Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations– December 2023

Programme Name: B Tech (ME)

Semester: Fifth

Subject Code: UG11T4507

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

Date: 22.12.2023	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.

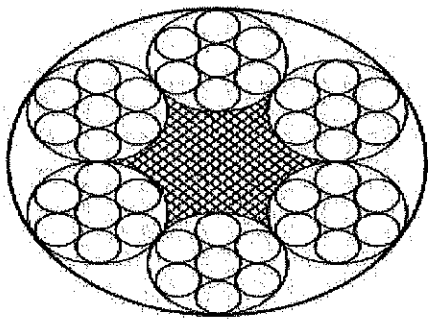
Section A

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

1. The design _____ is defined as the process of creating or selecting configurations, materials, shapes and dimensions for a product.

a. Synthesis
b. Application
c. Ergonomics
d. Aesthetic

2. The specification of wire rope shown below is written as



(a) 6 X 7 (6/1)
(b) 7 X 6 (6/1)
(c) 6 X 19 (6/1)
(d) None of the above

3. The static deflection of the shaft under the flywheel is 25 mm. Assuming g = 10m/s^2, the critical speed in rad/s will be_____
(a) 30
(b) 10
(c) 40
(d) 20

4. What is the pitch of a roller chain?
a. linear distance between the axes of adjacent roller
b linear distance between link
c. linear Distance between strand
d. linear distance between link plate

5. Which one is not mentioned bearing designation?
a. Type of bearing
b. Bearing series
c. Bore size
d. Pitch

6. Which one is not failure of pressure vessel?
a. Crack
b. Explosion
c. BLEVE
d. All of the above

7._____ connecting two parts of a mechanism, in which a projection in one fits into a recess in the other.
a. Rivet Joint
b. Welded Joint
c. Knuckle Joint
d. None of the above

8. Which degree of freedom is having simplified model of lathe machine?
a. Two degree of freedom system
b. Single degree of freedom system
c. Multi degree of freedom system
d. None of the above

9. Which bearing listed below are incapable of supporting radial load?
a. Taper roller bearing
b. Deep groove ball bearing
c. Angular contact bearing
d. Thrust ball bearing

10. Which one is not the methods to reduce stress concentration?
a. Modify geometry structure to avoid sharp corners, notches etc
b. Drilling holes
c. Removal of undesired material
d. Material of a structural component that cause an interruption to the flow of stress

Section B

Five Questions of 02 Marks each

11. Write the key steps in the design procedure of machine element.

12. What is the permissible shear stress as per the ASME code?

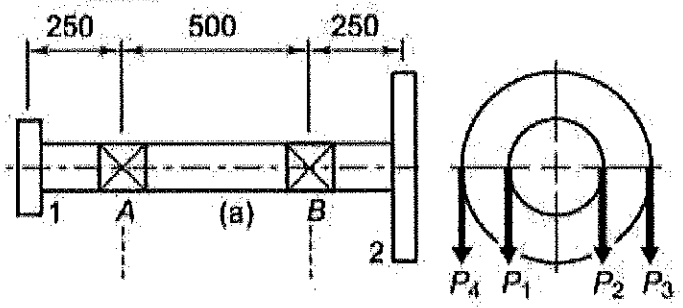
13. Briefly explain design feasibility and reliability

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

15.Draw S-N curve in fatigue testing and define fatigue limit.

Section C

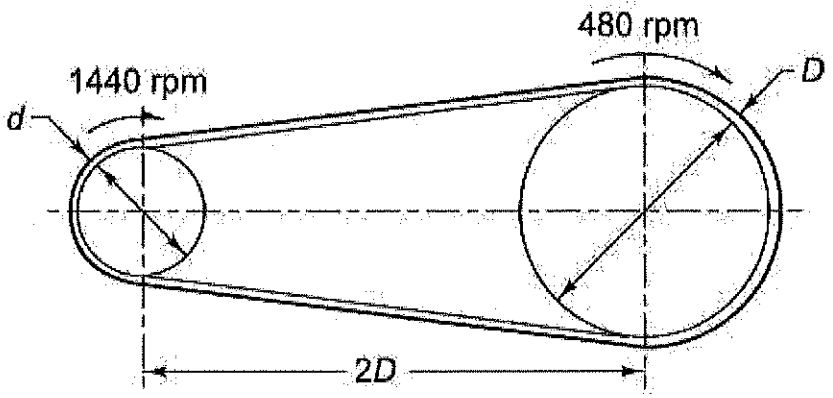
16. The layout of a shaft carrying two pulleys 1 and 2, and supported on two bearings A and B is shown in Figure . The shaft transmits 7.5 kW power at 360 rpm from the pulley 1 to the pulley 2. The diameters of pulleys 1 and 2 are 250 mm and 500 mm respectively. The masses of pulleys 1 and 2 are 10 kg and 30 kg respectively. The belt tensions act vertically downward and the ratio of belt tensions on the tight side to slack side for each pulley is 2.5:1. The shaft is made of plain carbon steel 40C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 3. Estimate suitable diameter of shaft. (10 marks)



Figure

17. The layout of a leather belt drive transmitting 15 kW of power is shown in Figure . The centre distance between the pulleys is twice the diameter of the bigger pulley. The belt should operate at a velocity of 20 m/s approximately and the stresses in the belt should not exceed2.25 N/mm2. The density of leather is 0.95 g/cc and the coefficient of friction is 0.35. The thickness of the belt is 5

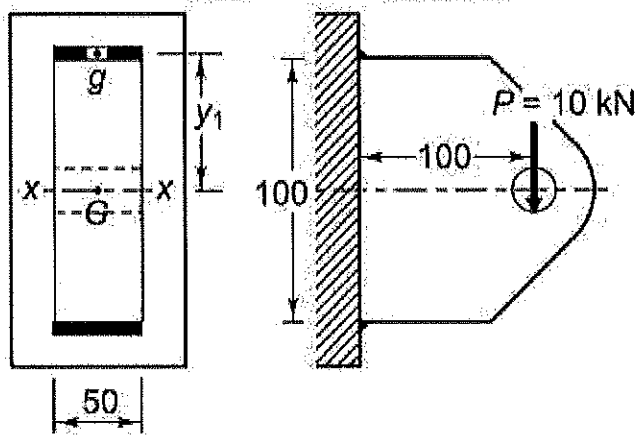
mm. Calculate: (a) the diameter of pulleys; (b) the length and width of the belt; and (c) the belt tensions. (10 marks)



Figure

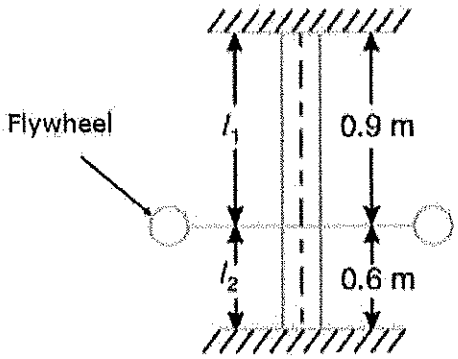
18.(a) A rigid coupling is used to transmit 20 kW power at 720 rpm. There are four bolts and the pitch circle diameter of the bolts is 125 mm. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are finger tight in reamed and ground holes. (7 marks)
(b) Explain Goodman design criteria for fluctuating loads. (3 marks)

19. A bracket is welded to the vertical column by means of two fillet welds as shown in figure. Determine the size of the welds, if the permissible shear stress in the weld is limited to 70 N/mm^2. (10 marks)



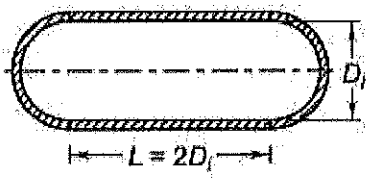
Figure

20. A flywheel is mounted on a vertical shaft as shown in figure. The both ends of the shaft are fixed and its diameter is 50 mm. The flywheel has a mass of 500 kg. Find the natural frequencies of longitudinal and transverse vibrations. Take E = 200 GN/m^2. (10 marks)



Figure

21.An air receiver consisting of a cylinder closed by hemispherical ends isshown in figure . 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/mm2) and the factor of safety is 4. Neglecting the effect of welded joints, determine the dimensions of the receiver. (10 marks)



Figure

22. A propeller shaft is required to transmit 50KW power at 600 rpm. It is a hollow shaft, having an inside diameter 0.8 times of the outside diameter. It is made of steel (Syt= 380 N/mm2) and the factor of safety is 4. Calculate the inside and outside diameters of the shaft. Assume (Ssy = 0.5 Syt)

(10 Marks)