Indian Maritime University

(A Cen4tral University, Govt of India)

End Semester Examinations – December 2024

Programme Name: B Tech (ME)

Semester: Fifth

Subject Code: UG11T4507

Subject Name: MARINE DESIGN: PRESSURE VESSELS, MACHINERY COMPONENTS AND VIBRATIONS

Date: 20.12.2024	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. The design of the pressure vessel is based on.

(a) longitudinal stress
(b) hoop stress
(c) longitudinal and hoop stress
(d) none of these

2. Ergonomic deals with --------

(a) design of controls
(b) design of displays
(c) energy expenditure in hand and foot operations
(d) all the three

3. --------- of the following materials has maximum strength.

(a) grey cast iron
(b) plain carbon steel
(c) alloy steel
(d) aluminium alloy

4. In clearance fit, ----------

(a) tolerance zones of hole and shaft overlap
(b) tolerance zone of hole is completely below that of shaft

(c) tolerance zone of hole is entirely above that of shaft
(d) none of the above

5. The shafts will have same strength on the basis of torsional rigidity, if -----

(a) diameter and length of both shafts is same
(b) material of both shafts is same
(c) angle of twist for both shafts is same
(d) all of above conditions are satisfied

6. The coefficient of friction in belt drive depends upon --------

(a)material of belt
(b) material of pulley
(c) materials of belt and pulley
(d) belt velocity

7. The number of teeth on driving sprocket should be more than 17 in order to ----------

(a) reduce wear
(b) reduce interference
(c) reduce undercutting
(d) reduce variation in chain speed

8. A rolling contact bearing number XX10 indicates that the bearing is having----- -----

(a) bore diameter of 10 mm
(b) bore diameter of 50 mm
(c) bore diameter of 100 mm
(d) outer diameter of 100 mm

9. The thickness of thin cylinder is determined on the basis of ---------

(a) radial stress
(b) longitudinal stress
(c) circumferential stress
(d) principal shear stress

10. In the case of steady state forced vibration at resonance, the amplitude of vibration is----------

(a) inversely proportional to damping coefficient
(b) inversely proportional to damping ratio
(c) inversely proportional to the resonant frequency
(d) directly proportional to the resonant frequency

Section B

Five Questions of 02 Marks each

11. What is stress concentration? List two causes of stress concentration.

12. What is design feasibility? State any two factors influencing design feasibility.

13. Explain in brief, unilateral and bilateral tolerances, with neat diagrams?

14. What are the different types of shafts and state their importance.

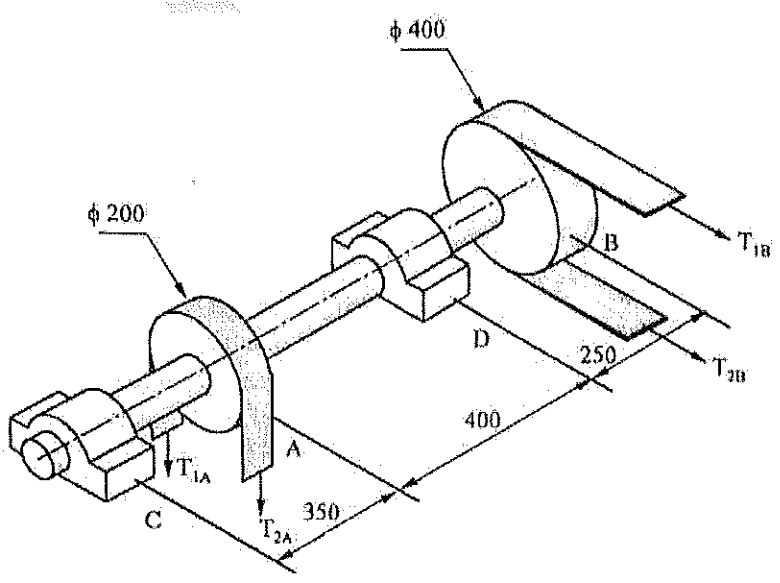
15. Briefly explain about HAZOP, HAZAN and HAZID.

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

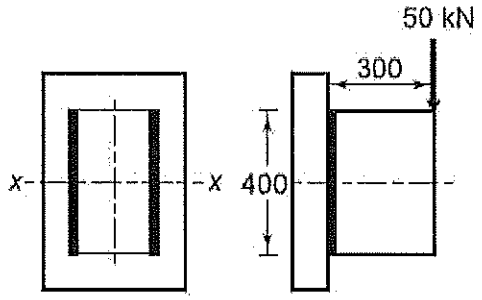
16. A flat rectangular key of size 10 x 8 mm is used on a shaft of 35 mm diameter. If the key has a yield strength of 300 N/mm^2, calculate the maximum power the key can transmit at 1440 rpm. Assume key length as 55 mm and the factor of safety as 3.

17. A shaft carrying two pulleys ia as shown in the figure below. Pulley A recieves the power, which is then transmitted to pulley B. The ratio of tensions in the belts is 2:1 and the maximum tension in each belt is limited to 3 kN. The shaft has an ultimate tensile strength of 550 MPa and a yield strength of 350 MPa. The pulleys are keyed to the shaft. Evaluate the shaft diameter, if K_B =1.5 and K_T = 1.0. The permissible angle of twist is 3 degrees per meter and G = 80 GPa.

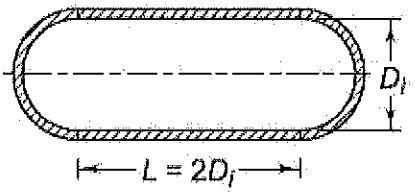


18. A deep groove ball bearing having bore diameter of 60 mm and rotating at 1440 rpm is subjected to a radial force of 2500 N and an axial force of 1200 N. The radial and thrust factors are 0.56 and 2.0 respectively. The load factor is 1.2. If the expected rating life of the bearing is 25000 hours, calculate the required dynamic capacity of the bearing.

19. A bracket is welded to the vertical plate by means of two fillet welds as shown in figure below. Determine the size of the welds, if the permissible shear stress is limited to 70 N/mm^2.

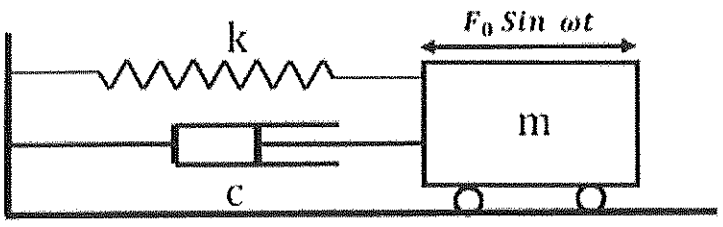


20. An air receiver consisting of a cylinder closed by hemispherical ends is shown in figure below. It has a storage capacity of 0.25 m^3 and an operating internal pressure of 5 MPa. It is made of plain carbon steel 10C4 (S_{ut} = 340 N/mm^2) and the factor of safety is 4. Neglecting the effect of welded joints, determine the dimensions of the receiver.



21. Single degree of freedom – Damped – Forced vibration system as shown in the figure is excited by the harmonic force $9600\,Sin\,200\,t$ Newton and it is found to vibrate with amplitude of 3.2 mm. System mass is 160 kg and spring stiffness is 4 kN/mm. Calculate:

    1) Coefficient of damping of the damper.
    2) Resonance Frequency.
    3) Steady state vibration amplitude if above excitation is at resonance frequency.
    4) Energy lost in the damper per cycle.



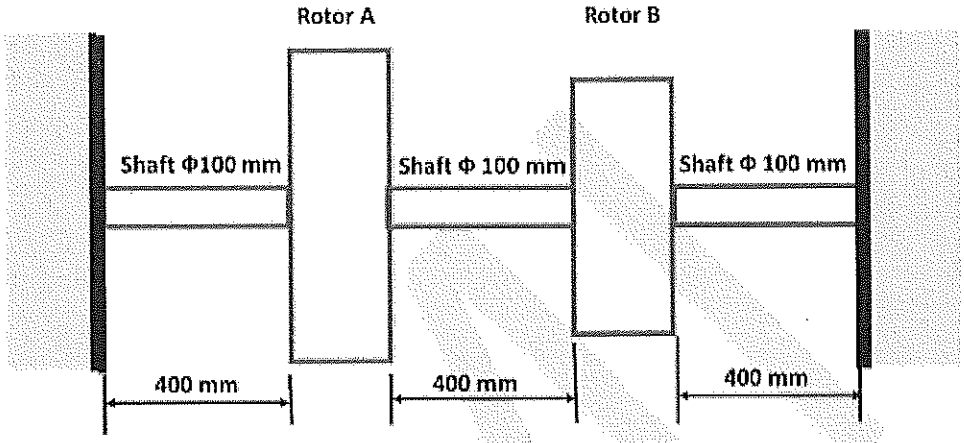
22. Consider system of Rotors and Shafts as shown in the figure and the data provided there of as,

Shaft Diameter = 100 mm, Modulus of rigidity of the shaft material = 84 GPa.
Rotor A: Mass = 160 kg, Diameter = 800 mm
Rotor B: Mass = 120 kg. Diameter = 600 mm

Calculate:

1) The natural frequencies of all modes of torsional vibrations of the system.

2) Ratio of amplitude of Rotor A and Rotor B for all modes of torsional vibrations



*****