Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–V • EXAMINATION – WINTER • 2014

Subject Code: 151905   **Date: 10-12-2014**
Subject Name: Machine Design – I
Time: 10.30 am - 01.00 pm   **Total Marks: 70**
Instructions:
  1. **Attempt all questions.**
  2. **Make suitable assumptions wherever necessary.**
  3. **Figures to the right indicate full marks.**
  4. **Use of standard design data book is permissible**

Q.1 **(a)** What is the function of spring? Explain with neat sketch of Leaf spring.   **05**
     (b) A rail wagon of mass 20 tonnes is moving with a velocity of 2m/s. It is brought   **09**
          to rest by two buffers with springs of 300mm diameter. The maximum deflection
          of springs is 250mm. The allowable shear stress in the spring material is
          600Mpa. Design the spring for the buffers.

Q.2 **(a)** What are the advantages and disadvantages of V-belt over flat belt drive.   **05**
     (b) Two shafts whose centers are 1metre apart are connected by a V-belt drive. The   **09**
          driving pulley is supplied with 95kW power and has an effective diameter of
          300mm. It runs at 1000r.p.m.while the driven pulley runs at 375r.p.m. The angle
          of groove on the pulleys is 40^0. Permissible tension in 400mm^2 cross-sectional
          area belt is 2.1 Mpa. The material of the belt has density of 1100 kg/m^3. The
          driven pulley is overhung, the distance of the center from the nearest bearing
          being 200mm. The coefficient of friction between belt and pulley rim is 0.28.
          Estimate: 1. The number of belts required; and 2. Diameter of driven pulley
          shaft, if permissible shear stress is 42Mpa.

OR

     (b) An overhung flat belt pulley transmits 35kW at 240r.p.m. The belt is vertical and   **09**
          angle of wrap may be taken as 180^0. The distance of the pulley center line from
          the nearest bearing is 350mm. µ=0.25. determine
            1. Diameter of the pulley;
            2. Width of the belt assuming thickness of 10mm;
            3. Diameter of the shaft;
            4. 4.dimensions of the key for securing the pulley on to the shaft; and
            5. Size of the arms **six** in number
          The section of the arm may be taken as elliptical, the major axis being **twice** the
          minor axis.
          The following stresses may be taken for design purpose:

Shaft-	Tension and Compression-	80Mpa
Shaft-	Shear-	50Mpa
Key-	Tension and Compression-	80Mpa
Key-	Shear-	50Mpa
Belt-	Tension-	2.5Mpa
Pulley Rim-	Tension-	4.5Mpa
Pulley arms-	Tension-	15Mpa

Q.3 **(a)** What are the design consideration points in the design of a friction clutch?   **05**

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(b) The brake as shown in fig.No.1 has the following specifications: **09**

Brake drum diameter	200mm
Angle of contact for each shoe	120^0
Braking torque	300 N.m
Drum speed	600r.p.m.
Coefficient of friction between drum and shoe	0.3
Value of $p_{av \times v}$	200 N-m/cm^2.sec

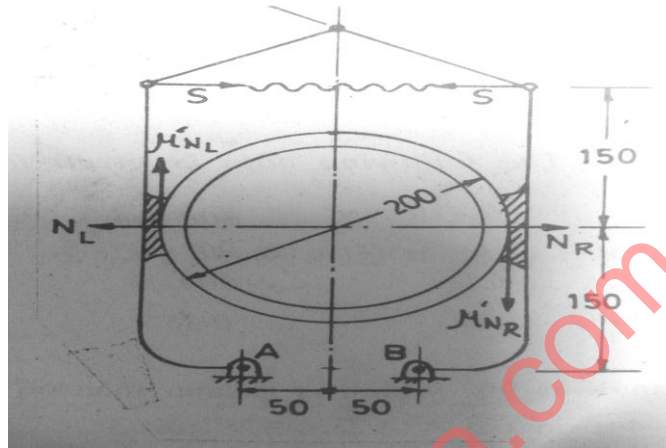Design the brake shoe and shows the designing of the spring of this brake mechanism.

Figure No.1
(All Dimensins are in mm)

OR

Q.3 **(a)** How does the function of a brake differ from that of a clutch? Also Describe with the help of a neat sketch the principle of operation of an internal expanding shoe brake. **05**

(b) A single dry plate clutch is to be designed to transmit 7.5kW at 900r.p.m. find: **09**
1. Diameter of the shaft
2. Mean radius and face width of the friction lining assuming the ratio of the mean radius to the face width as 4,
3. Outer and inner radii of the clutch plate, and
4. Dimension of the spring, assuming that the number of springs are 6 and spring index =6. The allowable shear stress for the spring wire may be taken as 420Mpa.

Q.4 **(a)** A circular bar of 500mm length is supported freely at its ends. It is acted upon by a cyclic load having a minimum value of 20kn and a maximum value of 50kN. Determine the diameter of bar by taking factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. The material properties of bar are given by : ultimate strength of 650 Mpa, yield strength of 500 Mpa and endurance strength of 350 Mpa. **07**

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(b) The load on the journal bearing is 150kN due to turbine shaft of 300mm diameter running at 1800 r.p.m. determine the following: **07**

1. Length of the bearing if the allowable bearing pressure is 1.6 N/mm^2, and
2. Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60^{0}C and viscosity of the oil at 60^{0}C is 0.02 kg/m-s and the bearing clearance is 0.25mm.

OR

Q.4 **(a)** Derive a soderberg's equationand state its application to different types of loadings **05**

(b) A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3kN for 10% of time, 2kN for 20% of time, 1kN for 30% of time and no load for remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95% reliability, Calculate dynamic load rating of the ball bearing. **09**

Q.5 **(a)** Design a small hydraulic press, The working pressure of the fluid operating the press is to be 20N/mm^2 and exerting a force of 100kN is required to press materials up to a maximum size of 300×300×450 high, the stroke length is 100mm. Design and draw the following parts of the press: 1. Design of ram; 2.Pillars;3.cylinder; and 4.Gland. **07**

The following design stresses:

Ram (Mild steel) :- σ_c= 75Mpa

Cylinder (Cast iron):- σ_t= 30Mpa

Pillars:- σ_t= 75Mpa

Stud:- σ_t= 75Mpa.

(b) Calculate the contact stress developed in the teeth of the spur gear drive from the following data: **07**

Design torque transmitted by the drive	150N-m
Pinion pitch diameter	135mm
Gear pitch diameter	270mm
Width of teeth	37mm

Modulus of elasticity for pinion and gear = 2.1×10^5 N/mm^2. Indicate whether teeth is safe under contact stress or not? (Assume the case of cylinder moving on the other cylinder)

OR

Q.5 **(a)** A cast iron pipe of internal diameter 200mm and thickness 50mm carries water under a pressure of 5 N/mm^2. Calculate the tangential and radial stresses at radius (r)= 100mm;110mm;130mm;140mm and 150mm. Sketch the stress distribution curves. **07**

(b) A truck spring has 12 number of leaves, two of which are full length leaves. The spring supports are 1.05m apart and the central band is 85mm wide. The central load is to be 5400N with a permissible stress of 280MPa. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring. **07**

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