Indian Maritime University

(A Central University, Govt of India)

Supplementary Examinations– March / April 2024

Programme Name: B Tech (ME)

Semester: Fifth

Subject Code: UG11T4507

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

Date: 03.04.2024	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. Factor of Safety (FoS) is related to

(a) Ultimate stress
(b) Ultimate strain
(c) Young's modulus
(d) None of the above

2. When the body vibrates under the influence of external force, then the body is said to be under _____.

(a) free vibrations
(b) natural vibrations
(c) forced vibrations
(d) damped vibrations

3. The static deflection of the shaft under the flywheel is 4 mm. Assuming g = 10m/s^2, What is the critical speed in rad/s?

(a) 50
(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 of the following joins two rotating shafts to each other?
a) Key
b) Coupling
c) Gear
d) Belt drive

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 shaper 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 is not recommended for supporting radial load?
   a. Taper roller bearing
   b. Deep groove ball bearing
   c. Angular contact bearing
   d. Thrust ball bearing

10. Which of the following is true about the roller bearing in comparison with ball bearing?
a) Power lost in friction is more
b) Axial dimensions are less

c) Radial dimensions are more
d) They have point contact

Section B

Five Questions of 02 Marks each

11. Write short note on design procedure of machine element.

12. What is ASME code?

13. Distinguish between feasibility and reliability.

14. Define- Stress concentration.

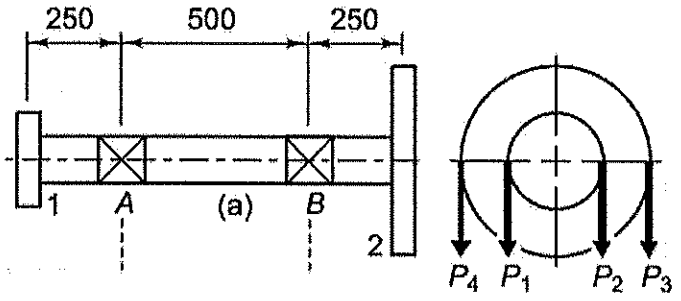
15.Draw stress- strain curve and define yield point.

Section C

16. A propeller shaft is required to transmit 60KW 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 5. Calculate the inside and outside diameters of the shaft. Assume (Ssy = 0.5 Syt)

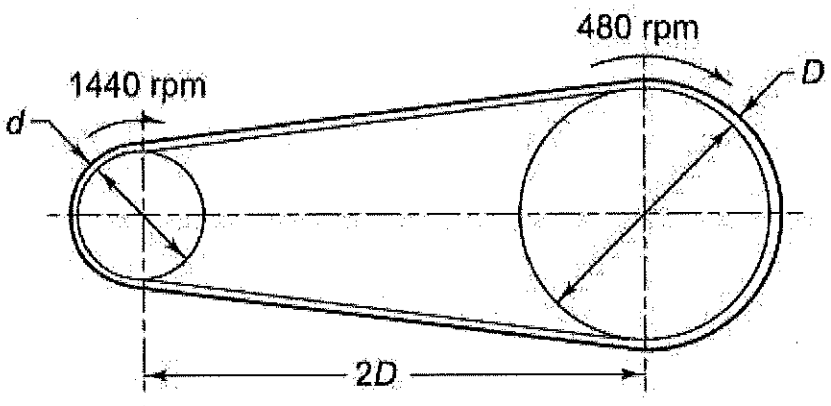
(10 Marks)

17. 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 15 kg and 35 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 4. Estimate suitable diameter of shaft. (10 marks)



Figure

18. 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 25 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 10 mm. Calculate: (a) the diameter of pulleys; (b) the length and width of the belt; and (c) the belt tensions. (10 marks)

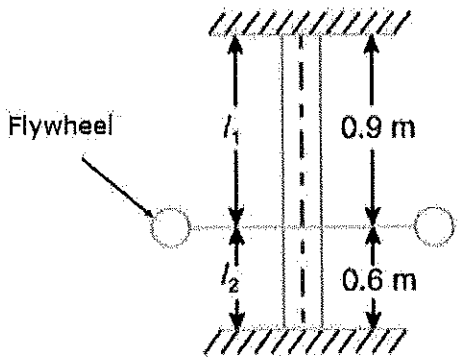


Figure

19. 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. (10 marks)

20. (a) Explain Goodman design criteria for fluctuating loads. (3 marks)
(b) Describe the design procedure of a chain drive in detail with suitable diagrams (7 marks)

21. A flywheel is mounted on a vertical shaft as shown in figure. The both ends of the shaft are fixed and its diameter is 60 mm. The flywheel has a mass of 1000 kg. Find the natural frequencies of longitudinal and transverse vibrations. Take E = 175 GN/m^2. (10 marks)



Figure

22.An air bottle consisting of a cylinder closed by hemispherical ends is shown in figure. It has a storage capacity of 0.25 m^3 and an operating internal pressure of 6 MPa. It is made of plain carbon steel 10C4 (S_{ut} = 340 N/mm2) and the factor of safety is 3. Neglecting the effect of welded joints, determine the dimensions of the receiver. (10 marks)