

THE KAVERY ENGINEERING COLLEGE
(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

Fifth Semester

Mechanical Engineering

ME3591 - Design of Machine Elements

Usage of PSG Design Data Book is Permitted

Regulations - 2021

Duration : 3 Hrs

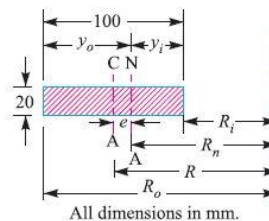
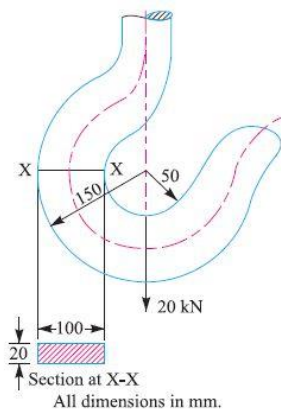
Maximum: 100 Marks

PART - A (ANSWER ALL QUESTIONS) (Marks 10*2=20)

Q.No	Questions	BLT	CO	Marks
1.	What is preferred numbers?	RE	1	2
2.	Give some methods of reducing stress concentration.	RE	1	2
3.	Why a hollow shaft has greater strength and stiffness than solid shaft of equal weight?	UN	2	2
4.	What are the types of keys?	RE	2	2
5.	How is a bolt designated? Give example.	UN	3	2
6.	Define welding.	RE	3	2
7.	List the application of leaf spring.	RE	4	2
8.	What is the function of flywheel?	RE	4	2
9.	What is bearing?	RE	5	2
10.	Define the term bearing life.	RE	5	2

PART - B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)

Q.No	Questions	BLT	CO	Marks
11. a	The crank hook carries a load of 20kN as shown in figure. The section at X-X is rectangular whose horizontal side is 100mm. Find the stress in the inner and outer fibres at the given section.	AP	1	13



Or

- b A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 Nm and a torque of T. If the yield point of the steel in tension is 200MPa, find the maximum value of this torque without causing yielding of the shaft according to
- The maximum principal stress theory,
 - The maximum shear stress theory and
 - The maximum distortion strain energy theory of yielding.

AP 1 13

12. a A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having a maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180° and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, allowing working stress of 63MPa in tension and 42MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on another pulley.

AP 2 13

Or

- b Design a protective type of cast iron flange coupling for a steel shaft transmitting 15kW at 200 rpm and having an allowable shear stress of 40 N/mm². The working stress in the bolt should not exceed 30 N/mm². Assume that the same material is used for shaft and key that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress of cast iron is 14 N/mm².

AP 2 13

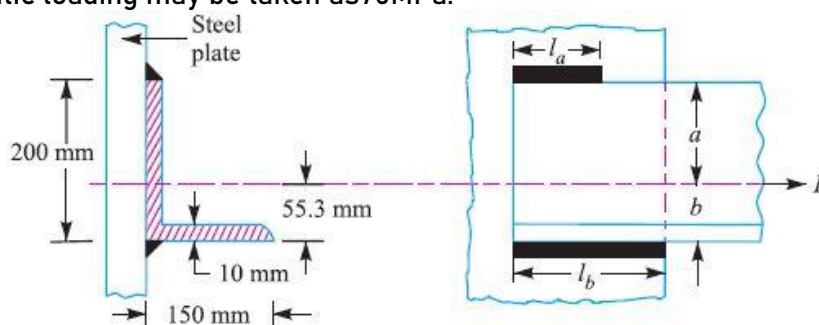
13. a A steam engine cylinder has an effective diameter of 350 mm and the maximum steam pressure on the cylinder cover is 1.25Mpa. Determine the number of bolts required to fix the cylinder cover and select the bolt. Take the permissible tensile stress in the bolt as 33Mpa.

AP 3 13

Or

- b A 200 x 150 x 10 mm angle is to be welded to a steel plate by fillet welds as shown in figure. If the angle is subjected to a static load of 200kN, find the length of weld at the top and bottom. The allowable shear stress for static loading may be taken as 75MPa.

AP 3 13



14. a A safety valve of 60 mm diameter is to blow off at pressure of 1.2 N/mm². It is placed on its seat by a close-coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of the wire is limited to 500 N/mm². The modulus of rigidity for the spring material is 0.8×10^5 N/mm². Calculate
- Diameter of spring wire
 - Number of active turns
 - Mean coil diameter
 - Pitch of the coil.

AP 4 13

Or

- b A multi-cylinder engine is to run at a speed of 600 r.p.m. On drawing the turning moment diagram to a scale of 1 mm = 250 N-m and 1 mm = 3°, the areas above and below the mean torque line in mm² are : + 160, - 172, + 168, - 191, + 197, - 162. The speed is to be kept within ± 1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Design the flywheel if the breadth is twice its thickness. The density of the cast iron is 7250 kg/m³ and its hoop stress is 6 MPa. Assume that the rim contributes 92% of the flywheel effect.

AP 4 13

15. a Select a single row deep groove ball bearing for a radial load of 4000N and an axial load of 5000N, operating at a speed of 1600rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load.

AP 5 13

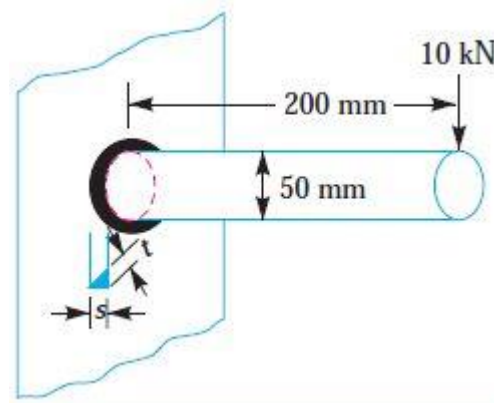
Or

- b Design of journal bearing for a centrifugal pump from the following data.
 Load on journal = 20kN,
 Speed of journal = 900rpm,
 Type of oil used is SAE 10 for which absolute viscosity at 55°C = 17CP
 Ambient temperature of oil = 15.5°C
 Maximum bearing pressure for the pump = 1.5 N/mm²
 Heat dissipation coefficient = 1232 J/s/m²/°C
 Calculate also mass of lubricating oil required for artificial cooling, if raise of temperature of oil is limited 10°C.

AP 5 13

*PART – C (Marks 1*15 = 15)*

Q.No	Questions	BLT	CO	Marks
16.	a A 50 mm diameter solid shaft is welded to a flat plate as shown in figure. If the weld size is 15mm, find the maximum normal and shear stress in the weld.	AP	3	15



Or

- b A railway wagon moving at a velocity 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1500kg. The springs are compressed by 150 mm in bringing the wagon to rest. The spring index can be taken as 6. The springs are made of oil-hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm² and modulus of rigidity of 81370 Mpa. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. Design the spring.

AP 4 15