P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)
Sixth Semester, B.E. - Automobile Engineering
Semester End Examination; May/June - 2018
Design of Machine Elements - II

Time: 3 hrs 　　　　　　　　　　　　　　　　　　　　　　　　　*Max. Marks: 100*

Note: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.
　　　　ii) DDH is permitted.

UNIT - I

1 a. What is a Curved beam? Give practical examples of machine components made of Curved beam. 　5

　b. A C-frame of a 100 kN capacity press is shown in Fig. Q.1(b). The material of the frame is grey cast iron with ultimate stress 200 N/mm^2 and the factor of safety is 3. Determine the dimensions of frame. 　15
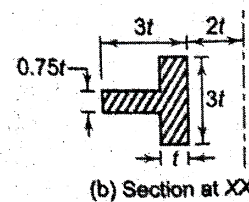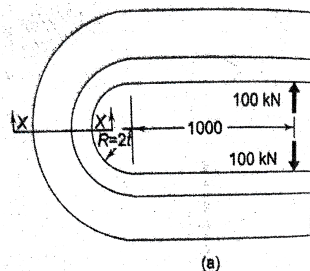

Fig. 1b.

2 a. Define following terms related to springs :

　　i) Solid and free length　　ii) Spring index　　iii) Spring rate 　6

　b. A helical compression spring made of circular wire is subjected to an axial force which varies from 2.5 kN to 3.5 kN. Over this range of force the deflection of spring should be 5 mm. The spring index can be taken as 5. The spring has square and ground ends. The spring is made of patented and cold drawn steel wire with sheer strength of 525 N/mm^2 and modulus of rigidity 81370 N/mm^2. Calculate; 　14

　　i) Wire diameter　　　　　　ii) Mean coil diameter　　　　iii) Number of active coils

　　iv) Total number of coils　　v) Solid length　　　　　　　vi) Free length

　　vii) Spring rate required　　viii) Actual spring rate

UNIT - II

3 a. List the advantages of gear drives. 　4

　b. Derive expression for strength of spur gear. 　6

　c. The following particulars of a single reduction spur gear are given; gear ratio = 10:1. Distance between centre = 660 mm. The pinion transmits 500 kW at 1800 rpm. Involute teeth of standard proportions (addendum) with pressure angle of 22.5°. Permissible normal pressure between teeth = 175 N/mm of width. Find; 　10

　　i) Nearest standard module if no interference occur　　ii) The number of teeth on each wheel

　　iii) Necessary width of pinions　　　　iv) Load on the bearing due to power transmission

4 a. Explain virtual number of teeth on helical gears. 　4

　b. A pair of helical gears with 30° helix angle is used to transmit 15 kW at 1000 rpm of the pinion. The velocity ratio is 4:1. Both the gears are made of hardened steel of static strength 100 N/mm^2. The gears are 20° stub and the pinion is to have 24 teeth. The face width may be taken as 14 times the module. Find the module and face width from stand point of strength and check the gears for wear. 　16

UNIT - III

5 a. Show the nomenclature of bevel gearing with a neat diagram.　　6

  b. A pair of bevel gears connects two shafts at right angles and transmits 9 kW. Determine the required module and gear dimensions for following data. Also check the gears for dynamic and wear load.　　14

Particulars	Pinion	Gears
No. of teeth	21	60
Material	Semi steel	Grey
BHN	200	160
Static stress	85 MPa	55 MPa
Speed	1200 rpm	420 rpm
Tooth profile	14½″composite	14½″composite

6. Design a 20° involute and gear to transmit 10 kW with worm rotating at 1400 rpm and to obtain a speed reduction of 12:1. The distance between the shafts is 225 mm.　　20

UNIT - IV

7 a. What the requirements for friction material are for clutches plates? Explain briefly.　　6

  b. Give the advantages of centrifugal clutch.　　4

  c. A plate clutch has three discs on the driving shaft and two on the driven shaft, providing four pairs of contact surfaces. The outside diameter of contact surface is 240 mm and the inside diameter is 120 mm. Assuming uniform pressure and $\mu = 0.3$, find the total spring force pressing the plates together to transmit 25 kW at 1575 rpm. If there are 6 springs each of stiffness 13 kN/m and each of constant surfaces worn by 1.25 mm, find maximum power that can be transmitted assuming uniform wears.　　10

8 a. Obtain an expression for the actuating force on a shoe brake when the line of action of tangential force passes through the fulcrum.　　6

  b. A differential band brake has an operating lever 2.25 m long. The ends of the brake band are attached so that their operating arms are 38 mm and 127 mm long. The brake drum diameter is 600 mm, the arc of contact is 300°, coefficient of friction is 0.22 and the band is 3.2 mm×100 mm.　　14

    i) Find the least force required at the end of operating lever, if the stress in the band is not to exceed 55 N/mm^2

    ii) What is the torque applied to the brake drum?　　　　iii) Is this brake self locking?

UNIT - V

9 a. Define and discuss the properties of good lubricant.　　5

  b. Derive Petroff's equation for coefficient of friction.　　5

  c. Find the frictional power loss for a Petroff's bearing 80 mm in diameter and 120 mm long. The radial clearance is 0.05 mm and the speed of the journal is 900 rpm. The oil used is SAE10 and its operating temperature is 80°C.　　10

10 a. List the advantages and disadvantages of rolling contact bearings.　　8

  b. A single row, deep groove ball bearing is to carry a radial load of 2500 N and a thrust load of 1500 N. The service imposes light shock and the bearing is to operate 40 hrs per week for 4 years. The speed of the shaft is 900 rpm. Select a medium series ball bearing.　　12

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