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**Question Paper Code: 55073**

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

Fifth Semester

Mechanical Engineering

15UME503 - DESIGN OF MACHINE ELEMENTS

(Regulation 2015)

(Approved data book are permitted)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The maximum distortion energy theory of failure is suitable to predict the failure of which one of the following type of materials  
(a) brittle            (b) ductile            (c) composite            (d) plastics
2. Factor of safety is the ratio of  
(a) breaking stress to working stress            (b) endurance limit to yield stress  
(c) elastic limit to ultimate stress            (d) yield stress to working stress
3. Woodruff key is generally  
(a) square            (b) rectangular            (c) semi-circular            (d) trapezoidal
4. In a flange coupling the weakest element is  
(a) key            (b) bolt            (c) flange            (d) shaft
5. Rivets are generally specified by  
(a) shape of head            (b) diameter of head  
(c) diameter of shank            (d) overall length

6. The size of the weld in case of fillet welded joint is the
- smaller side of the triangle of fillet
  - larger side of the triangle of fillet
  - hypotenuse of the triangle of fillet
  - perpendicular distance from the root to hypotenuse
7. Wahl stress factor takes into account
- direct shear stress
  - torsional shear stress
  - wire curvature effect
  - direct shear and wire curvature effect
8. What is the value of the radius of gyration of disc type flywheel as compared to rim type flywheel for the same diameter?
- $\sqrt{2}$  times
  - $1/\sqrt{2}$  times
  - 2 times
  - $1/2$  times
9. The bearing pressure is exerted at right angles to the shaft axis in a
- foot step bearing
  - collar bearing
  - radial bearing
  - taper roller bearing
10. A connecting rod should be equally strong in buckling about x-axis and y-axis. For that
- $I_{xx} = I_{yy}$
  - $I_{xx} = 2I_{yy}$
  - $I_{xx} = 4 I_{yy}$
  - $I_{xx} = 8I_{yy}$

PART - B (5 x 2 = 10 Marks)

- Give some methods of reducing stress concentration.
- Define the term critical speed.
- Define the term self-locking of power screws.
- What are the applications of spring? State any two functions of spring?
- Define kinematic viscosity.

PART - C (5 x 16 = 80 Marks)

16. (a) A hollow shaft of 40mm outer diameter and 25mm inner diameter is subjected to twisting moment of 120Nm; simultaneously it is subjected to an axial thrust of 10kN and a bending moment of 80Nm. Calculate the maximum compressive and shear stresses. (16)

Or

- (b) A circular bar of 500mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20kN and a

maximum value of 50kN. Determine the diameter of the bar by using factor of safety 1.5. Take  $K_1 = 0.85$ ,  $K_2 = 0.9$ . (16)

17. (a) Determine the required diameter of a uniform circular shaft carrying two pulleys of weight 2kN each. The shaft 750mm long is supported at the ends and carries two pulleys at 250mm and 500mm from the left end. Pull on the right pulley is 10kN vertically downwards. The shaft transmits a torque of 3kNm between the pulleys. Assume  $K_b = K_t = 1.5$  and allowable shear stress of 70MPa. (16)

Or

- (b) Determine the dimensions of flange coupling that connects a motor and a pump shaft. The power to be transmitted is 2kW at a shaft speed of 960rpm. Select suitable materials for the parts of the coupling and the list of the dimensions. (16)
18. (a) A steam engine of effective diameter 300mm is subjected to a steam pressure of  $1.5\text{N/mm}^2$ . The cylinder head is connected by 8 bolts having yield point 330MPa and endurance limit at 240MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak proof. Assuming factor of safety 2, find the engine size of bolt required. The stiffness factor for copper gasket may be taken as 0.5. (16)

Or

- (b) A rectangular steel plate 100mm wide is welded to a vertical plate to form a cantilever with an overlap of 50mm and an overhang of 150mm. It carries a vertical downward load of 60kN at free end. Fillet weld is done three sides of the plate for a permissible stress is  $140\text{N/mm}^2$ . Determine the size of the weld. (16)
19. (a) A relief valve must blow off at a pressure of 1.25MPa and should lift by 6mm for a 6% increase in pressure. The valve diameter is 65mm. Take the spring index as 8. Maximum allowable shear stress of the spring material is 600MPa, modulus of rigidity is  $81370\text{N/mm}^2$ . Consider Wahls correction factor, take inactive number of turns as 1. Design the valve spring. (16)

Or

- (b) A multi cylinder engine is to run at a constant load at a speed of 500rpm on drawing the crank effort diagram to scale of  $1\text{cm} = 2500\text{Nm}$  and  $1\text{cm} = 60^\circ$ . The area above and below the mean torque line were measured and found to be in order +1.60 , - 1.72 , +1.68 , -1.91 , +1.97 and -1.62. If the speed is to be kept within limits of  $\pm 1\%$  of the mean speed, design the suitable type of flywheel. (16)

20. (a) Design a journal bearing for a centrifugal pump for the given specifications. Diameter of the journal is 75mm, speed of the journal is 1140rpm and load on each journal is 11500N. (16)

Or

- (b) Select a suitable roller bearing for a 55mm diameter shaft. The bearing should be capable of withstanding 3000N radial and 1500N axial load at 750rpm. The bearing is to have a desired life of 2000hrs at a reliability of 94%. There is a light shock load and inner ring rotates. (16)

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