Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – December 2025

Programme Name: B Tech (ME)

Semester: V

Subject Code: UG11T4507

Subject Name: Marine Design: Pressure Vessels, Machinery Components & Vibrations

Date: 19.12.2025 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.
(iii) Scientific Calculator & Data Book are permitted.

Section A

MCQs- All questions are compulsory. (10 X 1Mark =10 Marks)

1. Which of the following best defines design synthesis in mechanical engineering?

A) Choosing material for a component

B) Combining principles, analysis, and creativity to develop a new component or system

C) Drafting a final drawing,

D) Calculating stress in a member

2. The series of preferred numbers used in standardization of dimensions is known as:

A) Fibonacci series

B) ISO series

C) Renard series

D) Geometric series

3. The endurance limit of a material is the:

A) Maximum stress before plastic deformation

B) Maximum stress that a material can withstand for infinite cycles without failure

C) Maximum stress before rupture

D) Maximum stress under static

4. The design of a solid shaft under fluctuating torsional and bending loads is usually based on:

A) Maximum principal stress theory

B) Modified Goodman relation

C) Coulomb-Mohr theory

D) Tresca criterion

5. The most common type of key used to transmit torque in shafts is:

A) Feather key

B) Woodruff key

C) Parallel rectangular key

D) Gib head key

6. A flange coupling is primarily used to:

A) Connect two misaligned shafts

B) Connect two shafts for power transmission without misalignment

C) Reduce speed

D) Increase torque

7. For a thin cylindrical pressure vessel subjected to internal pressure, the hoop stress is:

A) Half of longitudinal stress

B) Equal to longitudinal stress

C) Twice the longitudinal stress

D) Zero

8. The natural frequency of a torsional vibration system depends on:

A) Mass and damping

B) Stiffness and damping

C) Mass moment of inertia and torsional stiffness

D) Mass and applied torque

9. In product design, ergonomics primarily focuses on:

A) Cost optimization

B) User comfort and safety

C) Material selection

D) Machinability

10. Which of the following processes is most suitable for producing high-strength, complex-shaped components in small batches?

A) Casting

B) Forging

C) Injection molding (plastic)

D) Machining

Section B

Five Questions of 02 Marks each

11. Define fit and tolerance.

12.What is a coupling?

13.What is the function of a key in a shaft?.

14.Give practical examples of thick cylinder

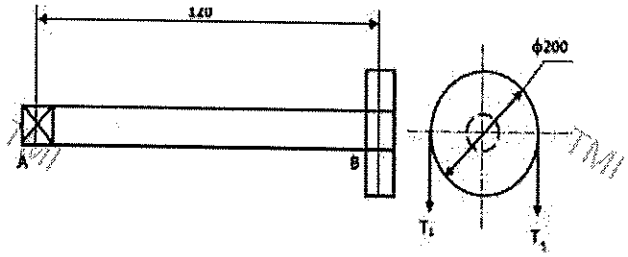
15.What is whirling of shafts?

Section C

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

16. A solid shaft is to transmit power from an electric motor to a machine through a pulley by means of a vertical belt drive with unit speed ratio. The pulley weighs 250 N and is overhanging at a distance of 120 mm from the bearing. Diameter of pulley is 200 mm. Maximum power transmitted at 150 rpm is 3 kW. Coefficient of friction between belt and pulley is 0.25; combined shock and fatigue factor in torsion is 1.5 and in bending is 2.0; permissible shear stress for the shaft material is 40 N/mm2. Design the shaft standard diameter

(10)

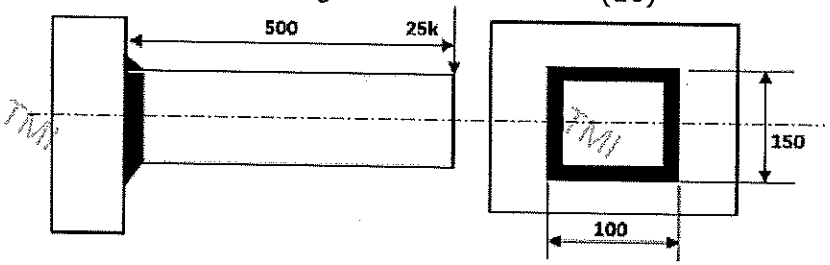


17. Design a flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having allowable shear stress of 40 MPa. Shearing in bolts should not exceed 30 MPa and allowable crushing stress as 50 Mpa. Assume that a same material is used for shaft and key and crushing stress is twice the value of shearing stress. Maximum torque is 25% greater than full load torque. The shear stress for cast iron is 14 MPa. (10)

18.An open belt drive connects two parallel shafts 1.2 m apart. The driving and driven shafts rotate at 350 rpm and 140 rpm respectively and driven pulley is 400 in diameter. The power to be transmitted is 1.1 kW. Design the drive with suitable assumptions. (10)

19. A single row deep groove ball bearing No 6002 is subjected to an axial thrust load of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition. (10)

20. A rectangular cross section bar is welded to a support by means of fillet welds as shown in fig. Determine the size of welds, if the permissible shear stress in the weld is limited to 75 MPa. Force of 25KN at a distance of 500 mm applied. All dimensions shown in fig. are in mm. (10)



21. A seamless cylinder with a storage capacity of $0.025m^3$ is subjected to an internal pressure of 20MPa.The length of the cylinder is twice its inner diameter. The cylinder is made of plain carbon steel with ultimate strength of $390N/mm^2$ and the factor of safety is 2.5. Determine the dimensions of the cylinder. (10)

22. A disc of polar moment of inertia $I = 0.6\ kg{\cdot}m^2$ is rigidly mounted at one end of a shaft whose torsional stiffness is $K = 720\ N{\cdot}m/rad$. The other end of the shaft is fixed. The disc is given an initial angular displacement $\theta_0 = 0.015$ rad and released from rest. Assuming no damping, determine

1. The natural angular frequency ω (rad/s) and natural frequency f(Hz).
2. The complete time response $\theta(t)$.
3. The maximum angular velocity and maximum angular acceleration. (3+3+4)