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# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

## II SEMESTER M.TECH (STRUCTURAL ENGINEERING)
## END SEMESTER EXAMINATIONS, MAY/JUNE 2016

SUBJECT: OFFSHORE STRUCTURAL ENGINEERING [CIE 582]

**REVISED CREDIT SYSTEM**

Time: 3 Hours 10/05/2016 MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

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| **1A.** | Discuss briefly on any 3 types of offshore structure with a neat sketch | **06** |
| **1B.** | For water depth of 60m, wave of height 3.0 m, and period 10sec. Determine the horizontal velocity and acceleration of water under wave crest at y = 45 m. Adopt Airy wave theory. | **04** |
| **2.** | Determine the maximum wave force and its location for a vertical pile in 35 m depth of water and wave height of 6m and wave length of 105 m. The pile has a diameter of 1.2 m and thickness 12mm. Adopt $C_D$=1.0 and $C_I$=2.0. Calculated the maximum stress induced in the pile due to bending moment and due to shear force independently. | **10** |
| **3.** | A steel member of an offshore structure, having yield stress of 250 MPa, wall thickness of 10 mm and radius 400 mm is subjected to net external pressure of 2MPa. Examine the hoop stress and design appropriate ring stiffeners if necessary spaced at 2.0m c/c to prevent buckling. Also calculate and plot the variation of the maximum longitudinal and radial/hoop stress at the restrained ends if the Possion's ratio is 0.3. | **10** |
| **4.** | A sand soil deposit has submerged weight of 7.0 kN/m$^3$. Determine the length of embedment of a steel pile 1.0m diameter, wall thickness 25mm to support an applied compressive load 5,000 kN. Assume a factor of safety of 2.0. Assume submerged weight of steel = 68.0 kN/m$^3$. Consider angle of friction = 30$^0$, K =0.7, Nq = 40, $f_{max}$ = 0.096MPa, $q_{max}$ = 9.5MPa. Also calculate the length of embedment required if the applied load is tensile of same magnitude as above and give your comments. | **10** |
| **5.** | An offshore gravity structure consists of four concrete columns supporting a deck and equipment weighing 90,000kN. The inside and outside diameter of the each column is 8m and 6m, respectively. Assuming the columns un-flooded; determine the dynamic amplification factor for waves of 12-sec wave period. Calculations show that a total force of 2000kN acting at the deck level on the entire three-dimensional structure will cause a deck deflection of 20 mm. Take damping factor as 3%, S.W.L = 60m and deck level = 70m from the foundation level. Assume the deck acts as rigid diaphragm. Also discuss the static method of analysis on dynamic effects of wave forces. | **10** |
| **6A.** | Write short notes on current loading, wind loading and wave loading on offshore structure with a neat sketch. | **06** |
| **6B.** | Explain bending stress amplification and fatigue in offshore structure. | **04** |