Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Design and Construction of Offshore Structures **Semester: I**
Programme:M.Tech. (Structural Engineering) **Course Code:CIVL7007**
Time: 03 hrs. **Max. Marks: 100**
Instructions:Attempt all Questions. Assume suitably any data not given and state clearly.

SECTION A

S. No.		Marks	CO
Q 1	**Explain for an offshore platform to be dynamically insensitive, why is it necessary to maintain the its natural time period less than 4 seconds.**	**[4]**	**CO1**
Q 2	**Sketch the variation of drag force, inertia force and total force as predicted by Morison equation for a wave hitting an offshore platform and show the approximate phase angle where total force is maximum.**	**[4]**	**CO2**
Q 3	**Explain how the residual stresses induced in the legs of jacket of an offshore platform can affect its design.**	**[4]**	**CO3**
Q 4	**What is difference between global and local buckling of various members of jacket of an offshore platform. Explain the parameters that are used in design to control these phenomena.**	**[4]**	**CO4**
Q 5	**For design of offshore platforms , the effective length factor 'k' is taken as 1 for jacket leg main members and 0.8 – 0.9 for braces and cross members. Explain why it is so.**	**[4]**	**CO5**

SECTION B

Q 6	**A fixed offshore platform made up of a steel jacket is installed in sea for oil exploration, with the projection of jacket above MSL being 20m. Assuming that the jacket having a mass of 25000t is installed at a depth of 90m from MSL, the top width of jacket as 40x50m and slope of jacket legs as 1:10, calculate the natural time period of jacket.** **What will be the increase in time period of jacket when a deck weighing 30000 t is mounted on the jacket and check if the platform is still dynamically insensitive.**	**[10]**	**CO1**
Q 7	**A fixed offshore platform consisting of a steel jacket is installed in sea , with the projection of jacket above MSL being 20m.The Basic Wind velocity in**	**[10]**	**CO2**

	nearest sea coast can be taken as 60m (at 10m for 3 sec gust) above MSL. **Assume:** **a. The top width of jacket as 40x40m and slope of jacket legs as 1:10,** **b. The jacket to be made up of panels of 10m width having solidity ratio as 0.2,** **Calculate the wind force acting on the jacket panel joints.** **or** **Assuming the size of deck as 50x50x10m, calculate the wind force acting on the deck.**		
Q 8	**The leg of jacket of an offshore platform having 1.2 m nominal diameter is being fabricated in factory. Due to construction imperfections little variation in diameter is observed. The diameter of leg measured through various diagonals shows the least and maximum readings as 1190mm and 1210mm.** **Calculate the out of roundedness percentage and check if it is acceptable as per** **a. API code** **b. DNV code**	**[10]**	**CO3**
Q 9	**K joint in tubular members can be balanced or unbalanced. Illustrate through a figure the condition when this can happen. What is its effect on design of tubular members.**	**[10]**	**CO4**
SECTION-C			
Q 10	**A fixed offshore platform installed in Arabian sea is 100m deep below MSL. One of the leg of platform is hit by a sea wave that can be broken up into simple Airy linear waves. Assuming that a linear wave of height 2m and time period of 12 sec and 6m wave length hits the jacket leg at MSL. Calculate the velocity and acceleration of wave at 1.5 sec from start of wave at MSL and 10m below MSL.** **Or** **A fixed offshore platform installed in Arabian sea is 100m deep below MSL. One of the leg of platform of 1m diameter is hit by a simple Airy linear wave that has a velocity of 4m/s and acceleration of 4.4m/s. at MSL. Calculate the force that the wave can exert on the leg of platform at MSL.** **Assume following data:** **a. Drag and inertia coefficients = 0.6 and 2.0 respectively.**	**[20]**	**CO2**

	b. Thickness of marine growth = 150mm **c. Tidal driven currant at MSL = 1.5 m/s** **d. Wind driven currant at MSL = 2.0 m/s** **e. Density of sea water = 14.3 kN/m^3** **f. Wave kinematic factor = 0.9** **g. Currant Blockade factor = 0.85** **h. Conductor Shielding Factor = 0.9**		
Q 11	**A brace of size 500x12mm is connected to a chord of 800x20mm at an angle of 30^0. The loading on the brace is as follows:** **Axial load tensile = 1400KN** **In plane moment = 300 KNm** **Out plane moment = 200 KNm** **Check if the joint made in the existing chord is safe. If not design the joint.**	**[20]**	**CO5**

Following data may be used:

Qu the joint geometry factor is given as:

<u>For Calculation of allowable axial load (P_a) in chord</u>

<u>For T and Y joints</u>

Brace in axial tension

$Q_u = 30\ \beta$ (6 < Qu < 30)

Brace in axial compression

$Q_u = 2.8 + (20 + 0.8\ \gamma)\ \beta^{1.6}$ (0 < Qu < 36)

But not exceeding

$2.8 + 36\ \beta^{1.6}$

<u>For balanced K joints</u>

$Q_u = (16 + 1.2\ \gamma)\ \beta^{1.2} Q_g$

But not exceeding $40\ \beta^{1.2} Q_g$

Where Q_g is gap factor given as:

$Q_g = 1 + 0.2 (1 - 2.8 (g/D))^3$ for g/D not less than 0.05

But not less than 0.05

<u>For Calculation of allowable in plane moment in chord (M_{ai})</u>

$Q_u = (5 + 0.7 \gamma) \beta^{1.2}$

<u>For Calculation of allowable out plane moment in chord (M_{ao})</u>

$Q_u = 2.5 + (4.5 + 0.2 \gamma) \beta^{2.6}$

CONFIDENTIAL **Paper - II**

Name of Examination (Please tick, symbol is given)	:	**MID**		**END**	⌶	**SUPPLE**	
Name of the School (Please tick, symbol is given)	:	**SOE**	⌶	**SOCS**		**SOP**	
Programme	:	**M.Tech. (Structural Engineering)**					
Semester	:	**I**					
Name of the Course	:	**Design and Construction of Offshore Structures**					
Course Code	:	**CIVL7007**					
Name of Question Paper Setter	:	**Dr Vijay Raj**					
Employee Code	:	**40001380**					
Mobile & Extension	:	**7500212221, 1106**					
Graph paper							

FOR SRE DEPARTMENT		
Date of Examination	:	
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Note: - Pl. start your question paper from next page

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SECTION A

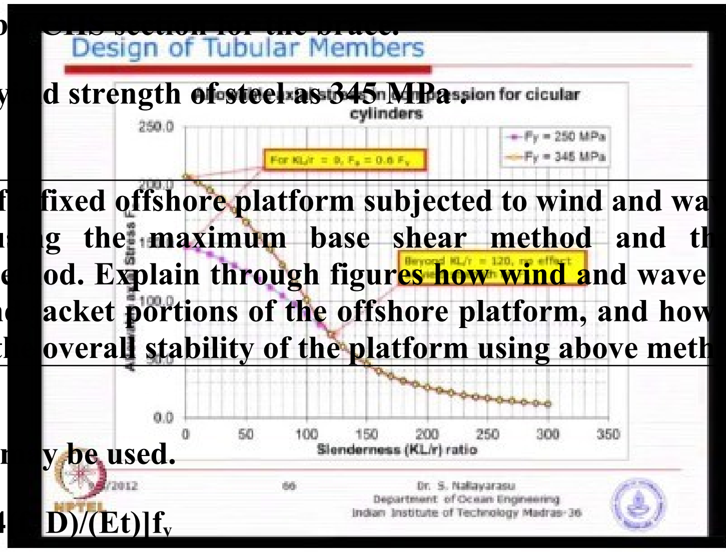
S. No.		Marks	CO
Q 1	**Explain through sketch, the difference between a well head platform and a process platform and explain why these are made combined in modern offshore platforms.**	**[4]**	**CO1**
Q 2	**Explain why a compliant offshore platform has a higher time period of vibration as compared to a fixed offshore platform, and what is its disadvantage.**	**[4]**	**CO2**
Q 3	**During the construction of legs of jacket of offshore platform, induced residual stresses can cause an ill effect on platform design. Explain how these can be either eliminated or at least minimized.**	**[4]**	**CO3**
Q 4	**Explain the parameter that is used in design of members of offshore platforms to control their stiffening, and how can stiffening be done when considered necessary.**	**[4]**	**CO4**
Q 5	**Most of the codes, do not permit D/t ratio beyond 60 for offshore structures. What problems can come in design of offshore structures, if D/t ratio exceeds 60.**	**[4]**	**CO5**

SECTION B

Q 6	**A fixed offshore platform consisting of a steel jacket is installed in sea at a depth of 80m from MSL, with the projection of jacket above MSL being 20m. Assuming the top width of jacket as 40x40m and slope of jacket legs as 1:10, calculate the natural time period of jacket assuming the preliminary mass of jacket as 20000 t.** **Check if a deck weighing 25000 t can be safely mounted on the jacket for carrying out the drilling operations without resonance due to sea waves.**	**[10]**	**CO1**
Q 7	**The jacket of an offshore platform projects 20m above MSL .The wind velocity has been recorded on the nearest sea coast as 55m/s at a height of 10m above MSL for 3 second gust. The jacket further carries a deck of size 50x50m and height 20m above it.** **Calculate the wind force for deck of offshore platform.** **or** **Plot the wind velocity variation for the projecting portion of the jacket above**	**[10]**	**CO2**

	MSL. Assume one hour averaging period.		
Q 8	**The leg of jacket of an offshore platform 10m long, having 1.1m nominal diameter and 25 mm thickness is being fabricated in factory. Due to construction imperfections variation in thickness is observed. The thickness of leg measured through various points shows the least and maximum readings as 22mm and 29mm.** **Calculate the eccentricity produced .** **Further a deviation of 6mm is noticed out of straightness. Calculate the total eccentricity produced and check if it is acceptable as per :** **a. API code (L/960)** **b. DNV code. (L/666)**	**[10]**	**CO3**
Q 9	**The joints in legs of offshore structures often need to be strengthened to carry the loads safely. Explain through figure how it can be done and how is the design modified to make it safe.**	**[10]**	**CO5**
	SECTION-C		
Q 10	**The leg of an offshore jacket structure is made up of panels 10m long. As a result of external loading of the member the following loads have been calculated as acting on one of the leg of the jacket panel:** **Axial load = 1000 kN** **Inplane moment = 800 kNm** **Outplane moment = 600 kNm.** **Design the leg member of the panel, such that it can carry the above loads safely.** **Or** **An offshore jacket structure has a brace member 11m long. The brace has been found to be subjected to following loads and moments as a result of wind and wave loads acting on the structure.** **Axial load = 900 kN** **Inplane moment = 400 kNm**	**[20]**	**CO4**

	Outplane moment = 300 kNm. **Design a suitab[illegible]** **Assuming the y[illegible]d strength [illegible]of steel as 345 MPa.**		
Q 11	**The stability of [illegible] fixed offshore platform subjected to wind and wa[illegible]e forces can be checked u[illegible]g the maximum base shear method and th[illegible] maximum overturning me[illegible]od. Explain through figures how wind and wave [illegible]ads can act on the deck an[illegible] [illegible]acket portions of the offshore platform, and how [illegible]hese can be used to check th[illegible] overall stability of the platform using above meth[illegible]ds.**	**[20]**	**CO2**



Following data m[illegible]y be used.

F_b = [0.84 – 1.74[illegible]D)/(Et)]f_y