

**Indian Maritime University**  
**(A Central University, Govt of India)**

**Supplementary Examinations – March/April 2025**

**Programme Name: B Tech (ME)**

**Semester: Fifth**

**Subject Code: UG11T4507**

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

Date: 19.04.2025	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

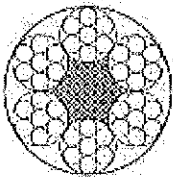
- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.

**Section A**

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

1. A spherical ball bearing is designed with reliability of  
(a) 10% (b) 20% (c) 50% (d) 90%

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  $g = 10 \text{ m/s}^2$ , the critical speed in rad/s will be \_\_\_\_\_  
(a) 30 (b) 10 (c) 40 (d) 20

4. Which among the following stress act along the circumference of the cylinder?  
(a) Longitudinal stress (b) Hoop stress (c) Compressive stress (d) None of the above

5. It is preferable to use an odd number of teeth for the driving sprocket in combination with an even number of chain links in chain drives in order to have  
(a) reduce polygonal effect (b) reduce back sliding (c) uniform wear and tear on the teeth and rollers (d) None of the above

6. The period of oscillation is minimum for the below damped vibratory system  
(a) System with critical damping (b) Under damping vibratory system (c) Over damped vibratory system (d) None of the above

7. 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

8. For the design of brittle material, which is the preferred theory of failure  
(a) Maximum Principal stress theory (b) Maximum shear stress theory (c) Maximum Principal strain theory (d) None of the above

9. For the design of component subjected to fluctuating loads, which is the most conservative design criteria

(a) Goodman line (b) Gerber line (c) Soderberg line (d) None of the above

10. The optimum velocity of the belt with initial tension ( $P_i$ ) and mass per unit length ( $m$ ), for maximum power transmission is given by

(a)  $\sqrt{P_i/m}$  (b)  $\sqrt{P_i/3m}$  (c)  $\sqrt[3]{P_i/m}$  (d) None of the above

### **Section B**

Five Questions of 02 Marks each

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

12. Explain the term fit?

13. Briefly explain design feasibility and reliability

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

15. Define transverse vibration with example?

### **Section C**

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

16. A standard cross section for a flat key, which is fitted on a 50mm diameter shaft is 16X10mm. The key is transmitting 475N-m torque from the shaft to the hub. Key is made of commercial steel ( $S_{yt} = S_{yc} = 230 \text{ N/mm}^2$ ). Determine the length of the key, if the factor of safety is 3. (10Marks)

17. The layout of a leather belt drive transmitting 15 kW of power is shown in Figure 2. 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 exceed  $2.25 \text{ N/mm}^2$ . The density of leather is  $0.95 \text{ g/cc}$  and the coefficient of friction is  $0.35$ . The thickness of the belt is  $5 \text{ mm}$ . Calculate: (a) the diameter of pulleys; (b) the length and width of the belt; and (c) the belt tensions. (10 marks)

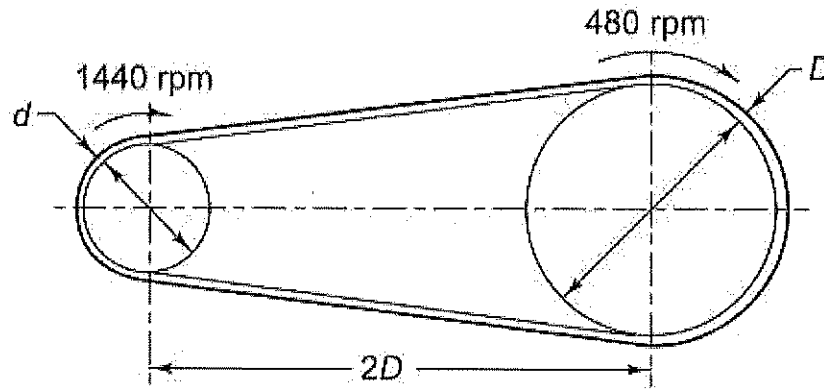


Figure 2

18.(a) A rigid coupling is used to transmit  $20 \text{ kW}$  power at  $720 \text{ rpm}$ . There are four bolts and the pitch circle diameter of the bolts is  $125 \text{ mm}$ . The bolts are made of steel 45C8 ( $S_{yt} = 380 \text{ N/mm}^2$ ) 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  $70 \text{ N/mm}^2$ . (10 marks)

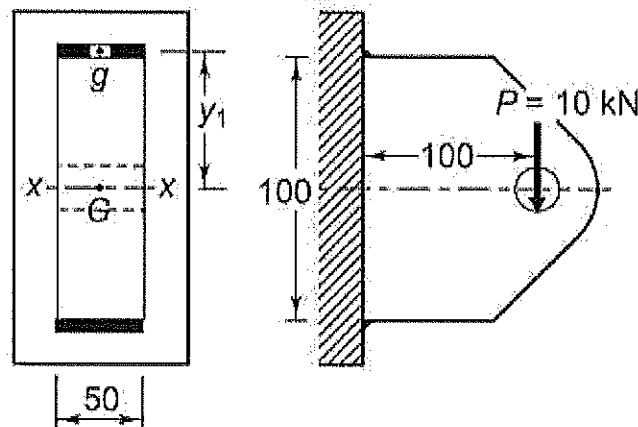


Figure 3

20. A flywheel is mounted on a vertical shaft as shown in figure 4. The both ends of the shaft are fixed and its diameter is  $50 \text{ mm}$ . The flywheel has a mass of  $500 \text{ kg}$ . Find the natural frequencies of longitudinal and transverse vibrations. Take  $E = 200 \text{ GN/m}^2$ . (10 marks)

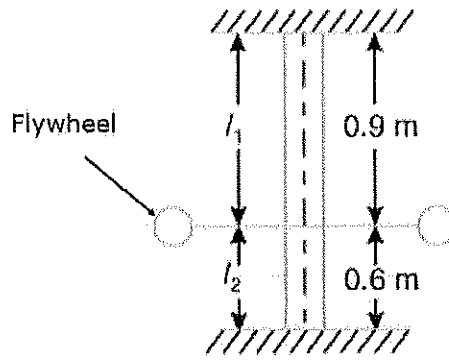


Figure 4

21. Explain design consideration of a pressure vessels subjected to internal pressure? 10Marks

22.(a) For the two degrees of freedom system as shown in figure 6, find the equations of natural frequency of system in terms of  $k$ ,  $m$ ,  $I_0$  and  $r$ .

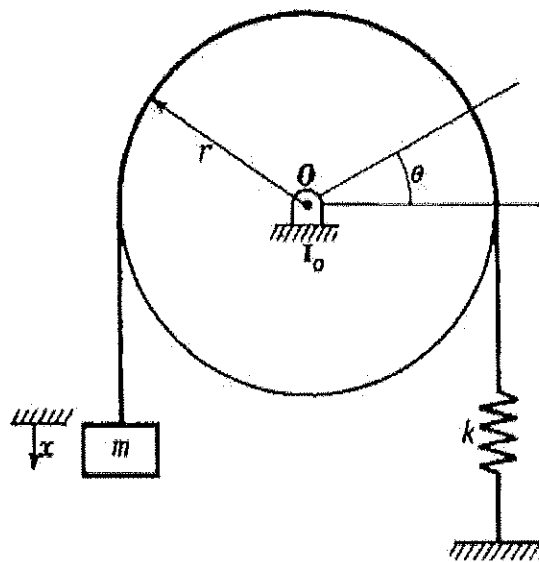


Figure 6

(4 marks)

(b) What are aesthetic and ergonomic considerations in machine design?

(3+3 marks)