Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

UG/PG DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2026

Fifth Semester

Mechanical Engineering

ME3591& DESIGN OF MACHINE ELEMENTS

Use 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	BTL	CO	Marks
1.	List down any two significant theories of failure in design of machine elements	K1	1	2
2.	What are the methods to reduce stress concentration?	K1	1	2
3.	Differentiate between Keys and splines.	K2	2	2
4.	List out types of stresses that are induced in shafts.	K1	2	2
5.	Where do you use a knuckle joint? Give two practical examples.	K3	3	2
6.	Give two reasons why riveted joints are being replaced by welded joints?.	K2	3	2
7.	Define surge in springs.	K1	4	2
8.	Brief why fly wheels are used in punching machines.	K2	4	2
9.	What is the significance of a sommerfeld number in bearing design?	K2	5	2
10.	What are the primary functions of an oil seal?	K1	5	2

PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)

Q.No		Questions	BTL	CO	Marks
11.	a	A hypothetical machine member by 60 mm in diameter and 250 mm long is supported in one end as the cantilever is subjected to various types of loadings, as given below. Find the principal stresses and maximum shear stress in each case. (i) Axial load 15 kN. (ii) Transverse load 3 kN at the free end. (iii) Twisting moment of 1 kNm at the free end, clockwise, while viewing from the free end side. (iv) (i) and (ii) together. (v) (i) (ii) and (iii) together.	K3	1	16
		Or			
	b	A crane hook of approximate trapezoidal cross-section shown in Fig.1. It is made of plain carbon steel 45C8(Syt = 380 N/mm^2) and the factor of safety is 3. Determine the load carrying capacity of the hook.	K3	1	16

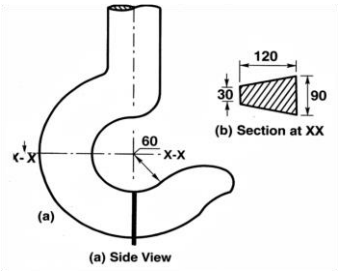

Figure 1

12.	a	A Steel solid shaft transmitting 15 KW at 200 rpm is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth, of 5 mm module is located 100mm to the left of the right hand bearing and delivers power	K3	2	16

horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear, determine the diameter of the shaft.

Or

	b	Design a muff coupling to connect two steel shafts transmitting 20 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30C8 (S_{yt} = S_{yc} = 400 N/mm2). The sleeve is made of grey cast iron FG 200 (Sut = 200 N/mm2). The factor of safety for the shafts and key is 3.5 . For the sleeve, the factor of safety is 6 based on ultimate strength.	K3	2	16
13.	a	A bolt M20x2.5 ISO metric thread is subjected to a fluctuating load of 0 to 12000N. Endurance strength - 210MPa. The bolt and the part are of the same material and length. Yield stress=490MPa, stress concentration factor= 3.85, component area 362mm^2. Calculate. i) Factor of safety without preload ii) Minimum initial load to prevent joint opening. iii) Factor of safety with 10kN preload. Comment on it iv) Minimum force in the part for a given loading and a preload of 10kN.	K3	3	16

Or

	b	A plate 100mm wide and 12.5mm thick is to be welded to another plate by means of single transverse and double parallel fillet welds. Determine the length of weld run in each case, if the joint is subjected to varying loads. The recommended design stress in tension is not to exceed 70N/mm^2 and in shear 56N/mm^2 for static loading.(Fig.2)	K3	3	16

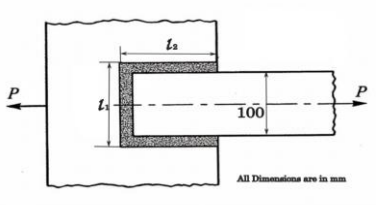

Figure 2

14.	a	The intercepted areas between the output torque curve and the mean resistance line of a turning moment diagram for a multi cylinder engine, taken in order from one end are as follows: -35, +410, -285, +325, -335, +260, -365, +285,-260 sq.mm. The diagram has been drawn to a scale of 1mm =70 N-m and 1 mm 4.5°. The engine speed is 900 r.p.m. and the fluctuation in speed is not to exceed 2% of the mean speed. Find the mass and cross-section of the flywheel rim having 650 mm mean diameter. The density of the material of the flywheel may be taken ia 7200 kg/ m^2 The rim is rectangular with the width 2 times the thickness. Neglect effect of arms, etc.	K3	4	16

Or

	b	It is required to design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force should be approximately 30 mm. The spring index can be taken as 6. The spring is made of patented and cold-drawn steel wire. The ultimate tensile strength and modulus of rigidity of the spring material are 1090 and 81370 N/mm² respectively. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate: (i)wire diameter, (ii) mean coil , (iii) number of active coils. (iv) total number of coils, (v) free length of the spring; and	K3	4	16

(vi) pitch of the coil.
Draw a neat sketch of the spring showing various dimensions.

15. a Following data is given for a 360 deg hydrodynamic bearing : K3 5 16
Radial load =3.2 kN
Journal speed =1490 rpm
l/d ratio= 1
Unit bearing pressure=1.3 MPa
Radial clearance =0.05 mm
Viscosity of the lubricant=25 cP

Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing, calculate (i) Journal diameter and bearing length, (ii) coefficient of friction, (iii) power lost in friction and (iv) minimum oil film thickness.

Or

b A ball bearing operates on the following work cycle : K3 5 16

Element no.	Radial load N	Speed, rpm,	Element time
1	3000	720	30
2	7000	1440	50
3	5000	900	20

The dynamic load capacity of the bearing is 16.6 kN. Calculate
(i)The average speed of rotation
(ii) The equivalent radial load.
(iii)The bearing life and,
(iv)The bearing life at 95% reliability.