



## MET 288 Troubleshooting & Maintenance

Second Semester 2006/2007 (062)

### MET 288 Troubleshooting and Maintenance

[1 – 6 – 3]

Types of maintenance, tools and instruments, uses of machine manuals, machine history documentation failure analysis, Machinery Condition Monitoring, Vibration signals analysis, Oil Debris Monitoring and Analysis, Machine alignment and hoisting, Belts, Gears and Chains, Bearings, Troubleshooting and maintenance of Pumps, Compressors, Refrigeration and Air-conditioning, Heat Exchangers, Boilers, Turbines and Diesel engines.

**Prerequisites** MET152 Applied Mechanics, MET273 Welding & Forming

**Textbook** (TB) Troubleshooting: A Technician's Guide by William L. Mostia Jr.

**Notes** (HO) HBCC handouts.

**Faculty** Coordinator: M. Beecher, lecturer: M. Beecher.

**Aims** The purpose of this course is to give students mainly practical experience in industrial maintenance similar to the situations found by most mechanical technicians in the Kingdom. This will be achieved in part by having students perform assignments and projects that emulate real-life situations as well as delivery in the classroom using suitable teaching aids.

- Topics**
1. Introductory concepts. Preventive Maintenance & Condition Monitoring
  2. Fault Diagnostics
  3. Troubleshooting aids & approaches including electrical & electro-mechanical equipment
  4. PM specific (1 topic)
  5. Troubleshooting notes on four types of industrial equipment.

**Weekly schedule:** see pages 2 & 3.

#### Assessment Policy:

#### Weighting:

#### Letter Grading Scale:

Quizzes	10 %	95% - 100%	A+
Lab Reports	15 %	90% - 94%	A
Projects	5 %	85% - 89%	B+
First Major exam.	10 %	80% - 84%	B
Second Major exam.	10 %	75% - 79%	C+
Mid-Term Lab	10 %	70% - 74%	C
Lab Final	20 %	65% - 69%	D+
Final examination	<u>20 %</u>	60% - 64%	D
	100%	0% - 59%	F

*Adjustment of thresholds might be necessary depending on clustering of final results.*

#### HBCC Rules for Students

**attendance** you are expected to attend all classes. If you are temporarily absent, you are held responsible for making up all missed course theory and exercises.

**absenteeism** if you miss too many classes you will receive a DN grade.

**smoke free college** smoking is forbidden inside all college buildings.

**behaviour** if you disrupt the learning environment you may receive official disciplinary action.

**exam cheating** failure to obey KFUPM exam regulations can result in cancellation of your exam grade.

Prepared: Michael Beecher

Date: 20-OCT-09

Approved: \_\_\_\_\_

Date: \_\_\_\_\_

Week no.	Content	Ref.	Practical activities	Quiz/exam
1	<b>Introductions to:</b> Preventive Maintenance (PM) including installation & commissioning (I&C). Condition Monitoring (CM).	TB chap.6  HO I1	<b>Introduction to practical work:</b> Teamwork, hazards, safe procedures.  <b>Practical 01:</b> <i>Introduction to assembly tools and fasteners.</i>	
2	<b>Preventive Maintenance</b> Correct I&C - hoisting and shifting. Machine fixing & preparation, documentation & certification.  Routine servicing, repairing & rebuilding. Record keeping.	HO PM1 + PM2	<b>Practical 02a:</b> <i>Instruments and Measurements - feeler gauge, spirit level, torque wrench, tachometer, stroboscope.etc.</i>	Quiz 1
3	<b>Condition Monitoring</b> Continuous monitoring and sampling (e.g. oil debris.) Manual methods using various instruments.	HO CM1	<b>Practical 02b:</b> <i>Instruments and Measurements - manometer, pressure gauge, thermocouple.</i>	
4	Examples of manual record keeping. Recording devices (analogue/digital - dumb/intelligent).  Types of instruments to measure various physical stimuli.	HO CM1 + CM2	<b>Practical 02c:</b> <i>Instruments and Measurements - use of multimeter to measure resistors, diodes, capacitors. AC mains voltages and frequency.</i>	Quiz 2
5	<b>Fault Diagnostics (FD)</b> Test equipment (various types) Definitions of breakdowns, general faults and malfunctions. Symptoms, causes & problems. Overt & covert faults. Bathtub curve, definitions of terms. Effect of CM on bathtub curve.	TB chap.7 chaps.2-3  HO FD1 + FD2	<b>Practical 03:</b> <i>Use of a flow-chart to find &amp; repair faults introduced in to a workshop air compressor.</i>	
6	Analysis of FD. Definitions of failure rates by trailing.  Statistics of FD. Statistical failure rates, probabilities, reliability & life expectancy.	HO FD3 + FD4		Major 1
7	<b>Troubleshooting Principles (TS)</b> Troubleshooting aids, charts and diagrams.  Approaches to fault finding - sequential, iterative, elimination etc.	TB chaps.4-5  HO TS1 + TS2	<b>Practical 04:</b> <i>Rim &amp; Face Alignment 1: (Drilling machine)</i>	Quiz 3

8	<p><b>Troubleshooting Electrical Equipment</b> Typical examples of situations. Areas of basic electrical knowledge required.</p> <p>Troubleshooting approaches. Use of multi-meter - continuity &amp; resistance; Checking wires &amp; joints; components like switches, thermostats, heating coils &amp; diodes.</p>	HO TS3		Mid-term lab exam
9	<p><b>Shaft &amp; Bearing Alignments.</b> (PM specific) Axial/parallel shafts. Parallel/angular offsets.</p> <p>Symptoms &amp; problems arising from misaligned shafts or bearings. Instruments, tools and adjustment methods.</p> <p>Rim and face method (detailed analysis).</p>	HO PM3	<b>Practical 05:</b> <i>Rim &amp; Face Alignment 2: (Lathe tailstock)</i>	Quiz 4
10	<p><b>Boilers &amp; Heat Exchangers.</b> (Equipment 1) Types, principle &amp; uses. Symptoms &amp; causes of fouling &amp; corrosion. Burner &amp; fuel problems. Condition monitoring tips. Troubleshooting tips.</p>	HO EQ1	<b>Practical 06:</b> <i>Dismantling and inspecting condition of a centrifugal water pump.</i>	Quiz 5
11	<p><b>Pumps, Compressors &amp; Fans.</b> (Equipment 2) Industrial uses. Designs: reciprocating &amp; roto-dynamic; axial &amp; centrifugal. Various problems, maintenance &amp; troubleshooting tips.</p>	HO EQ2	<b>Case study 1:</b> <i>Shell &amp; tube boiler inspection &amp; written report.</i>	
12	<p><b>Electric Motors &amp; Generators.</b> (Equipment 3) Main AC &amp; DC motor types. Parts &amp; design features. Applications. Various problems, maintenance &amp; troubleshooting tips.</p> <p>Generators - single &amp; 3 phase. Problems &amp; troubleshooting tips.</p>	HO EQ3	<b>Practical 07:</b> <i>Dynamic balancing a long shaft.</i>	Major 2
13	<p><b>Refrigerators &amp; Air-conditioners.</b> (Equipm't 4) Types, domestic and commercial. Various problems, maintenance &amp; troubleshooting tips</p>	HO EQ4a	<b>Case study 2:</b> <i>Inspecting the condition of a 3-phase diesel-generator &amp; control system.</i>	Quiz 6
14	<p>Large scale air conditioning systems. Principles, components, circuits, heat transfer fluids. Various problems, maintenance &amp; troubleshooting tips</p>	HO EQ4b	(Lab quiz 2)	
15	Review			Final lab exam
16	Final exam (3 hours )			