X. A pair of helical gears are to transmit 15 KW. The teeth are 20° stub in diametrical plane and have a helix angle of 45°. The pinion runs at 10000 rpm and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa, determine a suitable module and face width from static strength considerations and check the gears for wear, given endurance limit is 618 MPa. (20)

***

B.Tech. Degree V Semester Examination in Naval Architecture and Ship Building, April 2005

MACHINE DESIGN

(Old Scheme)

Time: 3 Hours Maximum Marks: 100

(Use of machine design data book is permitted)
(Assume relevant data needed)

I. (a) Briefly explain the principles of design. (8)

(b) A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect 0.85, surface finish factor of 0.9. The material properties of the bar are given by : ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa. (12)

OR

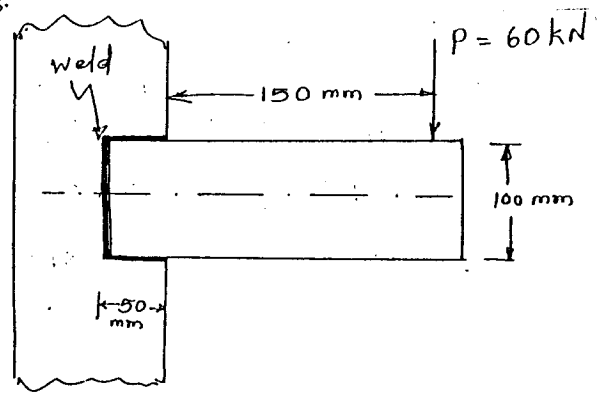
II. (a) Explain how springs are classified. (8)

(b) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm^2. (12)

III. Design the longitudinal and circumferential joints for a boiler for a pressure of 2.4 N/mm^2 and the largest inside diameter of the shell not to exceed 130 cm. Assume the following design stresses : tensile stress = 77 N/mm^2, shear stress = 62 N/mm^2 and compressive stress = 120 N/mm^2. (20)

OR

IV. A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P as shown in fig.



Determine the weld size if shear stress in the weld is not to exceed 140 MPa. (20)

V. A uniform circular mild steel shaft is mounted on two bearings 85 cm apart. The shaft carries a gear A 20 cm at 20 cm to the right of the left hand bearing and a pulley B 25 cm dia at 25 cm to the left of the right hand bearing. The gear is subjected to a horizontal force of 3.5 KN and a tangential vertical upward force of 9.6 KN. The pulley is driven by a horizontal belt with a tension on the tight side to be 6 KN and on the slack side to be 2 KN. Assuming the torsional shear stress to be 4 KN/cm² and shock and fatigue factors 2 and 1.5 respectively, design the diameter of the shaft. Take weight of the pulley to be 1.5 KN. (20)

OR

VI. Design and draw a cast iron flange coupling for a mild steel shaft transmitting 120 HP at 200 rpm. The allowable shear stress in the shaft 4 KN/cm² and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolt is 3 KN/cm². (20)

Contd.....3

VII. Design a journal bearing to support a load of 7.5 KN while the shaft runs at 700 rpm. using a hardened steel journal and bronze backed babbit bearing. The oil used has a viscosity of 25 centipoise at 52°C. Clearance may be assumed as 0.001 cm per cm diameter and ambient temperature 17°C. Check for the heating effect and state whether artificial cooling is necessary. (20)

OR

VIII. Select a single row deep groove ball bearing with the operating cycle listed below which will have a life of 15000 hrs. :

Fraction of cycle	Type of load	Radial (KN)	Thrust (KN)	RPM	Service factor
1/10	Heavy shock	2	1.2	400	3.0
1/10	Light shock	1.5	1.0	500	1.5
1/5	Moderate shock	1.0	1.5	600	2.0
3/5	No shock	1.2	2.0	800	1.0

Assume radial and axial load factors to be 1.0 and 1.5 respectively and inner race rotates. (20)

IX. A spur gear drive transmit 10 KW from a shaft rotating at 1200 rpm to a low speed shaft with a reduction 3:1. Assume that the teeth are 20° full depth involute with 24 teeth on the pinion. The pinion is to be of 40 C 8 normalised steel and gear of 30 C 8 normalised steel. Assume that the stalling torque is 140% of the rated torque, design the drive. (20)

OR

Contd.....4