Before answering the question paper the candidate should ensure that they have been supplied the correct question paper. Complaints in this regard, if any, shall not be entertained after the examination.

Note: Question No. 1 is Compulsory and attempt two questions from each section. All questions carry equal marks.

1. Attempt any four: [5 x 4 = 20]
   a) Explain in detail the basic procedure of machine design.
   b) Explain in brief limits and Fits.
   c) What is selflocking of a power screw? What is the condition of self locking and overhauling?
   d) What are the functions of key?
   e) 3) What is the difference between clutch and coupling? Name different types of clutches?

SECTION-A

2. A shaft made of mild steel is required to transmit 100KW at 300rpm. The supported length of the shaft is 3 metres. It carries two pulleys each weighing 1500N supported at a distance of 1 metre from the ends respectively. Assuming shear stress 60MPa, determine the diameter of the shaft. [20]

3(a) Explain in detail procedure for designing eccentric loaded bolted joint in shear. [5]
(b) A steel plate subjected to a force of 5KN and fixed to a channel by means of three identical bolts as shown in figure below. the bolts are made from plane carbon steel 45C8 ($S_{ut}=380\text{N/mm}^2$) and factor of safety is 3. Specify the size of bolts. [15]

4. A single threaded power screw, used in a screw jack, has a nominal diameter of 50 mm and pitch of 8 mm. the treads are square and the length of the nut is 48 mm. The screw is used to lift a load of 7.5 KN (Take $\mu$ between screw and nut $=0.14$) and collar friction is negligible. Calculate:
   - Principal shear stress in the screw body.
   - The transverse shear stress in the screw and the nut.
   - The bearing pressure.
   - State weather the screw is self locking or not. [20]

**SECTION-B**

5(a) What are the different types of key? [5]

(b) It is required to design a square key for fixing a gear on a shaft of 25mm diameter. The shaft is transmitting 15KW power at 720rpm to the gear. The key is made of steel 50C4 ($S_{YT}=460\text{N/mm}^2$) and the factor of safety is 3. For key material, the yield strength in compression can be assumed to be equal to the yield strength in tension. Determine the dimensions of the key. [15]

6(a) What is the function of brakes, define the types of brakes? [5]

(b) A plate clutch consists of one pair of contacting surfaces. The inner and outer diameters of the friction disk are 100 and 200mm respectively. The coefficient of friction is 0.2 and permissible intensity of pressure is $1\text{N/mm}^2$. Assuming the uniform wear theory, calculate the power transmitting capacity of the clutch at 750rpm. [15]

7(a) Distinguish between the various types of springs with proper diagram? [5]

(b) It is required to design helical compression spring subjected to 500 N. The deflection of spring corresponding to this force is approximately 20mm. The spring index is 6. The spring is made of oil hardened and tampered valve and the $S_{ut}$ is 1000 N/mm$^2$ and permissible shear stress should be taken as 30% $S_{ut}$. $G=81370\text{N/mm}^2$. Design the spring with proper diagram. [15]