

(3 Hours)

Marks : 80

- NB : (1) Question No.1 is **compulsory**
(2) Attempt **any three** from question no. 2 to 6
(3) Use of standard design data book like Mahadevan Reddy and PSG is permitted at examination.

1. Attempt any four :

- (a) Prove that the energy stored in Flywheel is given by

$$\Delta E = I \omega^2 C_s$$

Where all notation have their usual meanings.

- (b) Explain helical compression spring terminology in details with sketch.
(c) What are the requirement of good coupling. Enlist practical application of coupling.
(d) Give comparison between Rolling and sliding contact bearing.
(e) Write note on strength of welded joints.
2. (a) Design a knuckle joint to withstand a load of 10,000 N repeated in one direction. 10
The material used has an ultimate tensile strength 48,000 N/m², ultimate compressive strength of 48000 N/cm², and ultimate shear of 36,000 N/cm². Use a safety factor of 6 on ultimate strength.

- (b) A helical compression spring is required to deflect through approximately 25mm 10
when the external force acting on it varies from 500 to 1000 N. The spring index is 8. The spring has square and ground ends. There should be gap of 2mm between adjacent coils when the spring is subjected to the maximum force of 1000 N. The spring is made of cold-drawn steel wire with ultimate tensile strength of 1000 N/mm² and permissible shear in the spring wire should be 50% of the ultimate tensile strength ($G = 81370 \text{ N/mm}^2$). Design the spring and calculate.

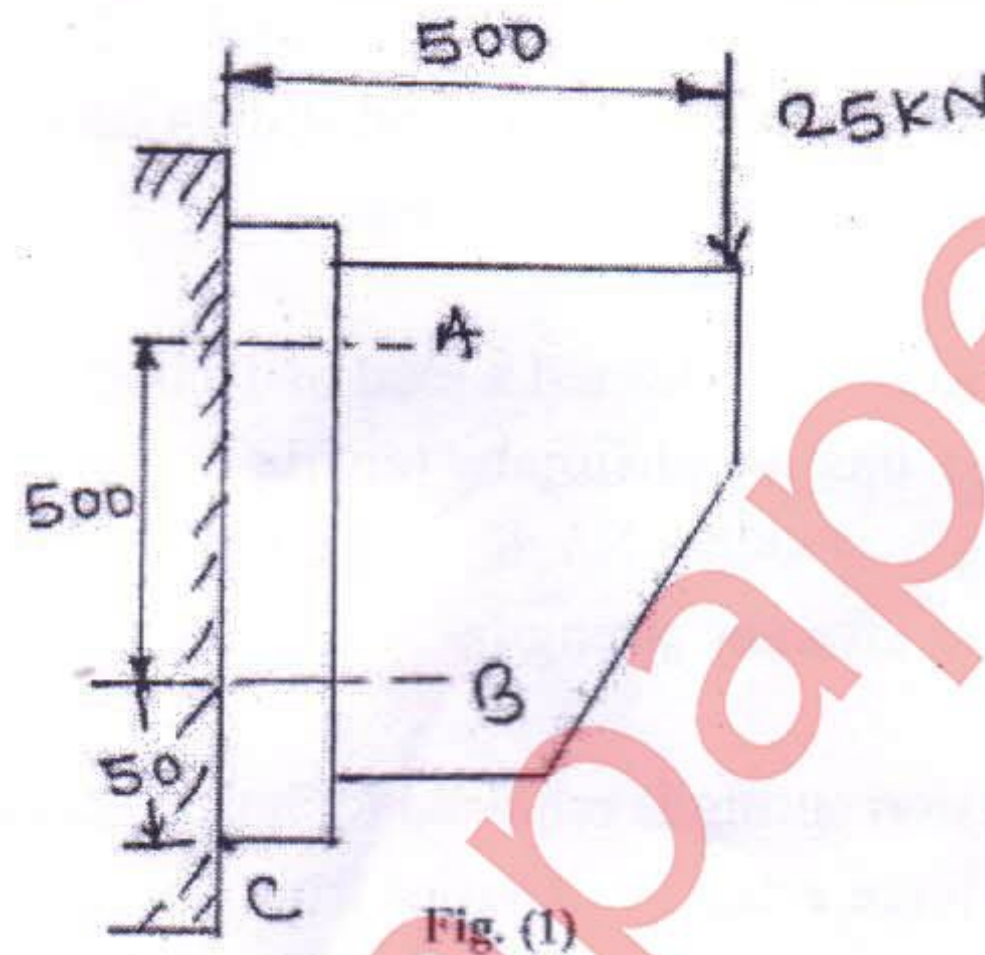
- (i) Wire diameter.
(ii) Mean coil diameter.
(iii) Number of active coils.
(iv) Total number of coils.
(v) Solid length.
(vi) Free length.
(vii) Required spring rate
(viii) Actual spring rate

3. (a) A steel solid shaft transmitting 15 KW at 200 rpm. is supported on two bearing. 10
750mm apart and has two gears keyed to it. The pinion having 30 teeth of 5mm module is located 100mm to the left of right hand bearing and deliver power

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horizontally to the right. The gear having 100 teeth of 5mm module is located 150 mm to the right of left hand bearing and receives power in a vertical direction from below. Use an allowable stress of 54 Mpa in shear. Determine the diameter of shaft.

- (b) A wall bracket is attached to the wall by means of four identical bolts two at A and two at B as shown in Fig.(1). Assuming that the bracket is held against the wall and prevented from tipping about the point C by all four bolts and using an allowable tensile stress in the bolts as 35 N/mm^2 , determine the size of the bolts on the basis of maximum principle stress theory. 10



4. (a) Explain the ASME code for the shaft design. 06

- (b) The following data is given for a 360° hydro-dynamic bearing : 07

Length to diameter ratio	=	1
journal speed	=	1400 rpm
journal diameter	=	100 mm
diametral clearance	=	$100 \mu\text{m}$
external load	=	10 kN

The value of minimum film thickness variable is given 0.3 Find the viscosity of oil that need to be used

- (c) A ball bearing is operating on a work cycle consisting of three parts - a radial load of 3000 N at 1440 rpm for one quarter cycle, radial load of 5000 N at 720 rpm for one half cycle and radial load of 2500 N at 1440 rpm for the remaining cycle. The expected life of the bearing is 10000 h. Calculate the dynamic load carrying capacity of the bearing. 07

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5. (a) The turning moment diagram of a multi-cylinder engine is drawn with a scale of 10 (1 mm = 2°) on the abscissa and (1mm = 1250 N-m) on the ordinate. The intercepted areas between the torque developed by the engine and the mean resisting torque of the machine, taken in order from one end are -30, + 400, -270, +330, -310, + 230, -380, +270 and -240 mm². The engine is running at a mean speed of 240 rpm and the coefficient of speed fluctuations is limited to 0.02. rimmed flywheel made of grey cast iron FG 200 ($\rho = 7100 \text{ kg/m}^3$) is provide. The rim contributes 90% of the required moment of inerria. The rim has rectengular cross- section with width to thickness ratio 1.5 determine the dimmension of the rim. 10
- (b) A cantilever beam made of cold-drawn steel 20C8 ($S_{ut} = 540 \text{ N/mm}^2$) is subjected 10 to a compltely reversed load of 1000 N as shown in fig (2). The notch sensitivity factor q at the fillet can be taken as 0.85 and expected reliability is 90% . Determine the diameter 'd' of the beam for the life of 10000 cycles.

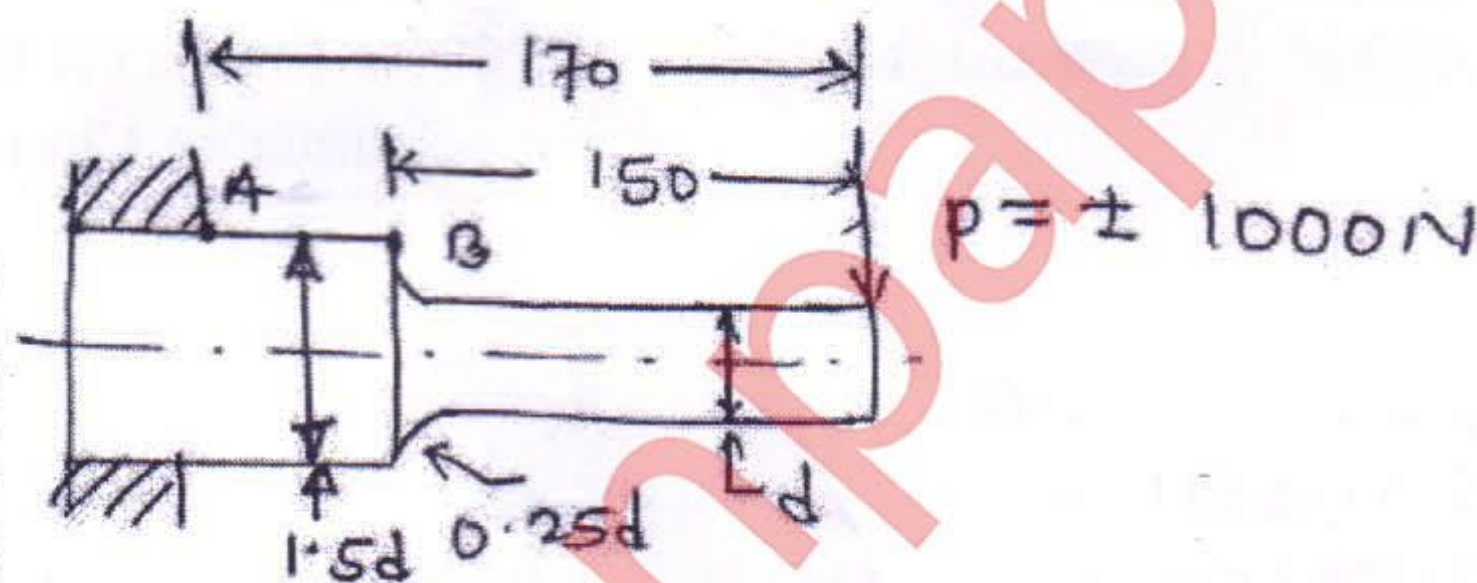


Fig. (2)

6. (a) Distinguish between the failure due to statics and fatigue loading. 06
- (b) Explain desing consideration of welded assemblies. 06
- (c) Designate the following engineering materials : 08
- (i) FG 200
 - (ii) 30 C8
 - (iii) 25 Cr4 Mo2
 - (iv) 16 Ni3 Cr2