(Please write your Exam Roll No.) Exam Roll No. .....

END TERM EXAMINATION

SIXTH SEMESTER [B.TECH.] JULY-2023

Paper Code: ETAT-302 **Subject: Machine Design**

Time: 3 Hours **Maximum Marks: 75**

Note: Attempt any five questions including Q.No1 which is compulsory. Select one question from each unit.

Q1 Write notes on the following topics in brief: **(5*5=25)**

(a) What are the principles of designing cast iron components?

(b) What is 'overhauling' of power screw? What is the condition for overhauling?

(c) What is fluctuating stress? Draw a stress-time curve for fluctuating stress.

(d) Discuss on bolts of uniform strength giving examples of practical applications of such bolts.

(e) Distinguish between interchangeable and selective assemblies.

UNIT-I

Q2 (a) What is stress concentration? What are the causes of stress concentration? **(5)**

(b) Two rods are connected by means of a cotter joint. The inside diameter of the socket and outside diameter of the socket collar are 50 and100 mm respectively. The rods are subjected to a tensile force of 50 kN. The cotter is made of steel 30C8 (Syt = 400 N/mm^2) and the factor of safety is 4. The width of the cotter is five times of thickness. Calculate:

(i) Width and thickness of the cotter on the basis of shear failure; and

(ii) Width and thickness of the cotter on the basis of bending failure. **(7.5)**

Q3 (a) What is factor of safety? Why is it necessary to use factor of safety? **(5)**

(b) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate strength of the material of the rod against tearing is 420MPa. The ultimate tensile and shearing strength of the pin material are 510 MPa and 396 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 6. **(7.5)**

UNIT-II

Q4 (a) A welded connection, as shown in Figure 1 is subjected to an eccentric force of 7.5kN. Determine the size of welds if the permissible shear stress for the weld is 100 N/mm^2. Assume static conditions. **(12.5)**

P.T.O.

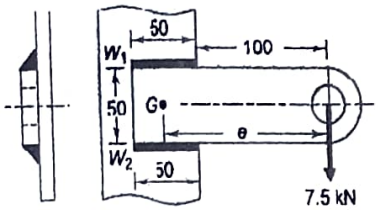

Figure 1.

Q5 (a) What is the difference between caulking and fullering? Explain with the help of neat sketches. **(5)**

(b) A bracket, attached to a vertical column by means of four identical rivets, is subjected to an eccentric force of 25 kN as shown in Figure 2. Determine the diameter of rivets, if the permissible shear stress is 60 N/mm². **(7.5)**

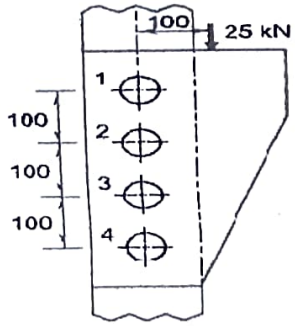

Figure 2.

UNIT-III

Q6 It is required to design a split muff coupling to transmit 50 kW power at 120 rpm The shafts, key and clamping bolts are made of plain carbon steel 30C8 (S_{yt} = 400 N/mm²). The yield strength in compression is 150% of the tensile yield strength. The factor of safety for shafts, key and bolts is 5. The number of clamping bolts is 8. The coefficient of friction between sleeve halves and the shaft is 0.3.

(a) Calculate the diameter of the input and output shafts.
(b) Specify the length and outer diameter of the sleeve halves.
(c) Find out the diameter of clamping bolts assuming that the power is transmitted by friction.
(d) Specify bolt diameter using standard empirical relations.
(e) Specify the size of key and check the dimensions for shear and compression criteria. **(12.5)**

P.T.O.

Q7 A helical compression spring is used to absorb the shock. The initial compression of the spring is 30 mm and it is further compressed by 50 mm while absorbing the shock. The spring is to absorb 250 J of energy during the process. The spring index can be taken as 6. The spring is made of patented and cold-drawn steel wire with an ultimate tensile strength of 1500 N/mm² and modulus of rigidity of 81370 N/mm². The permissible shear stress for the spring wire should be taken as 30% of the ultimate tensile strength. Design the spring and calculate:
(i) wire diameter ;(ii) mean coil diameter;(iii) number of active turns; (iv) free length; and(v) pitch of the turns. **(12.5)**

UNIT-IV

Q8 A steel pinion with 20° full depth involute teeth is transmitting 7.5 kW power at 1000 rpm from an electric motor. The starting torque of the motor is twice the rated torque. The number of teeth on the pinion is 25, while the module is 4 mm. The face width is 45 mm. Assuming that velocity factor accounts for the dynamic load, calculate:
(i) the effective load on the gear tooth; and
(ii) the bending stresses in the gear tooth. **(12.5)**

Q9 (a) What is the criterion for dynamic load carrying capacity of ball bearing? **(4)**

(b) 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, a 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 10,000 hrs. Calculate the dynamic load carrying capacity of the bearing. **(8.5)**

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