# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

BSME/BEME Y4S2

EMG 2418 : PNEUMATICS AND ELECTRO-HYDRAULICS

END OF SEMESTER EXAMINATION

**SERIES:** APRIL 2016

**TIME:** 2 HOURS

**DATE:** 16 May 2016

**Instructions to Candidates**

You should have the following for this examination
*-Answer Booklet, examination pass and student ID*
*-scientific calculator*
*-Drawing instruments*

This paper consists of **FIVE** questions. Attempt any THREE questions.
**Do not write on the question paper.**

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**Question ONE**

(a) Outline the THREE operations properties unique to pneumatic systems,

(4 marks)

(b) Explain briefly the FOUR operational characteristics of pneumatics system brought about by the compressibility property of air.

(6 marks)

(c) A load of mass 500 kg is to be lifted to a distance of 600 mm and the available air pressure at point of use is 7 bar. If the load is to be moved the full distance in 3 seconds and the cylinder is to make four complete cycles per minute and allowing for 40% losses in the cylinder and using Table 1 calculate:
   (i) the diameter of the air cylinder required'
   (ii) the actual air consumption per minute by the cylinder,

(10 marks)

Table1: Standard Air Cylinders

| Bore (mm) | 80 | 100 | 125 | 140 | 160 |
|---|---|---|---|---|---|
| Rod Diameter (mm) | 22 | 26 | 30 | 30 | 36 |
| Stroke (mm) | Up to 750 | up to 750 | 25-1000 | 30-1000 | 35-1200 |

**Question TWO**

(a) (i) Explain briefly the principle of operation of a proximity sensor,

(iii) Illustrate the graphical representation of the following proximity sensors:

(I) Magnetic

(II) capacitive

(4 marks)

(b) With the aid of a diagram briefly describe an OR function and the equivalent electrical circuit diagram that can be used in an electro-hydraulic system.

(7 marks)

(c) Illustrate a typical electrical circuit diagram for electro-hydraulic system clearly indicating the following designation:

(I) Transformer

(II) Rectifier

(III) Switches

(IV) Magnetic coils

(9 marks)

**Question THREE**

(a) State any TWO installation requirements for each of the following pneumatics component:

(i) filter

(ii) System

(iii) piping

(b) Draw a maintenance schedule that outlines TWO tasks each carried out on pneumatics systems during the following period:

(6 marks)

(i) weekly
(ii) Half -yearly
(iii) Annual

(6 marks)

(c) For each of the following failure symptoms in compressed air system, state the TWO most likely causes and their remedies:
(i) Air escape from vent hole of the regulator
(ii) Oil not supplied to air in the lubricator

(8 marks)

**Question FOUR**

(a) (i) State the THREE advantages and TWO disadvantage of in a pneumatic system in relation to other fluid in power transmission.
(ii) Explain the circumstance under which a lubricator is used in a compressed air system

(6 marks)

(b) Explain with the aid of a graphical diagram the unidirectional speed control in a single-acting cylinder used pneumatic system,

(6 marks)

(c) It is required to lubricate a cylinder of internal diameter of 40 mm and having a stroke of 50 mm and working at gauge pressure of 4 bar. Using Table 2 and assuming an homogeneous mixture throughout the cylinder spread, calculate:
(i) the maximum length of 8mm copper tube that should be used between the lubricator and the cylinder,
(ii) Rate of consumption and consumed per minute, if the cylinder in c(i) stroke 3 times in minute with each stroke lasting 0.75

(8 marks)

Table 2 Metric SI units for some standard tube dimensions

| Nominal Bore mm | Med Weight Min ID mm | Heavy Weight Min ID mm | | | ID | OD mm | Light Gauge mm | Light Gauge at 30°C |
|---|---|---|---|---|---|---|---|---|
| 6 | 5·8 | 4·5 | 3 | 0·6 | 1·72 | 4 | 2·77 | 12 |
| 8 | 8·6 | 7·5 | 4 | 0·6 | 2·72 | 5 | 3·55 | 13 |
| 10 | 12·1 | 11·0 | 6 | 0·8 | 4·32 | 6 | 4·24 | 13 |
| 15 | 15·8 | 14·6 | 8 | 0·8 | 6·32 | 8 | 5·74 | 14 |
| 20 | 21·3 | 20·1 | 10 | 0·8 | 8·32 | 10 | 7·24 | 14 |
| 25 | 26·9 | 25·3 | 12 | 1·0 | 9·90 | 12 | 9·24 | 11 |
| 32 | 35·6 | 34·0 | 16 | 1·0 | 13·9 | 16 | 12·74 | 10 |
| 40 | 41·5 | 39·9 | | | | 18 | 14·7 | 9 |
| 50 | 52·5 | 50·8 | | | | 22 | 18·1 | 9 |
| 65 | 68·1 | 66·4 | | | | 28 | 23·14 | 9 |
| 80 | 80·0 | 78·4 | | | | | | |
| 100 | 104·0 | 102·0 | | | | | | |
| 125 | 129·0 | 128·0 | | | | | | |
| 150 | 154·0 | 153·0 | | | | | | |

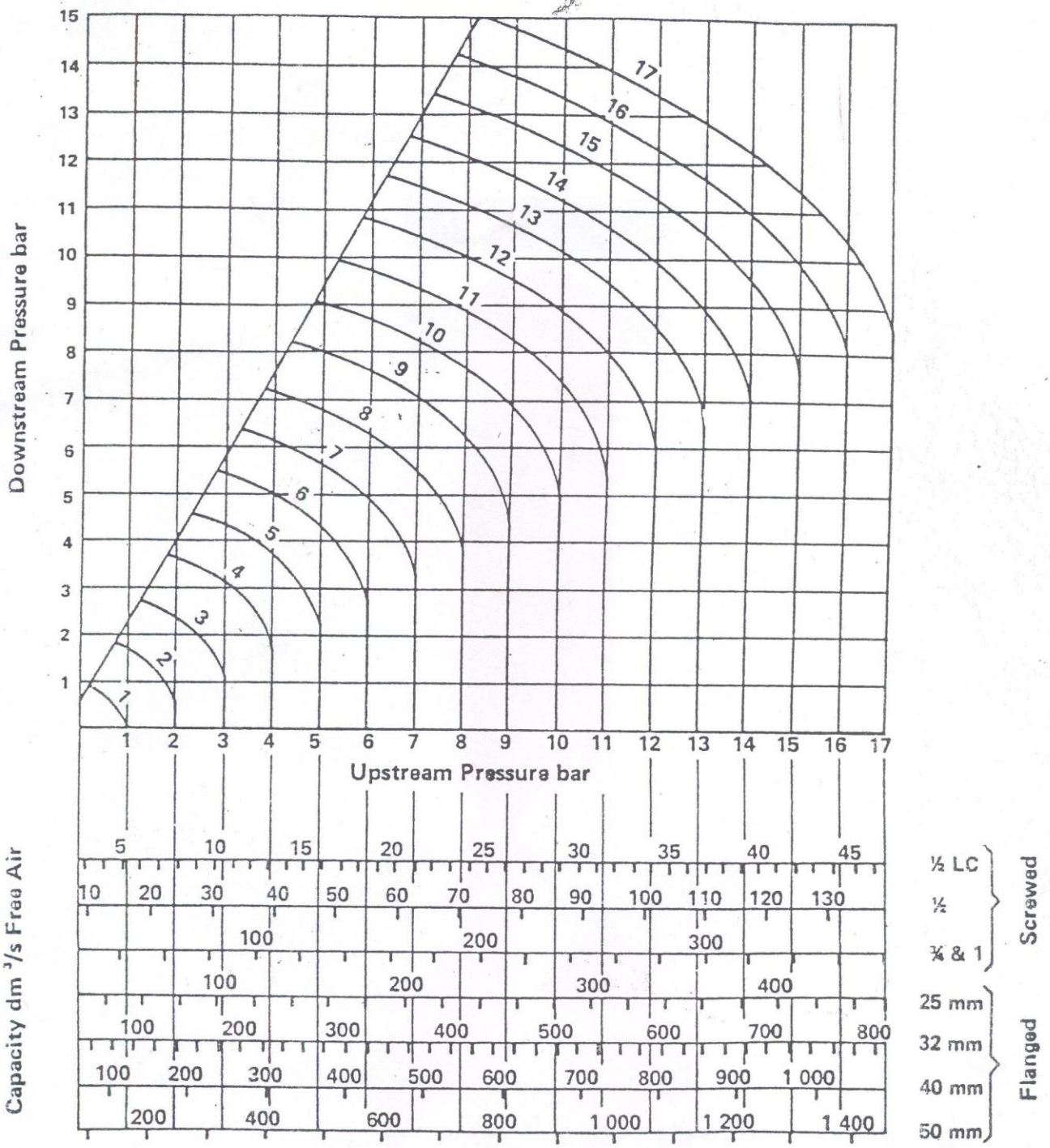
**Question FIVE**

(a) (i) Outline the TWO features that describes the operation of electro-hydraulic system,
(ii) State the THREE advantages of electrical or electronics controls in hydraulic.
(7 marks)

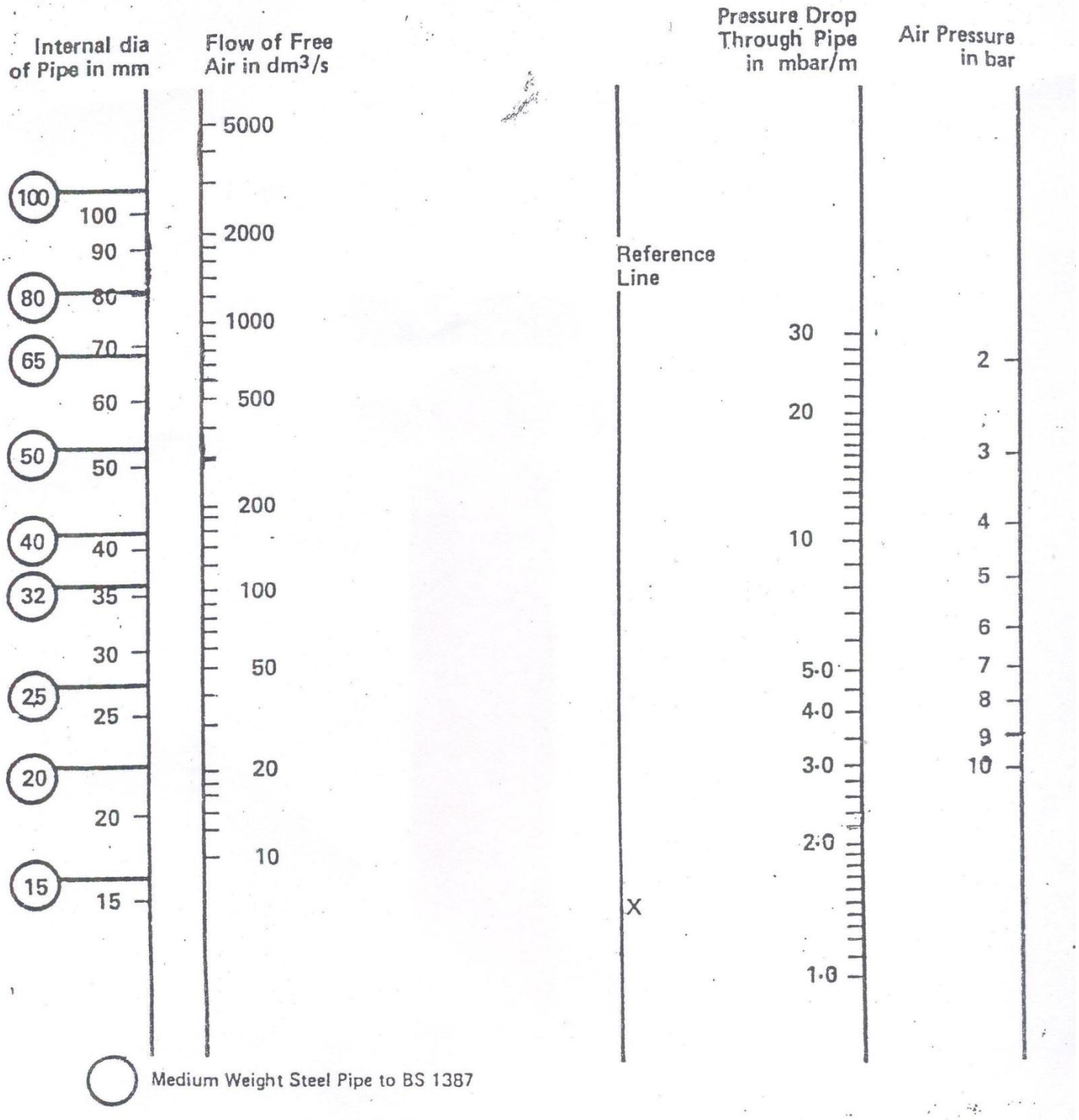
(b) With the aid of a schematic diagram describe the TWO principal sub-assemblies in an electro-hydraulic system,
(7 marks)

(c) (i) Illustrate a control loop system of a hydraulic bending cylinder,
(ii) Use a standard system to designate the control elements in the control loop in c (i). (7 marks)

Table 1 Metric SI Units Pressure Reducing Valve Sizing and Capacities



## Table 2 Metric SI Units Pressure Drop in Steel Pipes (15 mm to 100 mm)



## Table 3 Metric SI Units Pressure Drop in Pipes and Tubes (2·5 mm to 15 mm)