GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–V • EXAMINATION – SUMMER 2013

Subject Code: 151905   **Date: 29-05-2013**

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.**

Q.1	**(a)**	State and Illustrate various principal design rules as per Casting Design.	**07**
	(b)	What is Endurance Limit? Explain Design criteria with Solderberg's line.	**04**
	(c)	Find out the numbers of R[20/4 (100,í ..1000)] derived series.	**03**
Q.2	**(a)**	What is A.M. Wahl's factor in spring? Why it is used?	**03**
	(b)	Classify springs according to their shapes. Draw neat sketches indicating in each case whether stresses are induced by bending or torsion.	**04**
	(c)	A semi-elliptic leaf spring used for automobile suspension consists of three extra full ólength leaves and 15 graduated-length leaves, including master leaf. The center-to-center distance between two eyes of the spring is 1 m. The maximum force that can act on the spring is 75 KN. For each leaf, the ratio of width to thickness is 9:1. The modulus of elasticity of the leaf material is 207000N/mm^2. The leaves are pre-stressed in such a way that when the force is maximum, the stresses induced in all leaves are same and equal to 450 N/mm^2. Determine: (i) The width and thickness o the leaves; (ii) The initial nip; and (iii) The initial pre-load required to close the gap C between extra full-length leaves and graduated-length leaves.	**07**

OR

	(c)	A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 KN and a maximum value of 50 KN. Determine the diameter of bar by taking a 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**
Q.3	**(a)**	(i) State the law of belting.	**02**
		(ii) How will you designate V-belt?	**02**
		(iii) Why is the cross-section of the pulley an elliptical arm? Why is the major axis of the cross-section in the plane of rotation?	**03**

(b) An overhung cast iron pulley transmits 7.5 KW at 400 r.p.m. The belt drive is vertical and angle of wrap may be taken as 180^0. Find: **07**

    (i) Diameter of the pulley. The density of CI is 7200 kg/m^3

    (ii) Width of the belt, if the co-efficient of friction between the belt and the pulley is 0.25 assuming thickness t = 10 mm.

    (iii) Diameter of the shaft, if the distance of the pulley center line from the nearest bearing is 300 mm.

    (iv) Dimensions of the key for securing the pulley on to the shaft.

    (v) Size of the arms six in number.

The section of the arms may be taken as elliptical, the major axis being twice the minor axis. The following stresses may be taken for design purpose: Shaft and key: 80 MPa (Tension), 50 Mpa (Shear); Belt: 2.5 MPa (Tension); Pulley rim: 4.5 MPa (Tension); Pulley arms: 15 MPa (Tension).

OR

Q.3 **(a)** A simple chain No. 10B is used to transmit power from a 1400 rpm electric motor to a line shaft running at 350rpm. The number of teeth on the driving sprocket wheel is 19. The operation is smooth without any shocks. Calculate: (i) The rated power for which the chain drive is recommended. (ii) The tension in the chain for this rated power; and (iii) The factor of safety for the chain based on the breaking load. Use following data: **07**

At 1400 rpm, for chain 10B, power rating is 11.67 KW,

Service factor K_S: 1.3, Multiple strand factor K_1: 1.0, Breaking Load:22200 N, Tooth correction factor K_2: 1.11, Pitch: 15.875 mm.

(b) Discuss the procedure used in designing a cast iron pulley. **07**

Q.4 **(a)** A high-pressure cylinder consists of a steel tube with inner and outer diameters of 20 and 40 mm respectively. It is jacketed by an outer steel tube, having an outer diameter of 60 mm. The tubes are assembled by a shrinking process in such a way that maximum principal stress induced in any tube is limited to 100 N/mm^2. Calculate the shrinkage pressure and original dimensions of the tubes (E=207 KN/mm^2) **07**

(b) The inner diameter of a cylinder tank for liquefied gas is 250 mm. The gas pressure is limited to 15 MPa. The tank is made of plain carbon steel 10C4 (S_{ut} = 340 N/mm^2 and μ = 0.27) and the factor of safety is 5. Calculate the cylinder wall thickness. **04**

(c) What is thick cylinder? When do you use Lame∅s equation for cylinder wall thickness? **03**

OR

Q.4 **(a)** A single-row deep groove ball bearing No. 6002 is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition. **07**

[Static load capacity C_O: 2500 N, Dynamic Load Capacity C: 5590N]

(b) The thrust of propeller shaft in a marine engine is taken up by a number of collars integral with the shaft which is 300 mm in diameter. The thrust on the shaft is 200 KN and speed is 75 rpm. Find: (i) Numbers of collars required (ii) Power lost in friction and (iii) Heat generated at the bearing in KJ/min. Take μ=0.05 and bearing pressure = 0.3 N/mm^2. **07**

Q.5 **(a)** Following data is given for a caliper disk brake with annular pad, for the front wheel of the motor-cycle: **07**

Torque capacity = 1500 N-m
Outer radius of pad = 150mm.
Inner radius of pad = 100 mm.
Coefficient of friction = 0.35
Average pressure on pad = 2 MPa
Number of pads = 2

Calculate the angular dimension of the pad.

(b) Why a positive clutch is used? Describe, with the help of neat sketches the working of jaw or claw clutch. **04**

(c) What is the condition of self-locking in differential band brake? Why it should be avoided in speed control brake? **03**

OR

Q.5 **(a)** A multiple disc clutch, steel on bronze, is to transmit 4.5 KW at 750 rpm. The inner radius of the contact is 40 mm and outer radius of the contact is 70 mm. The clutch operates in oil with an expected co-efficient of 0.1. The average allowable pressure is 0.35 N/mm^2. Find (i) The total number of steel and bronze discs; (ii) The actual axial force required (iii) The actual average pressure; and (iv) The actual maximum pressure. **07**

(b) A Centrifugal clutch is to be designed to transmit 15 KW at 900 rpm. The shoes are four in number. The speed at which the engagement begins is 3/4 th of the running speed. The inside radius of the pulley rim is 150 mm. The shoes are lined with Ferrodo for which the co-efficient of friction may be taken as 0.25 Determine: (i) Mass of the shoes and (ii) Size of the shoes. **07**

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