Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SET B

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2024

Semester : Semester V - 2021
Course Code : MEC3090
Course Name : Design of Machine Elements-I
Program : B.Tech.

Date : 09-JAN-2024
Time : 9:30AM - 12:30 PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **4 X 5M = 20M**

1. Illustrate the stress-strain diagrams for Cast Iron, Mild Steel, Rubber band, Glass, and ABS plastic.
(CO2,CO1) [Knowledge]
2. Explain the distinctions between alternating stresses, repeated stresses, and reversed stresses in the context of fatigue analysis, draw the S-N curve.
(CO2,CO3) [Knowledge]
3. Provide an overview of keys, including their classification, and elaborate on one specific type.
(CO4,CO3) [Knowledge]
4. Design a square key to secure a gear on a 25 mm diameter shaft transmitting 15 kW power at 720 rpm. The key, made of steel 50C4 with a yield strength (Syt) of 460 N/mm², requires dimensions to meet a factor of safety of 3. Assume the yield strength in compression is equivalent to that in tension. Calculate the necessary key dimensions for optimal design.
(CO4,CO5) [Knowledge]

PART B

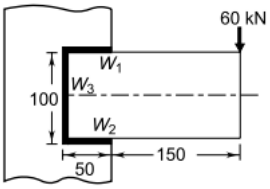
ANSWER ALL THE QUESTIONS **5 X 10M = 50M**

5. Determine the appropriate diameter for a mild steel shaft that is tasked with transmitting 15 kW at 300 rpm. The shaft, supported on two bearings 1.2 m apart, receives power via a 450 mm diameter pulley positioned 300 mm to the right of the right bearing. Power is then output through a 300 mm diameter gear situated 250 mm to the right of the left bearing. In this horizontal belt drive system, the gear imparts a downward tangential force. Considering a yield stress of 234 MPa for the shaft material and a factor of safety of 2, the shaft is running under suddenly applied loads and minor shock, and a tension ratio of 3 for the belt, what is the suitable diameter for the shaft? Additionally, the pressure angle is specified as 20 degrees. The equivalent bending moment is found to be 500 N-m.
(CO3,CO4) [Comprehension]

6. Devise a design for a triple riveted longitudinal butt joint with cover plates of equal width for a boiler with a diameter of 1200 mm, exposed to an internal pressure of 0.9 MPa. Consider a joint efficiency of 75%. For practical considerations, where d represents the rivet diameter. Specify material constraints with allowable tensile stress at 120 MPa, shear stress at 80 MPa, and compressive stress at 160 MPa.

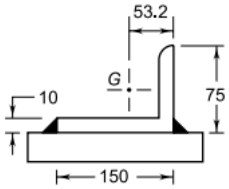
(CO3,CO4) [Comprehension]

7. To analyze the welded connection illustrated in Figure under a 60 kN eccentric force within the plane of the welds, the objective is to determine the necessary size of the welds. Given a permissible shear stress for the weld material of 100 N/mm² and assuming static conditions, what is the appropriate size for the welds to meet the specified shear stress criterion?



(CO5,CO4) [Comprehension]

8. To weld the long side of an ISA angle (150 × 75 × 10) to a steel plate with side welds only, a 10 mm fillet weld is employed. Under a static load of 125 kN, acting through the angle's center of gravity, located 53.2 mm from the short side, the task is to determine the necessary length of the fillet weld. Given an allowable load of 665 N per mm of weld length, what is the required length of the 10 mm fillet weld to meet this load criterion?



(CO4) [Comprehension]

9. The type of joint required for joining two trolleys to sustain axial loads of 50 kN and mandatorily containing a fork is a forked joint. To design this joint, the key parameters include ensuring that the tensile stress does not exceed 80 MPa, the compressive stress stays below 80 MPa, and the shear stress remains within the limit of 40 MPa. Consider these factors to create a robust forked joint for effective load-bearing between the trolleys.

(CO5) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS **2 X 15M = 30M**

10. Apply the principles of coupling design to determine the specific type and key parameters required for efficiently transmitting 50 kW of power from the BeLAZ 75710's transmission shaft to the differential, taking into account a shaft yield strength of 400 MPa, a Factor of Safety of 2.5, and a rotational speed of 1350 RPM.

(CO5,CO3) [Application]

11. Identify an axial joint, connect a locomotive's drive shaft and wheel assembly for synchronized movement. With a 100 kN load, design the joint to meet permissible stresses of 120 MPa (tension), 160 MPa (compression), and 80 MPa (shear), ensuring efficient axial load transmission and easy assembly.

(CO5,CO3) [Application]