

## **(5) DESIGN AND DEVELOPMENT OF SIGNAL CONDITIONING AND SENSOR TECHNOLOGY**

**NSQF Level:** 5

**SECTOR:** Electronics

**ELIGIBILITY:** Masters degree in Physics, Electronics, Instrumentation

**FEES:** Tuition Fees- Rs 3000/- (Rs 100/- per credit)-30 credits

Laboratory Fees- Rs 2000/- (Rs 2000/- per Semester)

Total Fees- Rs 5000/-

**CERTIFICATE COURSE:** 6 months (450 hours)

**Credits:** 30

### **KEY COMPETENCIES:**

The learner will be able to:

- understand customer requirement w.r.t to product(s) and systems using transducers
- select appropriate transducers for the product or system to be designed
- design products and systems using appropriate transducer(s) including control systems and fall back mechanisms
- test the product or system designed and ensure that it meets performance, cost, regulatory, reliability and manufacturability requirements.
- ensure that the product or system meets redundancy and fail proofing requirements
- complete relevant documentation
- work in a safe, hygienic and professional manner

**ASSESSMENT:** Assessment include continuous assessments which will comprise of following:

- ✓ 20 marks of theory component
- ✓ 20 marks of internal assessments
- ✓ 60 marks of skill assessment conducted by assessors of SSC

**Course Structure:** The course can be run in any of the 2 semesters in a year.

Course aims at training of students in designing signal processing circuits with electronic components for different types of sensors and their testing looking requirements by industries. Six month training to a batch of 40 students will be provided that will include 150 hours theory and 300 hours of extensive experimentation and industrial training.

## **I. Structure:**

The significance of sensor technology is constantly growing. Sensors allow us to monitor our surroundings in ways we could barely imagine a few years ago. New sensor applications are being identified everyday which broadens the scope of the technology and expands its impact on everyday life.

The latest sensor equipment includes heart rate, electrical voltage, gas, light, sound, temperature, and distance sensors.

Sensors are at work in a wide variety of applications in construction, utilities, building management and office equipment. Increasing demands for monitoring safety and efficiency are being met by solutions custom-designed to perform reliably in some challenging environments.

These sensors, in turn, require signal conditioning before a data acquisition device can effectively and accurately measure the signal. Key signal conditioning technologies provide distinct enhancements to both the performance and accuracy of data acquisition systems.

The testing of these signals requires highly sophisticated instruments with very high precision. These facilities are partly available at a few centres in India but are limited for research activities. Large industries have their own R & D Centre and students training programmes as per their requirements. However small industries require trained manpower as well as easy R & D facilities which they are unable to establish at their own. The proposed Centre will facilitate both students and small industries in design and testing of sensors along with signal conditioning components.

Students will be trained in designing and testing of sensors along with signal conditioning components by trained faculty both from academia and industries. The available design and testing instruments will be used by industries in design and testing of sensors along with signal conditioning components. In this way, the centre will provide a common platform for students and industries. The students will realize the present day requirement of industries while industries will have an opportunity of finding suitable candidates for their work.

The Centre will provide an extensive training programme of six month duration for post graduate Electronics, Physics, Instrumentation students in designing and training of sensors along with signal conditioning components. This will include lecture programme of 150 hours and 300 hours of extensive experimentation and Industrial training.

The students will also have industrial exposure for realization of industrial requirements. The industries will also have a chance for face to face interaction with this centre. Hence this centre will be a common platform for students and industries in fulfilling their mutual requirements.

## **II. Course design:**

- (i) The course content of proposed six month course for students will have lecture programme of 150 hrs, 300 hrs for lab training and Industrial Training
- (ii) The 200 hrs duration extensive lab work will include designing of prototype and their lab testing.

## **III. Course content:**

The lecture programme will have following modules. These modules will include introduction to Sensor and Transducer parameters, Actuators, passive and active filters, design techniques for interfacing components, measurement techniques, basics of OPAMP, ADC, DCA etc.

**Sensors:** Chemical sensors, Optical sensors, Optical fibre sensors

**Transducers:** Displacement, Level, Pressure, Flow, Temperature etc.,

**Actuators:** Mechanical, Electrical, Hydraulic and Pneumatic actuators.

**Signal Conditioning Elements:** Bridges: Basic circuit theorems, DC Bridges, AC bridges, Concept, Design Consideration, Wein Bridge etc., analysis and design. EMI effects and EMC measures, Shielding and grounding techniques, Enclosure design guidelines.

**Analog Signal Conditioning:** Operational Amplifier, Characteristics, Specifications, Basic amplifier configurations and Application; Single ended and differential signals, Instrumentation Amplifier, Active filters, F to V and V to F conversion, Phase lock loop.

**Analog and Digital Interface:** Analog to Digital convertors, Digital to Analog convertors, Applications of DACs, Study of typical ICs, Problems on Analysis and designing.

**Digital Signal Processing:** Time domain and frequency domain signal representation, impulse response, Fourier transform, Digital filter design, Isolation and Interfacing filtering.

## **IV. Protocols for outreach**

The proposed course aims a rigorous six months long training of students looking present days requirements of Automation in industries. The minimum qualification of students for this six months training course will be M.Sc. Physics, Electronics, Computer, Instrumentation or B.E/Tech. in Electrical / Electronics & Communication / IT.

Present day industries require properly trained engineers and hence this centre will provide a rigorous training to students looking requirements of industries. This centre will also provide a platform where industry personals will interact directly with students. Industries will be able to mold students as per requirements of sensor technology and hence the students will be able to get job opportunities in the Sensor industries, Electronics industries and wireless industries.

**Major equipment and facilities required:**

1. Hydraulic and Pneumatic Trainer
2. Spectrum analyzer
3. Signal generator up to 10GHz
4. Transducers and Electronic Components