UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	PIPING ENGINEERING
COURSE CODE	:	BNL 30403
PROGRAMME	:	BNL
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) In steels physical metallurgy, pure iron composed of a body-centred cubic lattice. The first step in the heat treatment of steel is to heat the material to some temperature in or above critical range. Describe with your own words about full annealing process and briefly explain the martensite principle phase.

(8 marks)

(b) Sketch the Time - Temperature transformation T-T-T Diagram to shows the effect of non-equilibrium cooling of steel through ferrite, austenite, ferrite and cementite phases.

(4 marks)

(c) Water depth of 250 ft assuming the specific weight of water is 78 lb/ft^3, calculate the pressure in piping (psi). If the atmospheric pressure on piping is 18.9 psi, calculate the absolute pressure at that location.

(4 marks)

(d) The ASME 31 codes provide minimum requirements which do not replace competence and experience. Some code sections apply to a specific industry or apply to liquid hydrocarbons transportation pipeline. Describe the ASME B31.5: (REFRIGERATION PIPING) requirement and application.

(4 marks)

Q2 (a) Sketch the pressure reducing station by using the components such as Gate Valve, Reducing Valve, Ball Valve and Globe and Relief Valve.

(5 marks)

(b) Non-Destructive Examination (NDE) most often referenced by code and applied to the fabrication and installation of piping components and system. Industrial Piping undergoes a variety of major testing relying upon the specific facility and the requirements for the piping. Discuss briefly the piping test as follows:

(i) Sensitive Leak Test
(ii) Hydrostatic Test
(iii) Pneumatic Test

(6 marks)

(c) In the series pipes the same fluid flows through all the pipes, and the head losses are cumulative, however, in a parallel piping system the head losses (hf1, hf2, hf3) are the same in each parallel branch associated with that system and discharge flow (Q1,Q2,Q3) are cumulative. **Figure Q2 (c)** show the situation where the parallel and series pipe connected which ZA, ZB are elevations of points A and B, y, is the density of the fluid and Q is the discharge flow through the approach pipe and the exit pipe. Determine Q1, Q2 and Q3.

(9 marks)

Q3 (a) Unlike pipe and piping fittings, valves are multicomponent items, with a variety materials of construction and static (stationery) and dynamic (moving) parts. Discuss

(i) The function of Butterfly valve
(ii) Method on selecting the sizing of Control valve

(4 marks)

(b) A concrete pipe (2m inside diameter) is used to transport water from a pumping facility to a storage tank 5 km away. Neglecting any difference in elevations, calculate the friction factor and pressure loss in kPa/km due to a friction at a flow rate of 34,000 m^3/h. Assume a pipe roughness of 0.05mm. If a delivery pressure of 4 kPa must be maintained at the delivery point and the storage tank is at an elevation of 200 m above that of the pumping facility, calculate the pressure required at the pumping facility.

(10 marks)

(c) Acceptence standard for piping examination were developed to ensure the criteria has been followed by the owner and agent. As a Industrial Technologist, elaborate the criteria of :

(i) Acceptance Standard for Visual Examination
(ii) Acceptence Standard for Radiography
(iii) Acceptence Liquid Penetrant

(6 marks)

Q4 The input data has been given by the designer and you as a Industrial Technologist were appointed to involved with this operating plant facilities.

Input Data

Application	:	Heat Exchanger - Reboiler Channel
Design pressure (P_d)	:	400 psi
Test Pressure (P_t)	:	600 psi
Gasket type	:	comprofile
Gasket dimensions	:	ID = 37.63 in OD = 38.88 in

Tightness class required T3, therefore C= 10.0
Assembly efficiency (e) = 1.0, using hydraulic stud tensioners
Gb= 387 psi a=0.33 Gs = 14.0 psi

Calculate:
(i) Gasket operating stress
(ii) Seating stress
(iii) Design factor
(iv) Design bolt load

(20 marks)

Q5 (a) Pressure testing is required by most piping codes to verify that a new, modified, or repaired piping system is capable of safely withstanding its rated pressure and is leak tight. There are many different methods for pressure and leak testing in the field. Distinguish the difference between vacuum and bubble test for leakage testing and illustrate both of testing methods.

(8 marks)

(b) Explain briefly the hardness testing and list **FOUR (4)** the common hardness testing methods.

(6 marks)

(c) **Figure Q5 (c)** shows the x-t trace measured from a part of a pipeline after it was struck with a hammer. The effective mass of the pipeline was 20 kg with undamped natural frequency, ω= 63 rads^{-1}, damping factor, α = 0.8 s^{-1}. Calculate the natural frequency and damping ratio.

(6 marks)

- END OF QUESTONS -

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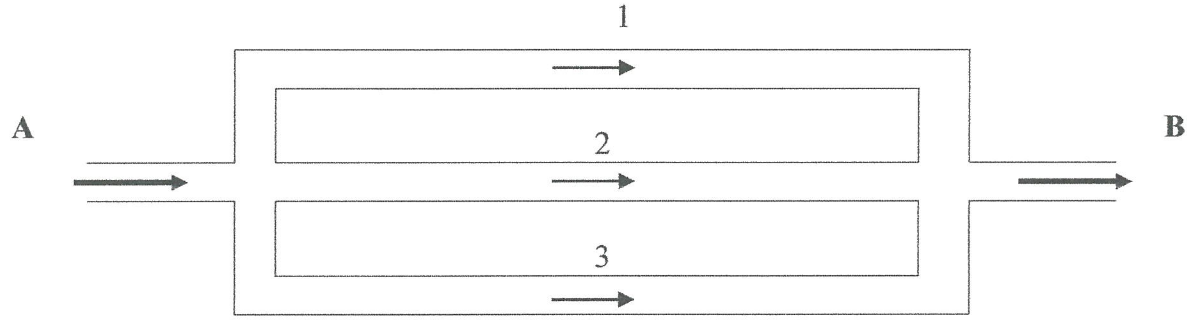

Given:

L_1= 3000 ft	D_1= 1 ft	ε_1=0.001 ft	ρ = 2 slug / ft^2	Z_A= 100 ft
L_2= 2000 ft	D_2= 8 in	ε_2=0.001 ft	ν = 0.00003 ft^2/ s	Z_B= 80 ft
L_3= 4000 ft	D_3= 16 in	ε_3=0.001 ft	PA = 80 psi	

Figure Q2 (c)

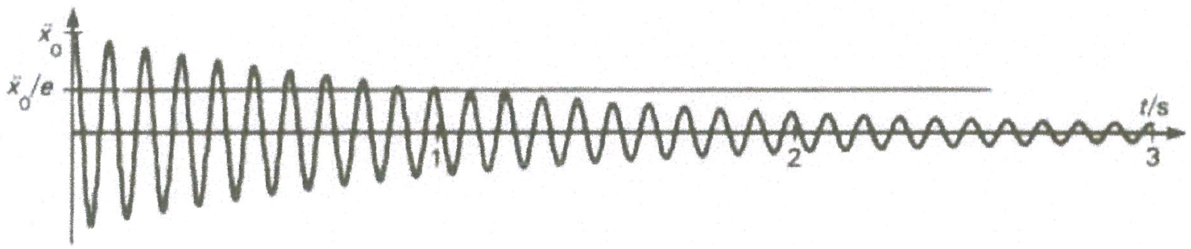

Figure Q5 (c)

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Gasket operating stress

$$S_{m1} = G_s[G_b / G_s x T_{pa}{}^{a}]^{1/Tr} \quad (1)$$

Seating stress

$$S_{m2} = G_b[ex1.5]T_{pa}{}^{a} = Pd[Ai / Ag] \quad (2)$$

Design factor

$$M_o = the\ greater\ of\ \frac{S_{m1}}{Pd}\ or\ \frac{S_{m2}}{Pd}\ or\ 2 \quad (3)$$

Design bolt load

$$W_{mo} = Pd(AgMo + Ai) \quad (4)$$

Where

A	The slope associated with part A tightness data
A_g	Area of gasket-seating surface, in^2 (mm^2) = 0.7854 (OD^2 - ID^2)
A_i	Hydrostatic area; the area against which the internal pressure is acting in^2 (mm^2) = 0.7854 G^2
b_o	Basic gasket seating width, in (mm) b_o= (OD - ID)/4
b	Effective gasket seating width
b	b_o, when $b_o \leq 1/4$ in
b	$\sqrt{b_o / 2}$ when $b_o > 1/4$ in
C	Tightness constant C = 0.1 for tightness class T1 (economy) C = 1 for tightness class T2 (standard) C = 10 for tightness class T3 (tight)
E	Joint assembly efficiency; recognizes that gasket-operating stress is improved depending on the actual gasket stress achieved during boltup; e= 0.75 for manual boltup e= 1 for ideal boltup e.g., hydraulic stud tensioners, ultrasonic
G	Diameter of location of gasket load reaction, in (mm), from ASME section 8
G	(OD+ID)/2 if $b_o \leq 1/4$ in =OD - 2b, if $b_o > 1/4$ in
G_b	The stress intercept at Tp = 1, associated with part A tightness data psi (MPa)
G_s	The stress intercept at Tp = 1, associated with part B tightness data psi (MPa)
P_d	Design pressure, psi (MPa)
P_t	Test pressure (generally 1.5 x Pd), psi (MPa)
S_{m1}	Operating gasket stress, psi (MPa)
S_{m2}	Seating gasket stress, psi (MPa)
M_o	Design factor
T_p	Tightness parameter. T_p is a dimensionless parameter used to relate the performance of gaskets with various fluids, based on mass leak rate. recognizes that leakage is proportional to gasket diameter (leak rate per unit diameter). T_p is the pressure (in atmospheres) required to cause a helium leak rate of 1 mg/sec for a 150 mm OD gasket in a joint. PVRC researchers have related T_p to other fluids through actual testing as well as use of laminar flow theory
T_{pa}	Assembly tightness; the tightness actually achieved at assembly = 0.1243 x C xP_t
T_{pmin}	Minimum tightness; acceptable tightness for a particular application = 0.1243 x C x P_d
T_r	Tightness ratio = log (Tpa)/log (Tpmin)
W_{mo}	Design bolt load, lb (kN)

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