



UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
JANUARY 2017 SEMESTER

COURSE CODE	: LNB40702
COURSE NAME	: OFFSHORE AND SUBSEA STRUCTURES
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	: BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN NAVAL ARCHITECTURE & SHIPBUILDING
DATE	: 08/07/2017 SAT
TIME	: 9.00 AM - 11.00 AM
DURATION	: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.
 2. This question paper has information printed on both sides.
 3. This question paper consists of **TWO (2)** sections; Section A and Section B. Answer **ALL** questions in Section A and **THREE (3)** questions from Section B.
 4. Please write your answers on the answer booklet provided.
 5. Write your answers only in **BLACK** or **BLUE** ink.
 6. Answer all questions in English.
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THERE ARE 6 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions
 Please use the answer booklet provided.

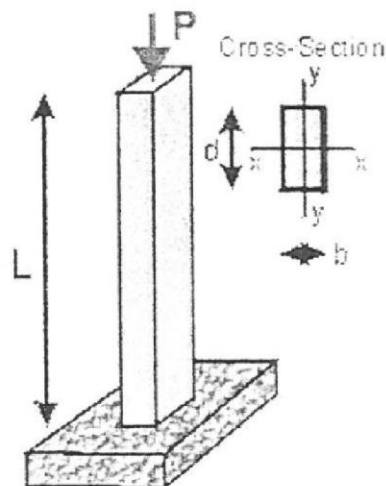
Question 1

- (a) Specify which load types that need to be considered in connection with design of offshore structures. Describe briefly three (3) types of the loads belonging to the various structures. (10 marks)
- (b) An aluminum ($E = 70 \text{ GPa}$) column built into the ground has length, $L = 2.2 \text{ m}$, and is under axial compressive load P . The dimensions of the cross-section are $b = 210 \text{ mm}$ and $d = 280 \text{ mm}$. Determine:
- i) The critical load to buckle the column.
 - ii) If the allowable compressive stress in the Aluminum is 240 MPa , is the column more likely to buckle or yield?
 - (iii) If the factor of safety is $F.S.=1.95$, what is the allowable buckling load.

Given:

The Moment of Inertia for a rectangle is: $I = (\text{base})(\text{height})^3/12$.

$$\text{Euler buckling formula: } P_{cr} = \frac{p^2 EI}{L_e^2}$$



(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 major types of pipeline system. (10 marks)
- (b) Describe three types of offshore piling system. Please use diagram or sketches where necessary. (10 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only THREE (3) questions.

Please use the answer booklet provided.

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

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 150m 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 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 EXAMINATION PAPER