

# GUJARAT TECHNOLOGICAL UNIVERSITY

## INSTRUMENTATION AND CONTROL (APPLIED INSTRUMENTATION) (03)

### SENSOR DATA FUSION

**SUBJECT CODE: 2730306**

M.E. SEM-III

**Type of course:** Major Elective - IV

**Prerequisite:** Sensor and measurements, Digital signal processing, signals and System, Intelligent systems, Data structure.

**Rationale:** This course provides an overview and fundamentals of various types of algorithms for sensor data fusion.

#### Teaching and Examination Scheme:

| Teaching Scheme |                |   | Credits | Examination Marks |        |                 |     |        |    | Total Marks |
|-----------------|----------------|---|---------|-------------------|--------|-----------------|-----|--------|----|-------------|
| L               | T              | P | C       | Theory Marks      |        | Practical Marks |     |        |    |             |
|                 |                |   |         | ESE (E)           | PA (M) | PA (V)          |     | PA (I) |    |             |
|                 |                |   |         |                   |        | ESE             | OEP | PA     | RP |             |
| 3               | 2 <sup>#</sup> | 2 | 5       | 70                | 30     | 20              | 10  | 10     | 10 | 150         |

#### Content:

| Sr. No. | Topics  | Teaching Hrs. | Module Weightage |
|---------|---|---------------|------------------|
| 1.      | <b>Introduction</b><br>Sensors and sensor data, Limitations of single sensor, Advantages of multisensor data fusion, Multisensor data fusion applications, Data fusion models, Generic fusion architectures   | 6             | 5-10%            |
| 2.      | <b>Algorithms for Data Fusion</b><br>Taxonomy of algorithms for multi-sensor data fusion. Learning of fusion models: Learning Bayesian classifier, Rule learning from decision tree algorithms.   | 6             | 5-15%            |
| 3       | <b>Estimation</b> :Kalman filtering, practical aspects of Kalman filtering, extended Kalman filters, particle filter, Decision level identify fusion. Knowledge based approaches.   | 10            | 15-25%           |
| 4       | <b>Advanced Filtering</b> : Data information filter, extended information filter. Decentralized and scalable decentralized estimation. Sensor fusion and approximate agreement. Optimal sensor fusion using range trees recursively. Distributed dynamic sensor fusion.   | 10            | 20-30%           |
| 5       | <b>High Performance Data Structures</b> : Tessellated, trees, graphs and function. Representing ranges and uncertainty in data structures. Designing optimal sensor systems within dependability bounds. Implementing data fusion system, Application of multisensor data fusion for mobile robot mapping and Navigation. | 10            | 15-25%           |

**Reference Books :**

1. Das SK, "High-level Data Fusion," Artech House
2. Hall DL, "Mathematical techniques in Multisensor data fusion," Artech House
3. Brooks RR and Iyengar SS, "Multi-Sensor Fusion," Prentice Hall
4. Gelb A, "Applied Optimal Estimation," MIT Press
5. Candy JV, "Signal Processing," McGraw-Hill
6. Liggins.II, "Handbook of Multisensor Data Fusion", Taylor & Francis

**Course Outcome:**

After learning the course the students should be able to

1. Understand the structure of various types of algorithms for sensor data fusion.
2. Understand the structure of various types of advance filtering techniques.
3. Understand the data structures.

**List of Experiments:**

Student has to prepare various algorithms for sensors data fusion and filtering techniques covered in this course with any computing tools (MatLab, Scilab, etc...).

Prepare research paper and submit report of various algorithms for sensors data fusion techniques covered in this course.

**Open Ended Problem:** Solution of the open ended problem(s) in guidance of course instructor is mandatory.

**Major Equipment:**

Computer Laboratory

**List of Open Source Software/learning website:**

- Matlab, Scilab
- NPTEL

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.