M. Tech in IoT and Sensor Systems

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The NIELIT University M.Tech in IoT and Sensor Systems programme transforms education into the complex world of linked devices and data-driven decision-making. The programme goes beyond jargon to explore the fundamentals of IoT. It provides students with a solid foundation in computer science mathematics, including calculus, linear algebra, and discrete mathematics, to analyse complex data, optimise algorithms, and design efficient systems to handle immense amounts of data from sensors and interconnected devices.

The programme guarantees that theoretical knowledge is absorbed and confidently implemented in real-world situations through a holistic and personalised learning experience. Whether they're interested in machine learning's predictive capacity or data visualisation for real-time insights, students can customise their education through electives. Labs related to electives allow students to experiment and improve their skills.

Research Methodology and IPR help students conduct rigorous research and comprehend intellectual property rights in innovation. This foundation prepares students for their Mini Project, where they solve IoT and sensor system problems using theoretical and practical abilities. The programme introduces students to cutting-edge topics like cloud computing, distributed databases, knowledge discovery, and web analytics. Audit courses expose students to many subjects, and laboratories reinforce learning and abilities. The Dissertation phase in the latter semesters allows students to contribute meaningfully to the field by choosing an IoT and sensor systems subject of interest. This individual research allows students to shape this dynamic sector. Students can also choose an Industrial Project for industry experience.

NIELIT University knows that academic achievement is only part of the equation, thus it prepares students for the competitive world of IoT and sensor systems. Professional networking, career coaching, and industry placements and internships are available through the programme. Graduates are confident, skilled professionals ready to make a difference in the world of networked gadgets and data-driven decision-making.

Program Educational Objectives (PEOs):

PEO1: Graduates will demonstrate expertise in the fundamental principles of IoT and Sensor Systems, including mathematical foundations, advanced data structures, and algorithms, preparing them to tackle complex challenges in the field.

PEO2: Graduates will be adept at applying their knowledge through practical applications, mini-projects, and an industrial project, fostering a spirit of innovation and the ability to contribute meaningfully to the industry.

PEO3: Graduates will embrace lifelong learning, adapting to evolving IoT trends, technologies, and methodologies for sustained professional development and growth in their careers.

PEO4: Graduates will uphold ethical standards, considering societal impacts, intellectual property rights, and responsibly contributing to social, environmental, and ethical considerations in the development and implementation of IoT solutions.

Program Outcomes (POs):

PO1: Graduates independently solve complex challenges in IoT and Sensor Systems, showcasing research skills and proposing effective solutions.

PO2: Effective Communication: Proficient oral and written skills empower graduates to articulate technical concepts and collaborate effectively within interdisciplinary teams.

PO3: Continuous Learning: Graduates embrace lifelong learning, adapting to evolving IoT trends, technologies, and methodologies for sustained professional development.

PO4: Innovation and Research: Graduates contribute innovatively to IoT and Sensor Systems, applying advanced algorithms and AI, demonstrating research competence, and fostering technological advancements.

PO5: Ethical Responsibility: Graduates uphold ethical standards, respecting intellectual property, considering societal impacts, and responsibly contributing to social, environmental, and ethical considerations.

SEMESTER-1

S. No.	Course Code	Subject
1	ICL101	RESEARCH METHODOLOGY AND IPR
2	ISL101	IOT FUNDAMENTALS AND ARCHITECTURE
3	ISL102	PRINCIPLES OF SENSORS AND SIGNAL CONDITIONING
4	ISLXXX	DISCIPLINE ELECTIVE-1
5	ISLXXX	DISCIPLINE ELECTIVE-2
6	ICL102	AUDIT COURSE
.7	ISP101	IOT FUNDAMENTALS AND ARCHITECTURE LAB
8	ISP102	PRINCIPLES OF SENSORS AND SIGNAL CONDITIONING LAB

SEMESTER-2

S. No.	Course Code	Subject
1	ISL201	INDUSTRIAL INTERNET OF THINGS
2	ISL202	WIRELESS SENSORS NETWORK
3	ISL03X	DISCIPLINE ELECTIVE-3
4	ISL04X	INDUSTRY ELECTIVE-1
5	ISL203	MINI PROJECT
6	ACL 103	AUDIT COURSE
7	ISP201	SYSTEM DYNAMICS AND CONTROL SYSTEMS LAB
8	ISP202	DATA ACQUISATION LAB

SEMESTER-3

S. No.	Course Code	Subject
1	MTIS301	MOOCS
2	MTIS302	INTERNSHIP
3	MTIS351	DISSERTATION PHASE-1

SEMESTER-4

S. No.	Course Code	Subject
1	MTIS351	DISSERTATIO N PHASE-2

Course Code	**ICL101**
Course Name	RESEARCH PROCESS METHODOLOGY AND IPR
Pre-Requisites	

COURSE OBJECTIVE

After completion of this course, students should be able to

1. Develop understanding of the basic framework of research process, various research designs and techniques.
2. Identify various sources of information for literature review and data collection
3. Develop an understanding of the ethical dimensions of conducting applied research

LECTURE WITH BREAKUP

Module 1: Review of Statistics Concept of mean, mode, median, arithmetic mean, geometric mean, harmonic mean etc., Probability and problem solving, Distributions: Gaussian, chi-square, student-t distribution Design of experiment, Hypothesis, testing and identification, Problems on hypothesis testing

Module 2: Research Skills What is research, why research needs to be done, Research problem formulation, Literature survey, Analysis of the problem, Experimental evaluation of the problem, Survey techniques, Statistical analysis. Writing of short and long abstracts, Writing and format of international and national journal papers, Report writing, English writing and communication skills, Power point and other presentation skills

Module 3: Research theory and Practice Structuring the research project, research ethics, finding and reviewing the literature.

Module 4: Data Collection and its Analysis Data sources, methods and approaches, the nature of data, collecting and analysing secondary data, collecting primary data, quantitative and qualitative data analysis, sampling and selection in qualitative research, making convincing arguments with qualitative data

COURSE OUTCOME

1. Understand research terminology.
2. Be aware of the ethical principles of research, ethical challenges and approval processes.
3. Describe quantitative, qualitative and mixed methods approaches to research.
4. Identify the components of a literature review process
5. Critically analyse published research

Recommended Readings

a. "Fundamentals of Research Methodology" 1st edition Dr Jayanta Kumar Nayak, Dr Priyanka Singh, SSDN Publishers and Distributers, 2015

b. "Qualitative Researching": Jennifer Mason, 2nd edition, SAGE Publication, 2002

c. "Research methods: the basics": Walliman and Nicholas, Taylor and Francis India, 2021

d. "The Essential Guide to Doing Research", 4th edition, Zina O' Leary, SAGE publications,2021

e. “Research Methodology Handbook. Introductory Guide to Research Methods for Social Research”: Stuart MacDonal & Nichola Headlam, CLES, 2008

Course Code	**ISL101**
Course Name	IOT FUNDAMENTALS AND ARCHITECTURE
Pre-Requisites	EMBEDDED SYSTEMS

COURSE OBJECTIVE
After completion of this course, students should be able to 1. Introduce evolution of internet technology and need for IoT. 2. Discuss on IoT reference layer and various protocols and software. 3. Train the students to build IoT systems using sensors, single board computers and open source IoT platforms. 4. Make the students to apply IoT data for business solution in various domain in secured manner.

LECTURE WITH BREAKUP
Module 1: Evolution of IoT Review of computer communication concepts (OSI layers, components, packet communication, Networks, TCP-IP, subnetting, IPV4 addressing and challenges). IPV6 addressing. IoT architecture reference layer.
Module 2: Introduction to IoT components Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open-source hardware, Examples of IoT infrastructure.
Module 3: IoT protocols and software MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP, XMPP and gateway protocols.
Module 4: IoT point to point communication technologies IoT Communication Pattern, IoT protocol Architecture, Selection of Wireless technologies (6LoWPAN, Zigbee, WIFI, BT, BLE, SIG, NFC, LORA, LiFi, Widi)
Module 5: Introduction to Cloud computation and Bigdata analytics Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Introduction to big data analytics and Hadoop
Module 6: IoT security Need for encryption, standard encryption protocol, light weight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security
Module 7: IoT application and its Variants. Case studies: IoT for smart cities, health care, agriculture, smart meters.M2M, Web of things, Cellular IoT, Industrial IoT, Industry 4.0, IoT standards
Module 8: Contemporary Issues

COURSE OUTCOME

1. Identify the IoT networking components with respect to OSI layer.
2. Build schematic for IoT solutions.
3. Design and develop IoT based sensor systems.
4. Select IoT protocols and software.
5. Evaluate the wireless technologies for IoT.
6. Appreciate the need for IoT Trust and variants of IoT.

Text Book(s):

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions withthe IoT Architecture Reference Model", Springer Open, 2016
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.

Reference Books:

1. LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, The Internet of Things: From RFID to the Next-Generation Pervasive Network, Aurbach publications, March,2008.
2. Vijay Madisetti , Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally "Internet of Things A Hands-on-Approach" Arshdeep Bahga & Vijay Madisetti, 2014.
3. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
4. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010
5. RonaldL. Krutz, Russell Dean Vines,Cloud Security: A Comprehensive Guide to Secure Cloud Computing,Wiley-India, 2010

Course Code	**ISL102**
Course Name	PRINCIPLES OF SENSORS AND SIGNAL CONDITIONING
Pre-Requisites	ANALOG CIRCUITS

COURSE OBJECTIVE

After completion of this course, students should be able to

1. To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterized, and analysed.
2. To introduce the students to sources and detectors of various Optical sensing mechanisms and provide in-depth understanding of the principle of measurement, and theory of instruments and sensors for measuring velocity and acceleration
3. To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.
4. To impart a reasonable level of competence in the design, construction, and execution of mechanical measurements strain, force, torque and pressure

LECTURE WITH BREAKUP

Module 1: Sensor fundamentals and characteristics
Sensor Classification, Performance and Types, Error Analysis characteristics

Module 2: Optical Sources and Detectors
Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.

Module 3: Intensity Polarization and Interferometric Sensors
Intensity sensor, Microbending concept, Interferometers, Mach Zehnder, Michelson, FabryPerot and Sagnac, Phase sensor: Phase detection, Polarization maintaining fibers.

Module 4: Strain, Force, Torque and Pressure sensors
Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors. Design of signal conditioning circuits for strain gauges, piezo, capacitance and optoelectronics sensors

Module 5: Position, Direction, Displacement and Level Sensors
Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magneto strictive sensors. Fibre optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor. Signal condition circuits for reactive and self-generating sensors.

Module 6: Velocity and Acceleration sensors
Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.

Module7: Flow, Temperature and Acoustic sensors Flow sensors: pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. microflow sensor, Coriolis mass flow and drag flow sensor. Temperature sensors- thermosensitive, thermoelectric, semiconductor and optical. Piezoelectric temperature sensor. Acoustic sensors- microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.
Module 8: Contemporary Issues

COURSE OUTCOME
1. Use concepts in common methods for converting a physical parameter into an electrical quantity 2. Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc. 3. Design and develop sensors using optical methods with desired properties 4. Evaluate performance characteristics of different types of sensors 5. Locate different types of sensors used in real life applications and paraphrase their importance 6. Create analytical design and development solutions for sensors. 7. Compete in the design, construction, and execution of systems for measuring physical quantities

Text Book(s):

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.

Reference Books:

1. GerdKeiser,"Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi.
2. John G Webster, "Measurement, Instrumentation and sensor Handbook", 2017, 2nd edition, CRC Press, Florida.
3. Eric Udd and W.B. Spillman, "Fiber optic sensors: An introduction for engineers and scientists", 2013, 2nd edition, Wiley, New Jersey.
4. Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of photonics", 2012, 1st edition, John Wiley, New York.

Course Code	**ISL201**
Course Name	INDUSTRIAL INTERNET OF THINGS
Pre-Requisites	FUNDAMENTALS OF IOT

COURSE OBJECTIVE
At the end of successful completion of the course, students will be able to: 1. Understand key skills employed in the IIoT & IoRT space building applications. 2. Design suitable network architecture and use appropriate learning algorithm. 3. Comprehend IOT protocols 4. Implement digital Twin 5. Implement IOT systems for robotics

LECTURE WITH BREAKUP
Module 1: Introduction IIoT Market Size and Potential Definition, IoT v IIoT, Next Generation Sensors, Sensor's calibration and validate sensor measurements, placement of IoT devices, sensors, low-cost communication system design, Top application areas include manufacturing, oil & gas, Embedded systems in the Automotive and Transportation market segment.
Module 2: IIoT Methodology Top operating systems used in IIoT deployments, Networking and wireless communication protocols used in IIoT deployments. Smart Remote Monitoring Unit, components of monitoring system, control and management, Wireless Sensor Network (WSN).
Module 3: Data driven Analytics of IIoT Implementing of industrial IoT Data flow, big data and how to prepare data for machine learning algorithms, Machine Learning algorithms, supervised learning & Un-supervised learning algorithms, Basics of neural network, activation functions, back-propagation.
Module 4: IP and Non-IP Protocols for IoT WPAN, IEEE 802.15.4, Bluetooth, NFC, 6LoWPAN; RFID, Zigbee Wireless HART Protocol, MQTT, IP and Non-IP Protocols, REST, CoAP.
Module 5: Implementing Digital Twin Develops a physics-based and data-driven digital equipment model to monitor assets and systems, Introduction to device localization and tracking; different types of localization techniques, Radio-Frequency Identification (RFID) and fingerprinting, Device diversity/heterogeneity issue in IIoT networks
Module 6: Internet of Robotic Things (IoRT) Introduction to stationary and mobile robots, Brief introduction to localization, mapping, planning, and control of robotic systems; Introduction to cloud-enabled robotics; Applications of IIoT in robotics; Architectures for IoRT, Examples and case studies: Open issues and challenges.

Reference Books:

1. "Industry 4.0: The Industrial Internet of Things", Alasdair Gilchrist, Apress, 2016
2. "Introduction to Industrial Internet of Things and Industry 4.0", Sudip Misra,Chandana Roy,Anadarup Mukherjee,CRC Press,2021
3. "Hands on Industrial Internet of Things",Giacomo Veneri,Antonio Capasso,Packt Press, 2018.

Additional Material:

1. Research papers

Course Code	**ISL202**
Course Name	WIRELESS SENSOR NETWOKS

Pre-Requisites	WIRELESS COMMUNICATION

COURSE OBJECTIVE
This course aims to expose the students to the central elements in the design of communication protocols for the WSNs and design knowledge in analysing the specific requirements for applications in WSNs. It also aims to design simple IoT systems comprising sensors, edge devices, wireless network connections, data analytics capabilities and cloud storage.

LECTURE WITH BREAKUP
Module 1: Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture, Hardware components, Energy consumption of sensor nodes, Network architecture: Sensor network scenarios, Optimization Goals and Design principles. Physical layer and transceiver design consideration in wireless sensor networks
Module 2: Fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols. ROUTING PROTOCOLS - Gossiping and agent-based unicast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, Data centric routing, Data aggregation
Module 3: Localization and positioning: Possible approaches, single hop localization, positioning in multi-hop environments. Time synchronization: Time synchronization problem, protocols based on sender to receiver and receiver to receiver synchronization in WSN.
Module 4: Programming Challenges in Wireless Sensor Networks, Tiny Operating System, Contiki OS, Event-Driven Programming, Techniques for Protocol Programming.
Module 5: Building blocks of an IoT device - Programming Inputs and outputs, Serial, SPI and I2C - Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino). Cloud Support: Cloud Storage models and communication APIs. Web server - Web server for IoT - Cloud for IoT - Designing a RESTful web API - Amazon Web services for IoT - Data Analytics for IoT: Apache Hadoop - Using map reduce for batch data analytics.

COURSE OUTCOME
At the end of successful completion of the course, students will be able to: 1. Explain the basics concepts of Wireless Sensor Network architecture and its principles. 2. Explain the various communication protocols in WSN stack. 3. Apply the concepts of localization and time synchronization. 4. Use open-source tools for the implementation of WSN 5. Design simple IoT systems comprising sensors, edge devices, wireless network connections, data analytics capabilities and cloud storage.

References:

1. Holger Karl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” 2011, 1st ed., John Wiley & Sons, New Jersey.
2. Fei Hu and Xiaojun Cao, “Wireless Sensor Networks Principles and Practice”, CRC Press,2010.
3. Feng Zhao and Leonidas Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Elsevier Publication, 2004.
4. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
5. ArshdeepBahga and Vijay Madisetti, "Internet of Things: A Handson Approach", Universities Press, 2014.
6. Matt Richardson & Shawn Wallace, “Getting Started with Raspberry Pi”, O'Reilly Media Press, 1st Edition, 2012.
7. AgusKuniawa, "Getting started with Intel IoT and Intel Galileo", Kindle Edition, 2015.
8. Sitharama Iyengar S, Nandan Parmeshwaran, Balkrishnan N and Chuka D, “Fundamentals of Sensor Network Programming, Applications and Technology”, John Wiley & Sons, 2011.

Course Code	**ISP101**
Course Name	IOT FUNDAMENTALS AND ARCHITECTURE LAB
Pre-Requisites	EMBEDDED SYSTEMS

COURSE OBJECTIVE

1. Introduce evolution of internet technology and need for IoT.
2. Discuss on IoT reference layer and various protocols and software.
3. Train the students to build IoT systems using sensors, single board computers and open source IoT platforms.
4. Make the students to apply IoT data for business solution in various domain in secured manner

LECTURE WITH BREAKUP
C programming
C++/JAVA programming
Python programming
Thinkspeak/thingsboard cloud platforms
Nodered
IoT usecases

COURSE OUTCOME

1. Identify the IoT networking components with respect to OSI layer.
2. Build schematic for IoT solutions.
3. Design and develop IoT based sensor systems.
4. Select IoT protocols and software.
5. Evaluate the wireless technologies for IoT.
6. Appreciate the need for IoT Trust and variants of IoT.

Course Code	**ISP102**
Course Name	PRINCIPLES OF SENSORS AND SIGNAL CONDITIONING LAB
Pre-Requisites	ANALOG CIRCUITS

COURSE OBJECTIVE

1. To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterised, and analysed.
2. To introduce the students to sources and detectors of various Optical sensing mechanisms and provide in-depth understanding of the principle of measurement, and theory of instruments and sensors for measuring velocity and acceleration
3. To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.
4. To impart a reasonable level of competence in the design, construction, and execution of mechanical measurements strain, force, torque and pressure

LECTURE WITH BREAKUP

Experiment 1:

Design of signal conditioning circuits for strain gauges- Strain, Force, pressure, and torque measurement

i. Strain measurement with Bridge Circuit
ii. Beam force sensor using Strain Gauge Bridge
iii. Beam deflection sensing with Strain Gauge Bridge
iv. Diaphragm pressure sensor using Strain Gauge Bridge
v. Shear strain and angle of shift measurement of hollow shaft After completing the 1st set of characteristics.

Design a weighing machine having a range of 0-5 Kg with a sensitivity of 5 mg. What modification has to be done to change the upper range to 100 Kg with a sensitivity of 100 mg.

Experiment 2:

Develop a displacement measurement system with the following sensors:

i. Inductive transducer (LVDT)
ii. Hall effect sensor

Experiment 3:

After studying the characteristics of temperature sensors listed below, develop a temperature measurement system for a particular application using the suitable sensor.

i. Thermocouple principles
ii. Thermistor and linearization of NTC Thermistor
iii. Resistance Temperature Detector
iv. Semiconductor Temperature sensor OA79
v. Current output absolute temperature sensor

Experiment 4:

Develop a sensor system for force measurement using piezoelectric transducer

Experiment 5:

Measurement of shear strain and angle twist using strain gauge is not suitable for many applications. Based on other sensing experiments carried out suggest a non-contact method and try to complete its proof of concept

COURSE OUTCOME

At the end of successful completion of the course, students will be able to:

1. Use concepts in common methods for converting a physical parameter into an electrical quantity
2. Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.
3. Design and develop sensors using optical methods with desired properties
4. Evaluate performance characteristics of different types of sensors
5. Locate different types of sensors used in real life applications and paraphrase their importance
6. Create analytical design and development solutions for sensors.
7. Compete in the design, construction, and execution of systems for measuring physical quantities

Course Code	**ISP201**
Course Name	DATA ACQUISATION LAB
Pre-Requisites	NIL

COURSE OBJECTIVE

1. To explore the fundamentals of data acquisition using sensors, NI data acquisition hardware, and LabVIEW.
2. To teach the basics of hardware selection, including resolution and sample rate, and the foundation of sensor connectivity, including grounding and wiring configurations.
3. To provide knowledge on using the NI-DAQmx driver to measure, generate, and synchronize data acquisition tasks and analyze the data in MATLAB/ LabVIEW
4. To impart adequate knowledge on programming finite and continuous acquisitions, as well as best practices in hardware/software timing, triggering, and logging.
5. To give hands-on experience configuring and programming NI data acquisition hardware using NI-DAQmx and LabVIEW.

LECTURE WITH BREAKUP

Experiment 1:
LabVIEW Graphical Programming, NI DAQmx, Data acquisition Toolbox to read data into MATLABand Simulink and write data into DAQ device

Experiment 2:
Acquire and generate analog signals.

Experiment 3:
Acquire and generate non-clocked digital data

Experiment 4:
Measure frequency, pulse width and count pulses using NI devices

Experiment 5:
Generate Pulse Width Modulated signal

Experiment 6:
Acquire and generate audio signals

Experiment 7:
Simultaneous and synchronized data acquisition

Experiment 8:
Simulink data acquisition

Experiment 9:
Arduino based multi-channel data acquisition

Experiment 10:
Remote data acquisition with NI WSN Gateway and nodes, CC3200 (WiFi)

COURSE OUTCOME

1. Develop PC-based data acquisition and signal conditioning.
2. Understand how to control the analog input, analog output, counter/timer, and digital I/O subsystems of a DAQ device
3. Perform different types of data acquisition and identify the correct sensor for their measurements. Develop integrated, high-performance data acquisition systems that produce accurate measurements

4. Acquire data from sensors, such as thermocouples and strain gages, using NI DAQ hardware and analyse the results in LabVIEW and MATLAB
5. Apply advanced understanding of LabVIEW and the NI-DAQmx API to create applications

Course Code	**ISP202**
Course Name	SYSTEM DYNAMICS AND CONTROL SYSTEMS LAB
Pre-Requisites	NIL

COURSE OBJECTIVE

1. To impart knowledge on performance specification, limitations and structure of controllers
2. To impart knowledge on design of controllers using root-locus and frequency domain techniques

LECTURE WITH BREAKUP

Experiment 1:
Introduction to real time controller system operations

Experiment 2:
Speed regulation measurement of DC motor using armature control system

Experiment 3:
Speed regulation and torque measurement of AC Servomotor using armature control system

Experiment 4:
Modeling and performance analysis of stepper motor position control system

Experiment 5:
Performance analysis of BLDC motor control system and its parameter estimation

Experiment 6:
ON/OFF temperature control system using LabVIEW platform

Experiment 7:
Step response analysis of second order system using Matlab

Experiment 8:
Frequency response analysis of LEAD/LAG compensating network

Experiment 9:
Temperature control of a plant using PID controller with LabVIEWplatform/MSP430

Experiment 10:
Modelling and implementation of level control system using PLC

Experiment 11:
a) Modelling and implementation of Speed regulation of servo motor using Fuzzy logic controller with Matlab/MSP430
b) Water level controller using Fuzzy logic controller
c) Comparison of plant performance with PID vs Fuzzy logiccontroller

Experiment 12:
a) Vertical take-off and landing system- Modelling, Current Control & Flight Control
b) Inverted pendulum control system: Modelling Balance Control design & Up control
c) HVAC system (Quanser NI Elvis): On-off Control, PI Control
d) DC motor speed control (Quanser NI Evis) : Modelling, Speed Control & Position Control.

COURSE OUTCOME

1. Realize the need of control system and its recent developments. Able to model the system and simulate the model.
2. Analyze the behavior of the first and second order systems in time domain and frequency domain.
3. Analyze the system stability based on time domain, frequency domain and root locus techniques.
4. Identify the need for incorporating the three-term controller based on the customized requirement of the control action.
5. Analyze the systems behavior in digital domain and develop digital control algorithm for the corrective action.