SET A

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

SEPTEMBER 2016 SESSION

SUBJECT CODE	:	LNB 40702
SUBJECT TITLE	:	OFFSHORE AND SUBSEA STRUCTURES
LEVEL	:	BACHELOR
TIME / DURATION	:	(2 HOURS)
DATE	:	23rd JANUARY, 2017

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. Please write your answers on the answer booklet provided.
3. Answer should be written in blue or black ink except for sketching, graphic and illustration.
4. Answer five (5) questions only.
5. Answer all questions in English.

THERE ARE 4 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FIVE (5) questions only.
Please use the answer booklet provided.

Question 1

(a) Please specify and briefly describe the effects of marine growth upon offshore platform reliability during its designed lifetime, say 25 years.

(10 marks)

(b) A wave in water 100 m deep has a period T of 10 seconds (s) and a wave height H_W of 2 m. Determine the wave celerity (velocity) C_W, wavelength L_W, and wave steepness S_W. Also calculate the water particle speed U_W
Given: [See formulas given in the last page].

(10 marks)

Question 2

(a) Write a short paragraph about the fundamental concept of static and dynamic analysis of offshore structures.

(10 marks)

(b) (b)A pinned-pinned steel column with Young's modulus of elasticity E = 210 GPa and yiels stress σ_y = 210 MPa has a length L = 5 m and a b x h solid rectangular cross-section with b=0.12 m, and h = 0.08 m. Will the column fail first by yield or elastic buckling?
Given: [See formulas given in the last page].

(10 marks)

Question 3

(a) Outline some typical features of tension leg platform for offshore production platform. Please use sketches or diagrams where necessary.

(10 marks)

(b) An offshore platform has 18,000 ft2 of submerged area, and the pile surface area from mudline to 150 ft below the seafloor is 17,000 ft2. The platform is to be installed in Malaysian waters in the South China Sea for 25 years and DG (Dow Galvalum) alloy anodes (270 lbs net weight) are to be used. Assume Cr = 8 lb/amp-r. Determine the required anodes.

Given: [See formulas given in the last page].

(10 marks)

Question 4

(a) An integrated production and processing topside module is being fabricated in Lumut, Perak and due to be installed on a truss SPAR sub-structure. The production field is located about 150 m offshore Sarawak in a 1000 m water depth region. Evaluate the methods to ensure the quality of welding work for the joints. Describe examples of how the quality assurance is achieved by taking into account the efficiency and risk considerations for the fabrication, assembly and erection work in construction. Please use diagrams or sketches where necessary.

(10 marks)

(b) (b)A working barge of 2,000 t displacement approaches an offshore platform's bumpers at 1.5ft/s. The stiffness of the bumpers (fenders) is 13 t/in. Determine the reaction and deflection.

Given: [See formulas given in the last page].

(10 marks)

Question 5

(a) Describe the following topics on structural integrity of offshore structures:

i. Hazard identification during the fabrication of the structure stage;

ii. The use of cathodic protection as corrosion control method.

(10marks)

(b) Construction of a semi-submersible with the volume displacement of 30,000 m3 is being completed at a fabrication yard in Lumut, Perak. The structure will be installed in a 700 m water depth area of offshore Sabah for a new oilfield. Explain the following with the use of diagrams or sketches where necessary:

i. Explain the pre-service analysis, engineering procedures and considerations of load-out option methods for the structure;

ii. Evaluate options for the installation method of the topsides.

(10 marks)

Question 6

(a) A spar is a deep-draft floating caisson, which is a hollow cylindrical structure similar to a very large buoy. Relate the connection of spar stability with current flow and strake.

(10 marks)

(b) Describe submarine pipelines and the physical factors to be taken into consideration prior to building the pipelines, e.g. waves and current.

(10 marks)

GIVEN FORMULAS

1.Since this is deep water (d = 100 m) wave, $L_W = gT^2/(2\pi)$ where g = 9.81 m/s^2,

Wave celerity $C_W = L_W/T$,

Wave steepness $S_W = H_W/L_W$,

Water particle speed $U_W = \pi H_W/L_W$.

2. Critical Euler buckling load $P_{cr} = \pi^2 EI/L^2$,

L_{eff} = length (effective) for the pinned-pinned case.

Minimum moment of inertia $I = bh^3/12$.

3. Life of an anode in years $Y_r = W/(C_r \times I)$,

where C_r = Consumption rate, lb/amp-yr,

W = Weight of anode, lb,

$I = 0.0050A_S + 0.002A_P$ = current output, amps,

A_S = Submerged area, ft^2,

A_P = Pile surface area, ft^2.

4. Kinetic energy of the vessel at impact, $KE = CWV^2/g$,

where W = Displacement tonnage in tonnes (t),

V = Approaching velocity in m/s,

C = Impact coefficient = 1.40 (in practical design),

g = 32 ft/s^2,

Also $KE = \frac{1}{2} R^2/k$,

where R = Reaction in tonnes,

k = Stiffness of the fenders (bumpers),

And $y = R/k$,

where y = Deflection created by the impact.

END OF QUESTIONS