Beni Suef Technological University

Electromechanical systems Maintenance Syllabus

Syllabus

Course Title: Electromechanical systems Maintenance

Course Code: N/A

Course Followers: Students of Mechatronics Department in 2nd year of 2nd semester

(Students of Mechatronics Department in 2nd semester of 2nd year)

Course Meeting Times

Labs: 1 session / week, 4 hours / session

Course Credits: 3

Course Introduction

For a mechatronics technician /Technologist it is essential to carry out corrective maintenance activities on Electrical/ mechanical equipment, in accordance with approved procedures. They will be required to maintain a range of mechanical equipment, such as gear boxes, pumps, machine tools, conveyor systems, work holding arrangements, engines, processing plant and equipment, and other organization-specific equipment. This will involve dismantling, removing and replacing faulty equipment at component or unit level on a variety of different types of mechanical assemblies and sub-assemblies. They will be required to maintain a range of electrical equipment, such as single, three-phase and direct current power supplies and control systems, motors and starters, switchgear and distribution panels, control systems, electrical equipment, wiring enclosures and luminaires. This will involve dismantling, removing and replacing faulty equipment, at component or unit level, on a variety of different types of electrical assemblies and sub-assemblies. They will be expected to apply a range

of dismantling and reassembly methods and techniques, such as soldering, crimping, harnessing and securing cables and components. They will be expected to apply a range of dismantling and assembling methods and techniques, such as proof marking to aid reassembly, dismantling components requiring pressure or expansion/contraction techniques, setting, aligning and adjusting components, torque loading components and making 'off-load' checks before starting up the maintained equipment. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. They will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Course Objectives

After successfully studying this course, students will learn:

- Explain how to be safe inside industrial plant.
- Cleanliness workplace
- Knowing fault-finding instruments
- Importance of Preventive Maintenance
- Explain how to regulate pressure.
- Knowing Pumps types
- Recognizing Loading valves
- Identifying Pumps problems
- Exhibiting types of Compressors.
- Knowing Air Receivers and Compressor Control
- Knowing Air treatment and service unit.
- Interpret system drawings, and design simple systems, for sequential control systems.
- Explain the principles of process control valves.
- Determine possible mechanical actuation systems for motion transmission involving linear-to-rotary, rotary-to-rotary, rotary-to-linear and cyclic motion transmission.
- Evaluate the capabilities of linkages, cams, gears, ratchet-and-pawl, belt and chain drives and bearings for actuation systems.
- Drawing pneumatic circuits
- Knowing notation of pneumatic components
- Controlling a Single Acting Cylinder

- Controlling a Double Acting Cylinder
- Forward/Backward Control of a Double Acting Cylinder
- Positioning Systems-Intermediate Stop Circuit-Self-Holding Circuit-Alternating Control Circuit
- Understanding the main concepts of logic circuits and their applications
- Discuss the relevance of electrical and electronic engineering, and its importance as an 'enabling technology';
- Describe the characteristics and advantages of a 'systems approach' to engineering;
- List the main elements that form the basis of all electrical and electronic systems and be able to cite real-world examples of such components;
- Identify the inputs and outputs of an engineering system and understand the significance of the choice of system boundary;
- Explain the varied characteristics of physical quantities and the need to represent these quantities by electrical signals;
- Use block diagrams to represent complex engineering systems.
- discuss the role of sensors in electrical and electronic systems;
- outline the requirement for a range of sensors of different types to meet the needs of varied applications;
- explain the meaning of terms such as range, resolution, accuracy, precision, linearity and sensitivity, as they apply to sensors;
- describe the operation and characteristics of a variety of devices for sensing various physical quantities;
- give examples from the diversity of sensing devices available and outline the different characteristics of these components;
- discuss the need for interfacing circuitry to make the signals produced by sensors compatible with the systems to which they are connected.

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- discuss the role of sensors in electrical and electronic systems;
- outline the requirement for a range of sensors of different types to meet the needs of varied applications.
- Describe the characteristics of simple circuits containing resistors, inductors and capacitors, and calculate the resonant frequency and bandwidth of such circuits.
- Discuss the operation and characteristics of a range of passive and active filters.
- Discuss the need for actuators in electrical and electronic systems;
- Describe a range of actuators, both analogue and digital, for controlling various physical quantities;
- Explain the requirement for actuators with different properties for use in different situations;
- Describe the use of interface circuitry to match a particular actuator to the system that drives it.
- Discuss the various forms of electrical machine;
- Explain how the interaction between a magnetic field and a rotating coil can be used to generate electricity.
- Explain how the interaction between a changing magnetic field and a coil can be used to generate motion.
- Describe the operation of various AC and DC forms of generator an motor
- Discuss the use of electrical machines in a variety of industrial and domestic applications.

Learning Outcomes

By the end of this unit students will be able to:

- Apply the health and safety requirements of the area in which the maintenance activity is to take place
- Carry out maintenance activities for different types of mechanical equipment including different techniques
- Carry out maintenance activities for different types of Electrical equipment including different techniques
- Replace/refit a range of mechanical and electrical components.

Prerequisites

Student Should Pass the following Courses

1. Mathematics for Technicians (1st year,1St Semester)

2. Electric circuits (1st year,2nd Semester)

Textbooks

The course textbooks are:

1. Allan R. Hambley, Electrical Engineering Principles and Applications (5^{th} edition), Pearson, 2011, New York. ISBN-13: 978-0-13-215516-8
2. William Bolton, MECHATRONICS A MULTIDISCIPLINARY APPROACH Fourth Edition, Pearson, 2008, New York. *ISBN: 978-0-13-240763-2.*
3. Andrew Parr MSc, CEng, MIEE, MInstMC, Hydraulics and Pneumatics A Technician's and Engineer's Guide Third edition,2011, Elsevier Ltd, ISBN-13: 978-0-08-096674-8

Labs (or Tutorials/Exercise, Workshop)

- Labs will be conducted during the weeks shown in the schedule. Each lab assignment involves one or more accomplishments which must be checked off by an instructor in the lab. The instructor will be available for help and lab check-off during those weeks in which a lab is in progress.
- Students must successfully complete a series of lab assignment works throughout the course. The instructor will gather a collection of work that demonstrates evidence of a range of techniques in this course.
- Lab assignments must be done on your own. Skipping the lab and submitting work copied from someone else is a serious breach of ethics, and will be handled by the Committee on Discipline.
- Lab assignments will be graded on a scale of 0 to 3 (3: lab complete, works, good job on pre- and post-lab; 2: lab mostly complete, reasonable job on pre and post lab; 1: lab partially done, marginal to poor job on pre- and post-lab; 0: lab not done, poor job on pre- and post-lab).

Lab Books

- You must obtain the contents of a few pages for every lab (from Lab #1 to lab #14) for recording measurements, observations and graphs of data taken during the in-lab exercises.
- Written pre-lab and post-lab exercises are also to be completed in your own papers.

Midterm Exam

- One midterm exam for testing the learning outcomes will be given in this term. The exam will take place few days after Lab #7 for a four-hour duration.
- Students have to demonstrate that the learning outcomes from Lab #1 to Lab#7 have been achieved.

Final Exam

- A four-hour final exam will be given during the end-of-term exam week.
- Students have to demonstrate that the learning outcomes from Lab activities after the midterm exam had been achieved.

Calendar

The calendar provides information on the course's lecture class (L), lab (Lab #), and exam (E) sessions.

SES #	TOPICS	KEY DATES
Lab #1	Safety, Cleanliness, Fault-Finding Instruments, Fault-Finding, Preventive Maintenance and Computer Simulation.	Lab report #1 in
Lab #2	Pressure Regulation, Pump Types, Loading valves, Pump problems, Filters.	Lab report #1 out Lab report #2 in
Lab #3	Compressor Types, Air Receivers and Compressor Control, Air Treatment, Service Units.	Lab report #2 out Lab report #3 in
Lab #4	Actuation Systems, Pneumatic and Hydraulic systems, Directional control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators.	Lab report #3 out Lab report #4 in

SES #	TOPICS	KEY DATES
Lab #5	Mechanical Systems, Types of motion, Kinematic Chains, Cams, Gears, Ratchet and Pawl.	Lab report #4 out Lab report #5 in
Lab #6	Belt and chain Drives, Bearings, Mechanical aspects of motor selection.	Lab report #5 out Lab report #6 in
Lab #7	Circuit Diagram-Notation of Pneumatic Components-Controlling a Single Acting Cylinder-Controlling a Double Acting Cylinder-Forward/Backward Control of a Double Acting Cylinder-Positioning Systems-Intermediate Stop Circuit-Self-Holding Circuit-Alternating Control Circuit- Exercises	Lab report #6 out Lab report #7 in
E1	Mid Term Exam	
Lab #8	YES Logic-NOT Logic -AND Logic -OR Logic -Application of Logic Control- Exercises	Lab report #7 out Lab report #8 in
Lab #9	Engineering System	Lab report #8 out Lab report #9 in
Lab #10	Sensors	Lab report #9 out Lab report #10 in
Lab #11	Displacement, Sound and Motion Sensors	Lab report #10 out Lab report #11 in

SES #	TOPICS	KEY DATES
Lab #12	RLC Circuit	Lab report #11 out Lab report #12 in
Lab #13	Filters	Lab report #12 out Lab report #13 in
Lab #14	Actuators	Lab report #13 out Lab report #14 in
E2	Final Exam	

Grading (or Assessment) Policy

Initial grading will be based on the following weighting:

ACTIVITIES	PERCENTAGES
Labs (performance & reports)	60%
Midterm	20%
Final exam	20%

- Lab assignments will be graded on a scale of 0 to 3

i) 3: lab complete, works, good job on pre- and post-lab;

ii) 2: lab mostly complete, reasonable job on pre and post lab;

iii) 1: lab partially done, marginal to poor job on pre- and post-lab;

iv) 0: lab not done, poor job on pre- and post-lab.

- Midterm & Final Exam will be grade on a scale of 0 to 3 according to the degree of achievement in each learning outcome.

i) 3: complete achievement in learning outcome;

ii) 2: mostly complete, reasonable achievement in learning outcome;

iii) 1: partially done, marginal to poor achievement in learning outcome;

iv) 0: not done, poor achievement in learning outcome.

Lecture notes

This section contains lab notes from every chapter of the practice manual, “1. Farag Ragab,

Pneumatics and Hydraulics (Practice Manual), BST, 2020”

LEC #	TOPICS	LECTURE NOTES (BOOK I FOR L1 TO L12 & BOOK II FOR L13)
L1	Safety, Fault-Finding and Maintenance	Module 1
L2	Hydraulic Pumps and Pressure Regulation	Module 2
L3	Air Compressors, Air Treatment and Pressure Regulation	Module 3
L4	Pneumatic and Hydraulic Actuation Systems	Module 4
L5	Mechanical Actuation Systems	Module 5
L6	Mechanical Actuation Systems (Part 2)	Module 5
L7	Fundamentals of Pneumatic Circuit	Module 6
L8	Logic Control Circuit	Module 7
L9	Engineering Systems	Module 8
L10	Sensors	Module 9
L11	Sensors (Part 2)	Module 9
L12	Second order Electric circuit	Module 10
L13	Filters	Module 11

Lab notes (or Practice Manual)

This section contains lab notes from every chapter of the practice manual,

LAB #	TOPICS	LAB NOTES (PRACTICE MANUAL CHAPTER)
Lab #1	Safety, Cleanliness, Fault-Finding Instruments, Fault-Finding, Preventive Maintenance and Computer Simulation.	**Module 1 (Lab#1)**
Lab #2	Pressure Regulation, Pump Types, Loading valves, Pump problems, Filters.	**Module 2 (Lab#2)**
Lab #3	Compressor Types, Air Receivers and Compressor Control, Air Treatment, Service Units.	**Module 3 (Lab#3)**
Lab #4	Actuation Systems, Pneumatic and Hydraulic systems, Directional control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators	**Module 4 (Lab#4)**
Lab #5	Mechanical Systems, Types of motion, Kinematic Chains, Cams, Gears, Ratchet and Pawl	**Module 5 (Lab#5)**
Lab #6	Belt and chain Drives, Bearings, Mechanical aspects of motor selection.	**Module 5 (Lab#6)**
Lab #7	Circuit Diagram-Notation of Pneumatic Components-Controlling a Single Acting Cylinder-Controlling a Double Acting Cylinder-Forward/Backward Control of a Double Acting Cylinder-Positioning Systems-Intermediate Stop Circuit-Self-Holding Circuit-Alternating Control Circuit- Exercises	**Module 6 (Lab#7)**
Lab #8	YES Logic-NOT Logic -AND Logic -OR Logic - Application of Logic Control- Exercises	**Module 7 (Lab#8)**
Lab #9	Engineering System	**Module 8 (Lab#9)**

LAB #	TOPICS	LAB NOTES (PRACTICE MANUAL CHAPTER)
Lab #10	Sensors	**Module 9 (Lab#10)**
Lab #11	Displacement, Sound and Motion Sensors	**Module 9 (Lab#11)**
Lab #12	RLC Circuit	**Module 10 (Lab#12)**
Lab #13	Filters	**Module 11 (Lab#13)**
Lab #14	Actuators	**Module 12 (Lab#14)**