SET A

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

JANUARY 2016 SESSION

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

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, INLUDING THIS PAGE.

SECTION A

INSTRUCTION: Answer two (2) questions only.

Please use the answer booklet provided.

Question 1

(a) Describe the following terms used in offshore and subsea structures:

(i) Unmanned production platform;

(ii) Subsea manifold.

(10 marks)

(b) A hollow circular steel column (E = 207 GN/m^2) is simply supported over a length of 6 m. The inner and outer diameters of the cross section are 75 mm and 100 mm, respectively. Determine:

(i) The slenderness ratio;

(ii) The critical buckling load;

(iii) The axial stress σ_{cr} at the critical buckling load.

Given: L/r = slenderness ratio,

$I = \pi(d_o^4 - d_i^4)/64$,

$A = \pi(d_o^2 - d_i^2)/4$, and

$r = \sqrt{(I/A)}$ where d_o is outside diameter and d_i internal diameter, r radius of gyration, I moment of inertia, A cross-sectional area of the column.

$P_{cr} = \frac{\pi^2 EI}{L^2}$ where P_{cr} is critical buckling load

(10 marks)

Question 2

(a) A pipeline system in oil and gas industry can be defined as a system of pipes and other components used for the transportation of hydrocarbon fluids, between (but excluding) plants. Describe three (3) major types of pipeline system.

(10 marks)

(b) Describe three (3) types of offshore piling system. Please use diagram or sketches where necessary.

(10 marks)

SECTION B

Answer three (3) questions only.

Question 3

(a) Explain buckling aspects of offshore structures with respect to geometric imperfections of tubular structure.

(10 marks)

(b) Vortex induced vibration (VIV) is a major design concern for all deep water riser systems operating in regions where severe current can be expected. Evaluate the formulation of VIV and how this phenomenon can pose severe risk in riser integrity.

(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) In a water depth of 100 m, calculate the minimum length of an anchor rope of diameter d 50 mm, weighing 100 N/m, required to withstand a horizontal force of 400 kN.

Given: $l/h = \sqrt{((2F_H/ph) + 1)}$;

where l = Minimum length of anchor line, m

h = Water depth, m

p = Weight of submerged line per unit length, N

F_H = Horizontal force at the line at the fairlead, kN.

It is necessary to add a safety length of 200 m, hence determine the minimum length of a 44 mm diameter chain weighing 420 N/m.

(10 marks)

Question 5

(a) Write a short paragraph on the following topics related to offshore structures:
(i) Vortex shedding;
(ii) Shape coefficient;
(iii)Storm surge.
You may use sketches or diagrams to illustrate your answers, where applicable.

(10marks)

(b) A construction of an offshore steel jacket structure weighing about 10,000 tonnes is being completed at a Fabrication Yard in Lumut, Perak. The structure will be installed in a 150 m water depth area of 200 km distance from Miri, Sarawak for a large gas field. Describe each of the (i) and (ii) below, including the required processes, equipment, safety and structural engineering considerations. Please use diagrams or sketches where necessary.
(i) Loadout of jacket structure;
(ii) Installation of topsides.

(10 marks)

Question 6

(a) Propose and evaluate three (3) possible methods for structural monitoring and assessment system that can be carried out for an offshore jacket structure under operation.

(10 marks)

(b) A spar is a deep-draft floating caisson, which is a hollow cylindrical structure similar to a very large buoy. Relate the connection between classic spar design and vortex induced motion (VIM).

(10 marks)

END OF QUESTION