phase 12:
1. Submission of the project report along with supporting model / poster / paper / documents
2. Teacher / Mentor is advised to keep the record of output of different studies [model / poster / paper / documents] submitted by the student
3. Teacher / Mentor will hand over the record of output of different studies [model / poster / paper / documents] to the department

HOD-INSTRUMENTATION ENGINEERING
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Second Year B.Tech Instrumentation Engineering Sustainable Development Goals			
Course Code:	IOHSM4AC	**Credit**	**01**
Contact Hours:	1 Hrs/week (Th)	**Type of Course:**	Theory
Examination Scheme	Term Work 25Marks		

Pre-requisites: Analog and Digital Techniques

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work	Internal	25

Course Objectives	
1	To discuss the sustainable development goals.
2	To explain framework of Seventeen Sustainable Development Goals.
3	To discuss structure and order of Sustainable Development Goals.
4	To study cases of Sustainable Development Goals.

Course Outcomes: Students will be able to	
4AC.1	Explain sustainable development goals
4AC.2	Describe framework of Seventeen Sustainable Development Goals.
4AC.3	Discuss structure and order of Sustainable Development Goals.
4AC.4	Report case studies of Sustainable Development Goals.

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Topics covered:
Unit 1: Introduction to SDGs (3 hrs) Sustainability, Sustainable development, Role of UN and the Need for SDGs, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs, Distinction between Development and Sustainable Development
Unit 2: Sustainable Development Goals (5 hrs) Framework and Structuring of Seventeen SDGs SDG 1: No Poverty SDG 2: Zero Hunger SDG 3: Good Health and Well-being SDG 4: Quality Education SDG 5: Gender Equality SDG 6: Clean Water and Sanitation SDG 7: Affordable and Clean Energy SDG 8: Decent Work and Economic Growth SDG 9: Industry, Innovation and Infrastructure SDG 10: Reduced Inequality SDG 11: Sustainable Cities and Communities SDG 12: Responsible Consumption and Production SDG 13: Climate Action SDG 14: Life Below Water SDG 15: Life on Land SDG 16: Peace and Justice Strong Institutions SDG 17: Partnerships to achieve the Goal
Unit 3: SDG Structure and Order (3 hrs) Interrelationships and Connections between Seventeen SDGs, SDG Structure and Order at Levels of People, Ecological and Spiritual , SDGs and Socio Ecological Systems: Economy; Society; Biosphere
Unit 4: Sustainable Development Goals- Case Studies (2 hrs) Case Studies from around the World, Case studies from India

Text Books:

1. Hazra, Somnath., Bhukta, Anindya (2020) Sustainable Development Goals An Indian Perspective, Springer International Publishing, Switzerland
2. Ziai, Aram (2016) Development Discourse and Global History from colonialism to the sustainable development goals. Routledge, London & New York
3. OECD (2019), Sustainable Results in Development: Using the SDGs for Shared Results and Impact, OECD Publishing, Paris, https://doi.org/10.1787/368cf8b4-en.
4. Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.

Relevant websites, movies, and documentaries

https://www.un.org/sustainabledevelopment/

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Second Year B.Tech Instrumentation Engineering Lifelong Learning Skill-I			
Course Code:	**IOLLC4L1**	**Credit:**	**1**
Examination Scheme	Term-work 25 Marks		

Lifelong Learning Skills courses introduced for holistic development of students where all the students are required to acquire 1 credit in 4th semester from **Extracurricular Activities** or **co-curricular Activities** which will have grades as below. Activity Certificate obtained either in 3rdsem or 4thsemfrom below mentioned activities will be considered for grading in 4th sem.

1) Extracurricular Activities:

Sr. No.	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Sports	Inter collegiate	Participation	P	Prize winner	C
		University	Participation	C	Prize winner	B
		Zonal	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O
2.	NSS/NCC	Camp	Attended	B		
		Camp + 5 Activities	Attended	B+		
		Camp + 10 Activities	Attended	A		
		Camp + 15 Activities	Attended	A+		
		Camp + 20 Activities	Attended	O		
3.	Cultural	Inter collegiate	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O
4.	Community Engagement	Certified by NGO/Authorities with report and geo-tagged photograph	1 Activity	B		
			2 Activities	B+		
			3 Activities	A		
			4 Activities	A+		
			5 Activities	O		

OR

2) Co-curricular Activities:

Sr. No.	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Conference	National	Participation	B	Prizewinner	A
		International	Participation	B+	Prizewinner	A+
		International (Scopus indexing)	Participation	A+	Prizewinner	O
2.	Journal Publication	Non-refereed but recognized and reputed journal/periodical having ISSN number.		B		
		Refereed Journal - As listed by UGC		A		
		Refereed Journals- As listed by Scopus		A+		

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		Refereed Journals - As listed by SCI/SCIE		O		
3.	Hackathon	AICTE SIH	Participation	A	Prizewinner	O
		National	Participation	B+		
		State	Participation	B		
		Zonal	Participation	P		
4.	Professional Body	National	Membership	P	3rd Prize	A
			Activities participation	B	2nd Prize	A+
			5 participations	B+	1st Prize	O
5.	Internship	1 week	Completed	C		
		2 week	Completed	B		
		3 week	Completed	B+	Sponsored Project	A+
		4 week	Completed	A	Job through internship	O
6.	Entrepreneurs hip	Awareness camp	Attended	A	Product Developed	A+
					Own Startup	O
7.	Project/ Technical events	Inter collegiate	Participation	P	Prizewinner	C
		University	Participation	C	Prizewinner	B
		Zonal	Participation	B	Prizewinner	B+
		State	Participation	B+	Prizewinner	A
		National	Participation	A	Prizewinner	A+
		International	Participation	A+	Prizewinner	O

The marks with respect to grades are as follows:

Sr. No.	Grade	Marks
1	O	25
2	A+	22
3	A	20
4	B+	18
5	B	16
6	C	13
7	P	10
8	F	0-5

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Second Year B.Tech Instrumentation Engineering Lifelong Learning Skill -II			
Course Code:	**IOLLC4L2**	**Credit:**	**1**
Examination Scheme	**ISE** **10**	**ESE** **10**	**TW** **5+**

Under IOLLC4L2 Campus to Corporate Readiness Program (CCRP) will be considered and evaluated.

- CCRP training will be conducted by an external agency for 2 hours per week during Semester IV and VI.
- The external agency will conduct the in-semester exam independently, as well as the end- semester exam.
- Evaluation rubrics for the end-semester exam will be provided by the external agency at the start of the training.

+ This term work marks are based on attendance of the student for CCRP sessions.

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