Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) Examination January 2024 (2019 Scheme)

Course Code: RAT302

Course Name: DESIGN OF MACHINE ELEMENTS

Max. Marks: 100   **Duration: 3 Hours**

(i) Use of approved design data book is permitted
(ii) Missing data if any may be suitably assumed

PART A

Answer all questions, each carries 3 marks.   Marks

1	Discuss about steps in design process.	(3)
2	Define factor of safety. What is its importance in design process?	(3)
3	A 60 mm diameter shaft is welded to a flat plate by 12 mm fillet welds as shown in Figure. Find the maximum torque that the joint can sustain, if maximum shear stress is not to exceed 75 MPa.	(3)
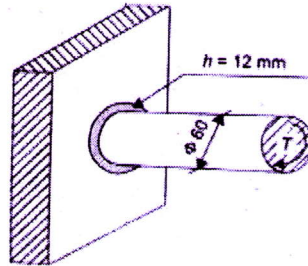
4	What are the merits and demerits of threaded joints?	(3)
5	What are the properties of spring material?	(3)
6	A mild steel shaft has to transmit 75KW at 200 rpm. The allowable shear strength in the shaft material is limited to 50 MPa. calculate suitable diameter of shaft.	(3)
7	What are the advantages and disadvantages of spur gear?	(3)
8	Distinguish between V-belt and flat belt.	(3)
9	Define static and dynamic load carrying capacity of ball bearing.	(3)
10	What is hydrodynamic lubrication? Explain with neat sketch.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	a)	Distinguish between standards and codes in design.	(4)

   b) A rectangular beam of 150 mm width and 250 mm depth is freely supported (10) over a span of 1.5 m. A load of 12 kN is dropped on the middle of the beam from a height of 15 mm. Find the maximum instantaneous deflection and stress induced in the beam. Take $E = 2 \times 10^5$ MPa.

<div align="center">OR</div>

12 a) What is preferred numbers? Explain its importance in design process. (4)

   b) A circular bar of 400 mm length is supported freely at its two ends. It is acted (10) upon by a central concentrated cyclic load having a minimum value of 30 kN and maximum value of 60 kN. Determine the diameter of bar by taking a factor of safety of 2, size effect of 0.85, surface finish factor of 0.9. The material properties of bar are; ultimate strength of 600 MPa, yield strength of 450 MPa and endurance strength of 325 MPa.

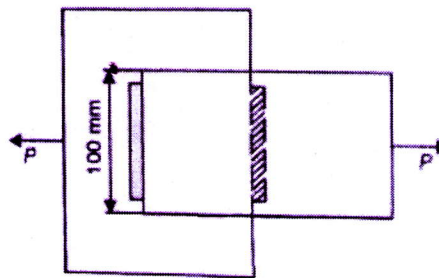<div align="center">Module II</div>

13 a) Explain various terns associated with screw thread with neat sketch. (8)

   b) The cylinder head of a steam engine is subjected to a steam pressure of 0.8 MPa. (6) It is held in position by means of 10 bolts. A soft copper gasket is used to make the joint leak proof. The effective diameter of the cylinder is 250 mm. Find the size of the bolt so that the stress in the bolt is not to exceed 90 MPa.

<div align="center">OR</div>

14 a) A plate 75 mm wide and 10 mm thick is joined with another plate by a single (8) transverse weld and a double parallel fillet weld as shown in Figure. The maximum tensile and shear stresses are 80 MPa and 60 MPa respectively. Find the length of each parallel fillet weld, if the joint is subjected to static loading.
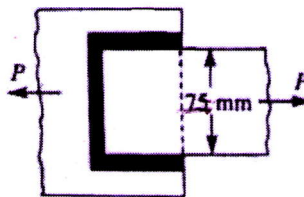
   b) Two plates 100 mm wide by 8 mm thick are joined together by double (6) transverse fillet welds as shown in Figure. Find the length of the weld required, if the strength of weld is equal to the strength of the plates. Take the allowable stress as 95 MPa.
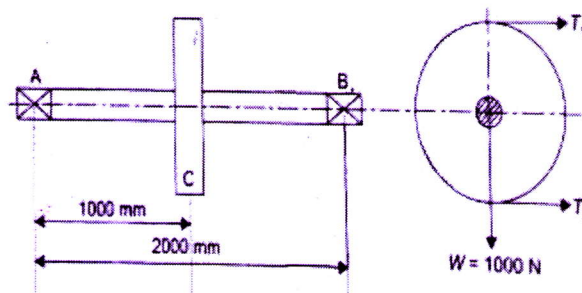
Module III

15   Design a helical compression spring for a maximum load of 950 N and for a   (14)
deflection of 20mm. the maximum permissible shear stress for the spring wire is
400N/mm^2, modulus of rigidity is 0.85×10^5 N/mm^2 and value of spring index is
5.

OR

16   A power transmission shaft is supported in bearings 2 m apart and carries a   (14)
pulley weighing 1 kN at its midpoint and it receives power by a belt drive. The
shaft transmits power to another machine by means of a flexible coupling just
outside the right bearing. The power transmitted is 25 kW at 150 rpm. The ratio
of belt tensions is 3:1. Estimate the size of the shaft if the permissible stress in
shear is 60 N/mm^2. Also calculate the twist in the shaft if G = 0.8×10^5 N/mm^2.
Take C_m and C_t as 1.6 and the pulley diameter is 180 mm.

Module IV

17   In a spur gear arrangement, a pinion made of cast steel is rotating at 1000 rpm   (14)
and is driving a cast iron gear at 250 rpm. The teeth are to have standard 20°
stub involute profiles and the maximum power to be transmitted is 30 kW.
Determine the module, face width, dynamic load and wear load. The pinion has
16 teeth with surface hardness of 250 BHN, take static stress for pinion as 100
MPa and for gear as 50 MPa. Assume E_p = 96 GN/m^2 and E_g = 207 GN/m^2.

OR

18   Select type of V-belt and number of belts required for 12 kW, 700 rpm induction   (14)
      motor to drive an exhaust fan in a steel plant at 350 rpm. The center distance
      between shafts is 1.3 m. Pitch diameter of the motor pulley is 180 mm.

Module V

19   Design a journal bearing to withstand a load of 5800 N. Speed of the journal is   (14)
      900 rpm. The journal is made of hardened steel and bearing is made of babbit.
      Operating temperature is 70°C and ambient temperature is 30°C. Check the
      design for thermal equilibrium and also determine the power loss at the bearing.
      The lubricant used is of grade SAE 40, 1/d =1.5.

OR

20 a) Derive Petroff's equation with suitable assumptions.   (6)

    b) A single-row deep groove ball bearing No. 6002 is subjected to an axial thrust of   (8)
        1200 N and a radial load of 2000 N. Find the expected life that 50% of the
        bearings will complete under this condition.

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