AE 242
Aerospace Measurements Laboratory

Course content

Credit structure L-T-P-C 2-0-2-6

Characteristics of measuring systems: Calibration, sensitivity and error analysis.
Air data measurements: Pressure altitude, airspeed
Flow measurements: Hotwire anemometer, manometer, angle of attack sensor
Temperature Measurements: Thermocouples, hot gas and cryogenic measurements, thermopiles
Strain measurements: Strain gage types, strain gage sensitivity.
Pressure measurements: Dependence of measurement dynamics on sensor construction.
Inertial and GPS based sensors: Accelerometers and gyroscopes; position, velocity and time measurements.
Attitude and heading reference systems: Errors in inertial sensors and characterization.
Sensor interfacing: amplifiers, filters, and other signal conditioning circuits, analog and digital conditioning, ADC/DAC, synchronous and asynchronous serial communication.

Course content

Text Books and references:

1. Doebelin, E., Measurement Systems: Application and Design, 4th Ed., McGraw-Hill, New York, 1990.
2. Grewal, M. S., Lawrence, R. and Andrews, A., GPS, INS and Integration, New York: John Wiley, 2001.
3. Collinson, R. P. G., Introduction to Avionics, Chapman and Hall, 1996.
4. Gayakwad, R. A., OPAMPs and Linear Integrated Circuits, 4th Ed., Pearson Education, 2005.
5. Titterton, D. H. and Weston, J. L., Strapdown Inertial Navigation Technology, 2nd Ed., AIAA Progress in Astronautics and Aeronautics, Vol. 207, 2004.
6. Strang, G. and Borr, K., Linear Algebra, Geodesy and GPS, Wellesley-Cambridge Press, 1997.
7. Doebelin, Ernest O. Manik, Dhanesh N., Doebelin's Measurement System, 6th Edition, New Delhi : Tata McGraw-Hill, 2011
8. Setup User Manuals and Component Data Sheets

Important Instructions

Slot L2 Tuesday: 14:00-17:00; Slot L5 Friday: 14:00-17:00;

Per week two sessions of one hour lecture for everyone
Per week two session of two hours laboratory. Students have to attend laboratory on Monday or Friday as per the declared list. Individual journal submission.
Will put a survey on moodle for you to select laboratory day.

We are in process of sending one kit to individual student for conducting experiment at their location. We will use the address given on ASC. Let us know if you wish to receive at different address.

Car driving

Car driving

Driver – get the sense from the environment and take decisions
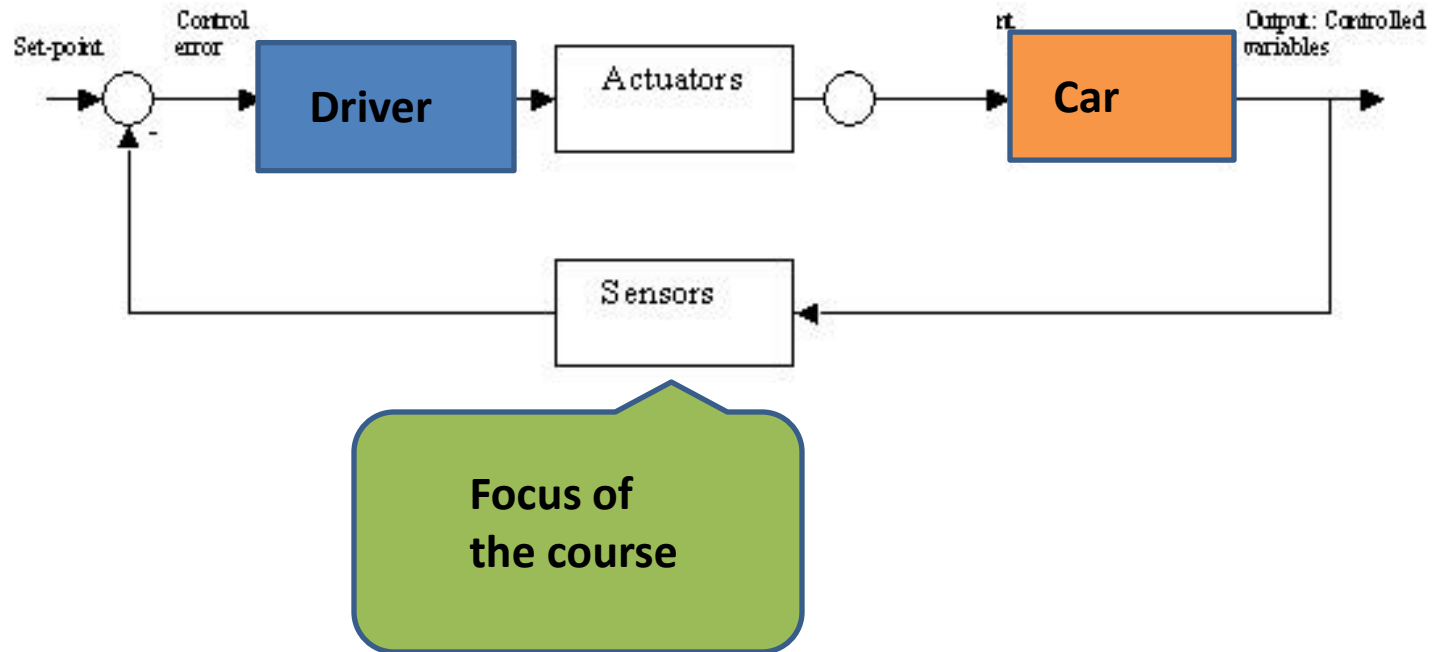: Speedometer to know the speed of the car

Driverless car – all the above is sensed and decisions are taken.
Accuracy, response time and content becomes very important.
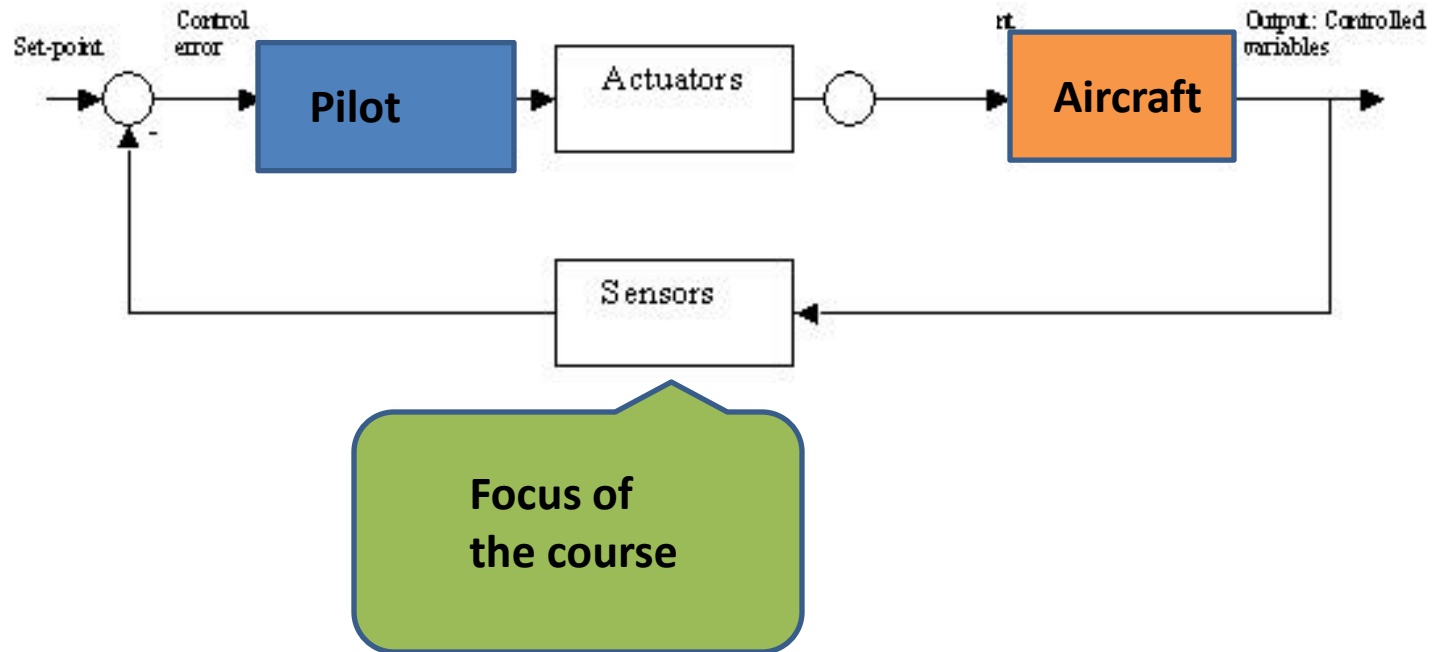
Aircraft flight

During the aircraft operation environment changes drastically. Accuracy is very important from safety considerations. Aircraft instrumentation is very challenging.
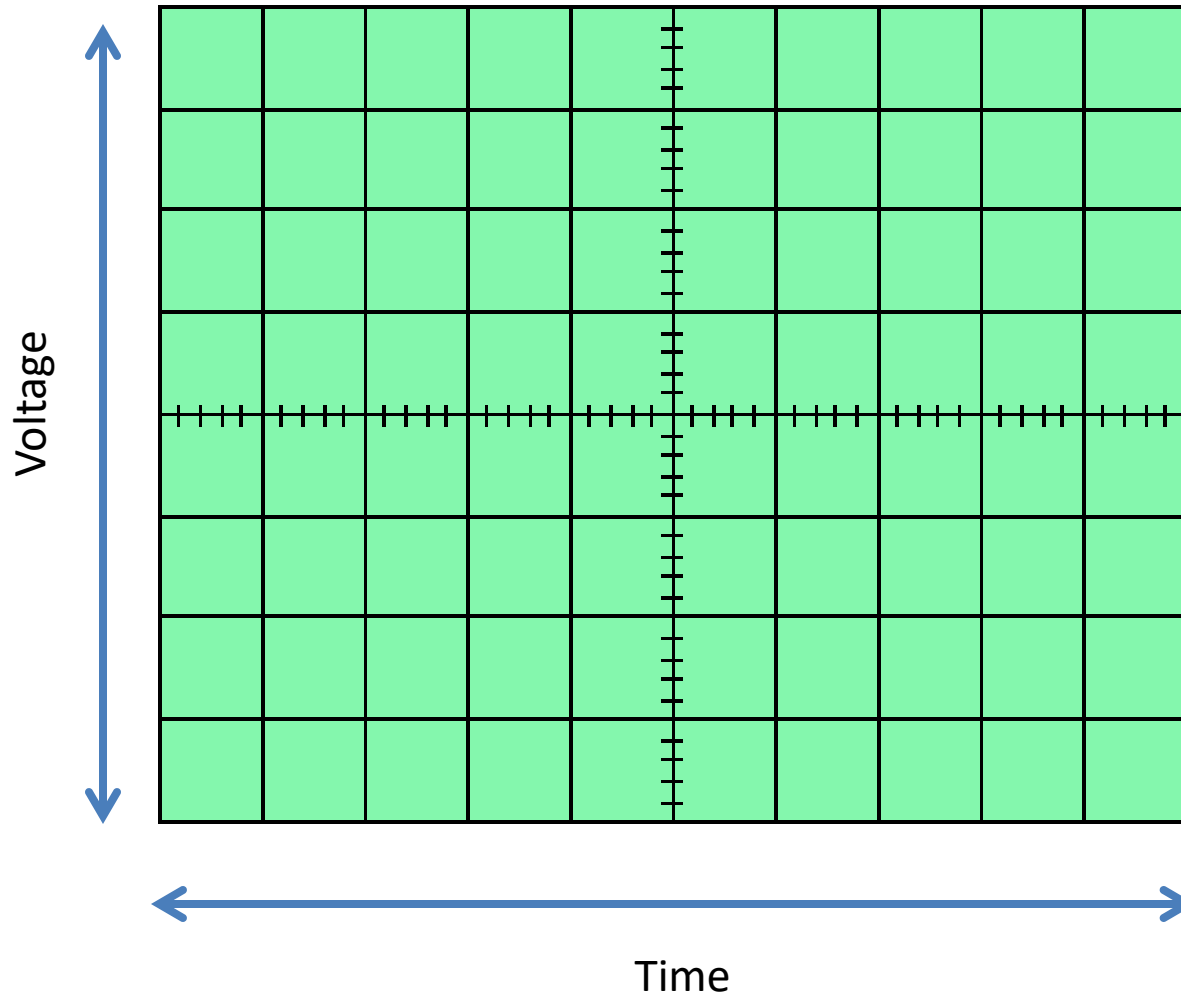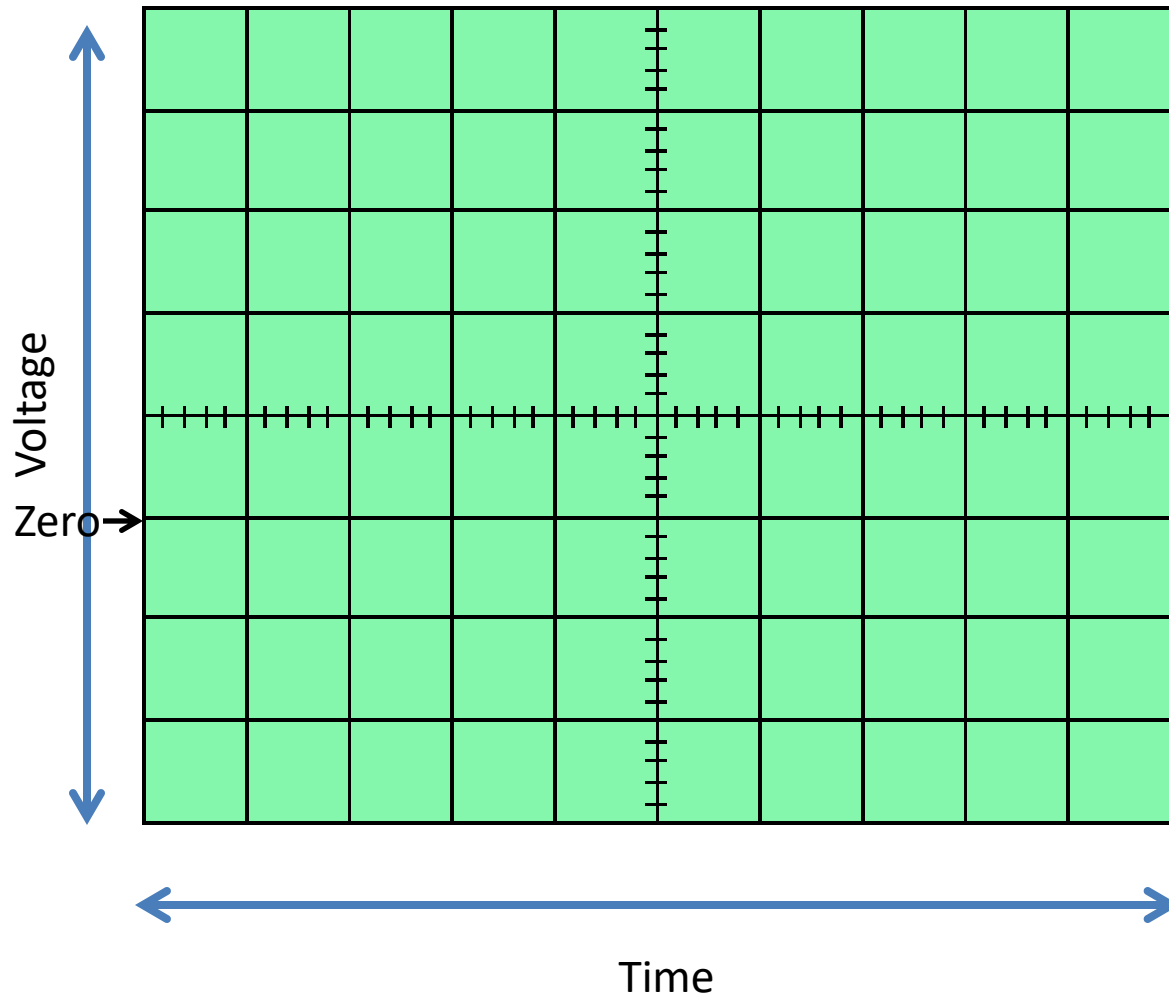
Control

Control

Set-point · Control error · **Pilot** · Actuators · nt · **Aircraft** · Output: Controlled variables · Sensors

Focus of the course

Oscilloscope

Voltage

Time

Horizontal - time/div
Vertical   - V/div

Oscilloscope

Voltage (vertical axis label)

Zero →

Time (horizontal axis label)

Horizontal - time/div = 0.1 sec/div
Vertical   - V/div = 1 V /div
Window (Span)
Horizontal –> 10 x 0.1 = 1sec
Vertical –> 1 x 8 = 8 V
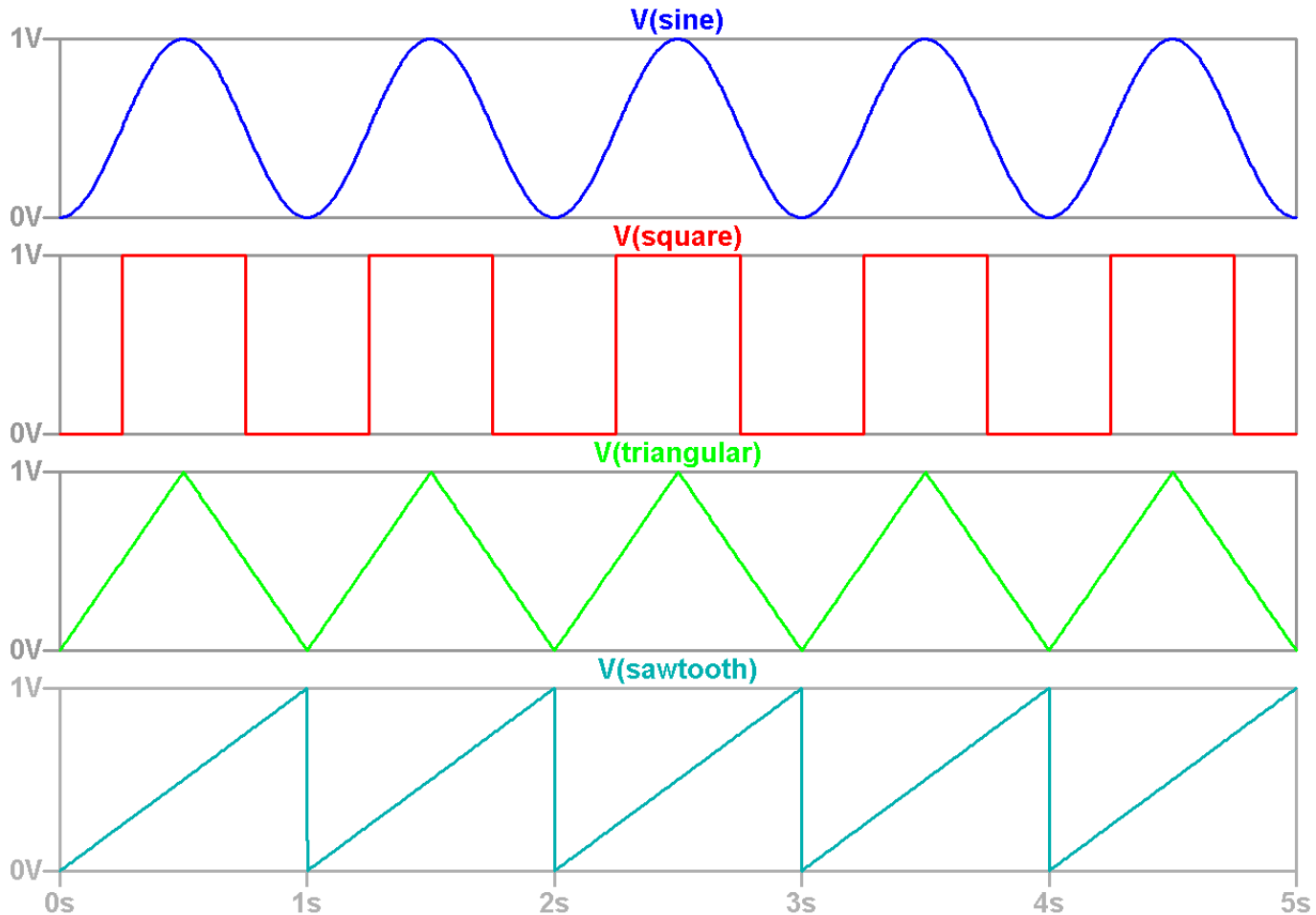
Vertical -> +5 to -3 V

Marker is available to identify zero position

Horizontal scale can be changed.
Vertical scale can be changed.
Zero position can be changed

Horizontal - time/div
Vertical   - V/div

Function Generator

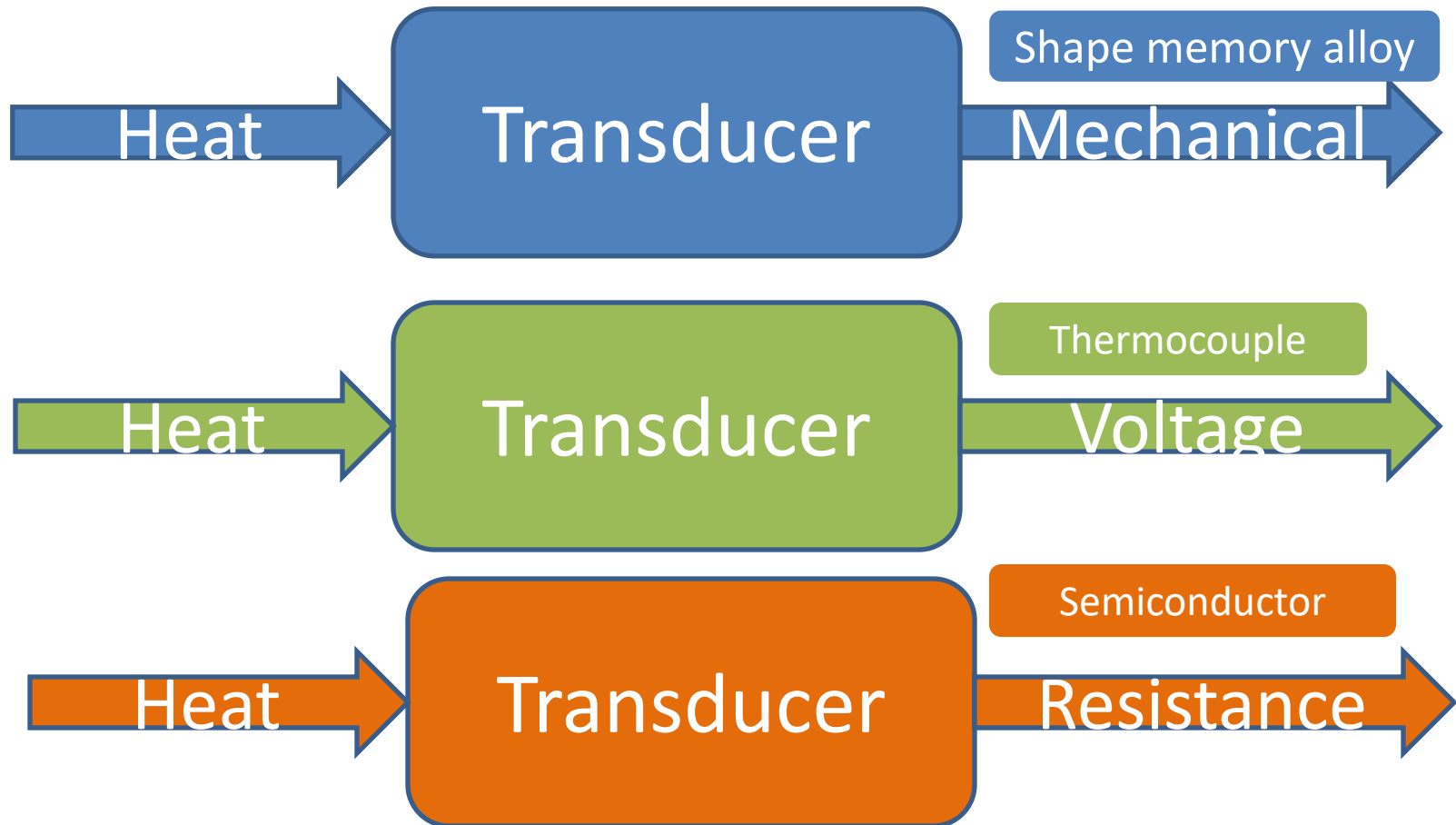You can generate waveforms of different shapes, frequency, amplitude, random signals etc.

Power Supply

Dual power supply: 0-15 V and 2 A current
Variable voltage and current limit
One can obtain -+15 V supply.

Transducers

Converts one form of energy to another

Heat → **Transducer** → Shape memory alloy / Mechanical

Heat → **Transducer** → Thermocouple / Voltage

Heat → **Transducer** → Semiconductor / Resistance

Evaluation

Credit structure L-T-P-C   2-0-2-6

Activity	Weightage
Quiz 5-6 (10 minutes)	25
Mid-sem	25
End-sem	30
Viva	5
Journal	15

No compensatory quiz

How many sensors are directly used by us in our daily life?

How many sensors are used in a modern car?

How many sensors are used in a modern transport aircraft?

How many sensors are used in a modern military aircraft?

Post your answer on moodle, along with source of information.