Papua New Guinea University of Technology
Department of Electrical and Communications Engineering
Lesson Plan

Subject	Instrumentation Systems and Process Control	**Subject Code**	EE411
Semester/year	Semester 1/2016	**Date Prepared**	5th February 2016
Instructor	Robert Amos	**Credit Hours (PNG standard)**	
Period	15 weeks	**Credit Hours (Engineering Accreditation Standard)**	

Subject Synopsis	This subject addresses the fundamental concepts and principles of instrumentation and process control systems used in the industries and practical hand-on on the design and simulation of industrial process control systems. It provides the students with the essential knowledge and applications of the electronic instruments and instrumentation systems, the transducers and the Programmable Logic Controllers (PLCs) involved in the monitoring and controlling of an industrial process. In the section of computer control it covers application of transducers and PLC programming for control of various industrial processes in the industries.
Contact hours	Lecture: 2 Hours/week Tutorial: 1 hour/week Laboratory + Project: 1 hour/week (average)
Evaluation	100% Continual Assessment
Learning Outcomes (LO)	LO.1 Understand the principles of operation of electronic analogue and digital instrumentation and their applications in instrumentation systems. LO.2 Understand the operations of PLC based instrumentation systems. LO.3 Understand the construction, logic and operation of Programmable Logic Controller (PLCs) LO.4 Apply the PLCs for control of various industrial processes in mining, manufacturing industries and traffic control. LO.5 Design flow charts, PLC wiring diagram and PLC Ladder diagram programs for process control systems. LO.6 Analyze and execute the developed PLC programs and monitor on-line process

	Distribution	(%)	LO1	LO2	LO3	LO4	LO5	LO6
Assessment Methods	Laboratory							
	Quizzes		X	X	X	X	X	X
	Tests		X	X	X	X	X	X
	Project					X	X	X
	Final Examinations							

References Used in Class	Industrial Electronics and Control, Newman, M., John Wily & Sons, New York, 1986
Additional References	Application of Programmable Logic controllers to Industrial Process Control, Departmental Hand-outs, 1990, Application of Programmable Logic controllers to Industrial Process Control, Korzeniowksi, K.,

Program Outcomes (Electrical and Communications Engineering)

PO1	An ability to apply the knowledge of mathematics, science and Engineering in all aspects of Electrical Engineering.
PO2	An ability to design and conduct experiments, as well as to analyse and interpret data.
PO3	An ability to design a system, component, or process to meet desired need within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
PO4	An ability to apply the techniques of using appropriate tools to investigate, analyse, design, simulate and/or fabricate/commission complete systems.
PO5	An ability to identify, analyse, formulate, design, simulate and/or fabricate/commission complete systems for engineering problems.
PO6	An ability to communicate effectively and to prepare formal technical plans leading to solutions and detailed reports for electrical systems.
PO7	An ability to work on multidisciplinary teams and comprehend his/her scope of work, deliverables and issues in which able to lead the team towards goal.
PO8	Possess an understanding of professional, safety and ethical responsibility.
PO9	Broad understanding of the impact of engineering solutions in a global, economic, environmental, and societal context.
PO10	Recognition of the need for, and an ability to engage in life-long learning to upgrade to higher learning and research activities.
PO11	Comprehensive knowledge of contemporary issues due to changing technical scenario.
PO12	An ability to manage projects in multidisciplinary environments and apply management techniques, skills, and project management tools necessary for engineering practice.

Week	Topic	Topic Outcomes (TO)	LO	PO	Delivery Methods	Continuous Assessments		
						Quiz	Test	Project
1	**Electronic Instruments & Instrumentation systems**	❒ Definition and terminologies ❒ History of the development of instrumentation and process control systems. ❒ Basic concepts and components of process control systems.	LO1	PO1 PO2	Lectures, Tutorials (No Lab)			
2		❒ Analogue and digital electronic measuring instruments. ❒ Instrumentation block diagrams ❒ Examples of instrumentations and process control systems in various industries.	LO1 LO2	PO1 PO2	Lectures, Tutorials (No Lab)			
3	**Transducers & Sensors**	❒ Types of transducers (analogue and digital) ❒ Application of transducers in process control systems. ❒ Electromechanical transducers ❒ Cathode Ray Oscilloscope (CRO) instrument.	LO1 LO2	PO1 PO2	Lectures, Tutorials (No Lab)			
4		❒ Thermal, displacement and level transducers ❒ Strain gauge ❒ Optical transducers (photoelectric devices) and applications	LO1 LO2	PO1 PO2	Lectures, Tutorials (No Lab)	Q1		
5	**Industrial Process Control**	❒ Control modes ❒ Application of automatic control in industries. ❒ Sequential control and relay control ❒ Timing devices	LO1 LO2	PO1 PO2	Lectures, Tutorials (No Lab)		T1	

6	**Programmable Logic Controllers (PLCs)**	❒ Introduction to relay control ❒ PLC theory of operation, functions, construction, inputs, outputs and programming devices ❒ Logic unit module, memory and CPU	LO2 LO3	PO2 PO3 PO4	Lectures, Tutorials, (No Lab)			
7	**PLC Programming & Application in Industries**	❒ Programming languages; ➡ Boolean statements ➡ Static logic ❒ PLC wiring diagram and ladder diagrams. ❒ ***Group Project 1*** *– Batch mixer in an industry.* Develop flow chart, PLC wiring diagram & PLC Ladder diagram program	LO2 LO3	PO2 PO3 PO4	(No Lectures, Tutorials, Lab)	Q2		Prj.1
8		❒ PLC wiring diagram and ladder diagrams. ❒ Timers and counters, etc. ❒ Group Project 1 Continue – Batch mixer in a building industry. Develop flow chart, PLC wiring diagram, PLC ladder diagram programme and simulation.	LO2 LO3	PO2 PO3 PO4 PO5	Lectures, Tutorials, laboratory		T2	
9		❒ Timers and counters, etc. ❒ ***Group Project 2*** *– (a) Chemical Operation in an industry, (b) Food process mixing and transfer industry*. Develop flow chart, PLC wiring diagram, PLC ladder diagram programme and simulation.	LO2 LO3 LO4 LO5 LO6	PO2 PO3 PO4 PO5	Lectures, Tutorials, laboratory			Prj.2
10		❒ Mnemonic code, machine code. ❒ Group Project 2 Continues – (a) Chemical Operation in an industry, (b) Food process mixing and transfer industry. Develop flow chart, PLC wiring diagram, PLC ladder diagram programme and simulation.	LO2 LO3 LO4 LO5 LO6	PO2 PO3 PO4 PO5	Lectures, Tutorials, laboratory			

11	**PLC Programming & Application in Industries**	❒ Application of PLCs to industrial process control. ❒ ***Group Project 3*** *– (a) Mining operation (Crusher and Conveyor), (b) Traffic lights.* Develop flow chart, PLC wiring diagram, PLC ladder diagram programme and simulation	LO4 LO5 LO6	PO2 PO3 PO4 PO5	Lectures, Tutorials, laboratory			Prj.3
12		❒ Application of PLCs to industrial process control. ❒ Group Project 3 continues – (a) Mining operation (Crusher and Conveyor), (b) Traffic lights. Develop flow chart, PLC wiring diagram, PLC ladder diagram programme and simulation.	LO4 LO5 LO6	PO2 PO3 PO4 PO5	Lectures, Tutorials, laboratory			
13	**Instrumentation Systems**	❒ Data recording from digital instruments ❒ Supervisory Control and Data Acquisition (SCADA) ❒ Distributed Control Systems (DCS) ❒ Digital control and their advantages and computer control instrumentation systems. ❒ VIS – Virtual Instrumentation System	LO4 LO5 LO6	PO2 PO3 PO4 PO5	Tutorials, laboratory	Q3		

Assessment Details			
Type	Group/ Individual	Learning Domain	Mark
Laboratory	Group	Psychomotor	
Quizzes	Individual	Cognitive	15
Class Tests	Individual	Cognitive	35
Project	Group	Cognitive	50
Final Examination	Individual	Cognitive	-

Assessment schedule:

		Week N$^{o.}$													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Assessment Methods	Laboratory															
	Quiz			X			X							X		
	Tests					X			X							
	Project								X		X		X			

LO-PO mapping:

		Programme Outcomes (POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Learning Outcomes LOs	LO 1	X		X									
	LO 2	X		X	X	X							
	LO 3	X	X	X									
	LO 4	X	X	X	X	X							
	LO 5	X	X	X	X	X							
	LO 6	X	X	X	X	X							

Prepared By: Mr Robert. A

Checked & Approved By:

(Head of the department ECE)

Date:

Date:

Remarks:

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