Subject Description Form

Subject Code	AP30005
Subject Title	Advanced Scientific Instrumentation
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To introduce background knowledge and provide practical training in computer controlled measurement techniques, application of sensors and transducers (including optoelectronic devices and optical fibers), noise reduction methods in electrical measurement, and process control in engineering and physics applications.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) apply various sensors and transducers in combined with electrical measurement instruments to solve scientific and engineering problem; (b) specify and analyze the source of noise in electrical measurements, and use techniques such as lock-in amplifier to enhance the ratio of signal to noise; (c) explain the characteristics of computer I/O devices and interfacing, serial and parallel communications, and data acquisition systems; (d) explain and apply the feed-back loop (proportional, integral and derivative) concept in automatic control systems; and (e) specify and analyze optical optoelectronic devices in optical fiber communication.
Subject Synopsis/ Indicative Syllabus	**Computer interfacing**: computer controlled electrical measurement with interfacing techniques such as RS-232, USB and IEEE488 interface. **Process control techniques**: proportional, integral and derivative (PID) process control concept in automatic control systems such as PID temperature controller. **Signal analysis**: Fourier transformation signal analysis using digital oscilloscope. **Signal noise reduction**: signal and noise characteristics and signal enhancement/noise reduction methods such as Lock-in Amplifier technique. **Optoelectronics and optical fiber communication**: optical fiber characteristics and analog/digital communications through optical fibers.
Teaching/Learning Methodology	**Lecture**: Background knowledge behind all experiments will be systematically introduced in lectures. Class work and assignments related to the content of lectures will be used to enhance students learning. Students are requested to give brief presentations on the topics related to the contents of experiments. **Laboratory session**: Students will use computer controlled instruments to conduct electrical and optical measurements as well as practice using of various sensors and transducers.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
(1) Continuous assessment	40	✓	✓	✓	✓	✓
(2) Practical examination	20	✓	✓	✓	✓	✓
(3) Written test	40	✓	✓	✓	✓	✓
Total	100					

Assignments will strengthen the students' basic knowledge and the analytical skills to solve the problems related to this subject. Practical examination is useful to assess students' experimental skills and knowledge learned from the lectures and lab works. Written test will review their understanding of the course and assess their ability to solve problems.

Student Study Effort Expected

Class contact:	
• Lecture	13 h
• Laboratory	39 h
Other student study effort:	
• Self-study	68 h
Total student study effort	120 h

Reading List and References

M. Tooley, "PC Based Instrumentation and Control", 3rd Edition, Oxford, Elsevier 2005.

G.P. Agrawal, "Fiber-optic Communication Systems", New York; John Wiley, 2002.

Terry Bartelt, "Instrumentation and Process Control", Clifton Park, NY: Thomson/Delmar Learning, c2007.