(Please write your Exam Roll No.) *Exam Roll No.* .....

END TERM EXAMINATION

SIXTH SEMESTER [B.TECH] MAY-JUNE 2018

Paper Code: ETAT-302 ***Subject: Machine Design***

Time: 3 Hours ***Maximum Marks: 75***

Note: Attempt all question as directed. Internal choice is indicated. Assume missing data suitably. Design data book is permitted.

Q1 Short answer type questions:- **(10x2.5=25)**

(a) What are the advantages of hole-basis system over shaft-basis system?
(b) What are the three basic types of standard used in design office?
(c) What is the effect of stress concentration on ductile and brittle components?
(d) Why are V-threads not used in power screws?
(e) What is the cause of residual stress in welded joint? How are they relieved?
(f) What is coupling? Where do you use it?
(g) What are the factors to be considered while selecting the types of key?
(h) What are the disadvantages of hollow shaft over solid shaft?
(i) What will happen when the viscosity of lubricant is very low in a bearing? Also write down different types of lubricant used in bearing.
(j) Why are gear drives superior to belt or chain drives?

Q2 Where do you use cotter joint? Give practical examples. Also design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. **(12.5)**

OR

Q3 (a) Explain the relationship between the grade of tolerance and corresponding manufacturing method. **(6)**

(b) What is meant by endurance strength of a material? How do the size and surface condition of a component and type of load affect such strength? Also write the influence of various factor of endurance limit of a ductile material. **(6.5)**

Q4 A triple-thread power screw, used in a screw jack, has a nominal diameter of 50 mm and pitch of 8 mm. The threads are square and the length of nut is 48 mm. The screw jack is used to lift a load of 7.5 kN. The coefficient of friction at the threads is 0.2 and the collar friction is negligible. Calculate: (i) the principal shear stress in the screw body; (ii) the transverse shear stresses in the screw and nut; and (iii) the unit bearing pressure. Also state whether the screw is self-locking or not. **(12.5)**

OR

Q5 What is function of rivet? Describe types of riveted joint? With neat and clean diagram, explain various failure modes of rivets. Also explain strength and efficiency of riveted joint. **(12.5)**

Q6 Define following terms used in compression spring: solid length, free length, spring index and spring rate. Also design a helical compression spring subjected to a maximum force of 7.5 kN. The mean coil diameter should be 150 mm from space consideration. The spring rate is 75 N/mm. the spring is made of oil hardened and tempered steel wire with ultimate

P.T.O.

strength of 1250 N/mm^2. The permissible shear stress for spring wire is 30% of ultimate strength (G = 81.37 kN/mm^2). Calculate: (i) wire diameter; and (ii) number of active coils. **(12.5)**

OR

Q7 Design a bushed-pin types of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm. The overall torque is 20% more than mean torque. The material properties are as follows: (a) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively; (b) The allowable shear stress for cast iron is 15 MPa; (c) The allowable bearing pressure for rubber bush is 0.8 N/mm^2; and (d) The material of the pin is same as that of shaft and key. **(12.5)**

Q8 It is required to design a pair of spur gear with 20° full-depth involute teeth consisting of a 20 teeth pinion meshing with a 50 teeth gear. The pinion shaft is connected to a 22.5 kW, 1450 rpm electric motor. The starting torque of motor can be taken as 150% of the rated torque. The material for the pinion is plain carbon steel Fe 410(S_{ut}= 410 N/mm^2), while the gear is made by grey cast iron FG 200 (S_{ut}= 200 N/mm^2). The factor of safety is 1.5. Design the gears based on Lewis equation and using velocity factor to account for the dynamic load. **(12.5)**

OR

Q9 Following data is given for a hydrostatic thrust bearing: thrust load = 150 kN, shaft speed = 720 rpm, shaft diameter = 500 mm, recess diameter = 300 mm, film thickness = 0.15 mm, viscosity of lubricant = 160 SUS and specific gravity = 0.86. Calculate supply pressure, flow requirement in litres/min, power loss in pumping and frictional power loss. Also define the static load carrying capacity of ball bearing. **(12.5)**

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ETAT-302
P2/2

(Please write your Exam Roll No.) *Exam Roll No. .....*

END TERM EXAMINATION

SIXTH SEMESTER [B.TECH] MAY-JUNE 2017

Paper Code: ETAT-302 ***Subject: Machine Design***

Time: 3 Hours ***Maximum Marks: 75***

Note: Attempt any five questions including Q.no.1 which is compulsory. Select one question from each Unit. Design data book is permitted and assume suitable missing data if any.

Q1 Write notes on following topics in brief and to the point. **(10x2.5=25)**

(a) Define factor of safety. What are the salient features used in the design of forging?
(b) What are fits and tolerances? How are they designated?
(c) State two principal design rules for casting design.
(d) List the different types of riveted joints and rivets.
(e) What do you understand by the term efficiency of a riveted joints?
(f) What do you understand by the single and double start threads?
(g) Distinguish clearly between pin, axle and shaft.
(h) How the shaft is designed when it is subjected to twisting moment only?
(i) What is meant by hydrodynamic lubrication?
(j) What are the commonly used materials for sliding contact bearings?

Unit-I

Q2 (a) Distinguish between design analysis and design synthesis. What are the three basic types of standards used in design? **(5)**

(b) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate tensile strength of rod material is 420 N/mm^2. The ultimate tensile and shearing strengths of pin material are 720 N/mm^2 and 395 N/mm^2 respectively. Use a factor of safety of 6. Assume permissible stress in tension and compression to be equal. **(7.5)**

Q3 (a) What is stress concentration? What are the methods of reducing stress concentration? **(5)**

(b) Determine the thickness of a 120 mm wide uniform plate for safe continuous operation if the plate is to be subjected to a tensile load that has a maximum value of 250 kN and a minimum value of 100 kN. The properties of the plate material are as follows: endurance limit stress = 225 MPa and yield point stress = 300 MPa, the factor of safety based on yield point may be taken as 1.5. **(7.5)**

Unit-II

Q4 Discuss the significance of the initial tightening load and the applied load so far as bolts concerned. A shaft of 20 mm diameter is welded coaxially with another shaft of much larger diameter. The shaft is to transmit a torque which is just safe for it. Calculate the width of the peripheral fillet weld between two shafts. The permissible shearing stress for the shaft material is 70 MPa and that for weld is 50 MPa. **(12.5)**

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ETAT-302
P.1/2

Q5 Why are square threads preferable to v-threads for power transmission? How does the helix angle influence on the efficiency of square threaded screw?
A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm^2, find (i) the torque required to rotate the screw, (ii) the stress in the screw and (iii) the number of threads of nut in engagement with screw. **(12.5)**

Unit-III

Q6 Under what circumstances are hollow shafts preferred over solid shafts? Give any two examples where hollow shafts are used.
Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 rpm. The angle of lap of the belt is 180^0 and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factor for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35 MPa. **(12.5)**

Q7 Classify springs according to their shapes.
Design a helical spring for a spring loaded safety valve for the following conditions:
Diameter of valve seat = 65 mm
Operative pressure = 0.7 N/mm^2
Maximum pressure when the valve blows off freely = 0.75 N/mm^2
Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm^2 = 3.5 mm
Maximum allowable stress = 550 MPa
Modulus of rigidity = 84 kN/mm^2
Spring index = 6
Draw a neat sketch of the free spring showing the main dimensions. **(12.5)**

Unit-IV

Q8 A gear drive is required to transmit 100 kW with driving pinion rotating at 1150 rpm and driven gear having a velocity ratio of 5.25. The pinion and gear are made in same steel having σ_u = 700 MPa and σ_{sur} = 550 MPa. The sum of teeth on pinion and gear is to be 300. Assume total design load factor of 1.5, fatigue strength reduction factor of 2, factor of safety against surface failure and bending of 1.67 and 1.8 respectively. b/A = 0.8. Calculate dimensions of gears. **(12.5)**

Q9 How do you express the life of a bearing? What is an average or median life?
Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load. **(12.5)**

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END TERM EXAMINATION

SIXTH SEMESTER [B.TECH] MAY-JUNE 2017

Paper Code: ETAT-302 ***Subject: Machine Design***

Time: 3 Hours ***Maximum Marks: 75***

Note: Attempt any five questions including Q.no.1 which is compulsory. Select one question from each Unit. Design data book is permitted and assume suitable missing data if any.

Q1 Write notes on following topics in brief and to the point. **(10x2.5=25)**

(a) Define factor of safety. What are the salient features used in the design of forging?
(b) What are fits and tolerances? How are they designated?
(c) State two principal design rules for casting design.
(d) List the different types of riveted joints and rivets.
(e) What do you understand by the term efficiency of a riveted joints?
(f) What do you understand by the single and double start threads?
(g) Distinguish clearly between pin, axle and shaft.
(h) How the shaft is designed when it is subjected to twisting moment only?
(i) What is meant by hydrodynamic lubrication?
(j) What are the commonly used materials for sliding contact bearings?

Unit-I

Q2 (a) Distinguish between design analysis and design synthesis. What are the three basic types of standards used in design? **(5)**

(b) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate tensile strength of rod material is 420 N/mm². The ultimate tensile and shearing strengths of pin material are 720 N/mm² and 395 N/mm² respectively. Use a factor of safety of 6. Assume permissible stress in tension and compression to be equal. **(7.5)**

Q3 (a) What is stress concentration? What are the methods of reducing stress concentration? **(5)**

(b) Determine the thickness of a 120 mm wide uniform plate for safe continuous operation if the plate is to be subjected to a tensile load that has a maximum value of 250 kN and a minimum value of 100 kN. The properties of the plate material are as follows: endurance limit stress = 225 MPa and yield point stress = 300 MPa, the factor of safety based on yield point may be taken as 1.5. **(7.5)**

Unit-II

Q4 Discuss the significance of the initial tightening load and the applied load so far as bolts concerned. A shaft of 20 mm diameter is welded coaxially with another shaft of much larger diameter. The shaft is to transmit a torque which is just safe for it. Calculate the width of the peripheral fillet weld between two shafts. The permissible shearing stress for the shaft material is 70 MPa and that for weld is 50 MPa. **(12.5)**

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Why are square threads preferable to v-threads for power transmission? How does the helix angle influence on the efficiency of square threaded screw? Q5

A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm², find (i) the torque required to rotate the screw, (ii) the stress in the screw and (iii) the number of threads of nut in engagement with screw. **(12.5)**

Unit-III

Under what circumstances are hollow shafts preferred over solid shafts? Give any two examples where hollow shafts are used. Q6

Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 rpm. The angle of lap of the belt is 180⁰ and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factor for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35 MPa. **(12.5)**

Classify springs according to their shapes. Q7

Design a helical spring for a spring loaded safety valve for the following conditions:

Diameter of valve seat = 65 mm

Operative pressure = 0.7 N/mm²

Maximum pressure when the valve blows off freely = 0.75 N/mm²

Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm² = 3.5 mm = δ

Maximum allowable stress = 550 MPa

Modulus of rigidity = 84 kN/mm²

Spring index = 6

Draw a neat sketch of the free spring showing the main dimensions. **(12.5)**

Unit-IV

A gear drive is required to transmit 100 kW with driving pinion rotating at 1150 rpm and driven gear having a velocity ratio of 5.25. The pinion and gear are made in same steel having $\sigma_u = 700$ MPa and $\sigma_{sur} = 550$ MPa. The sum of teeth on pinion and gear is to be 300. Assume total design load factor of 1.5, fatigue strength reduction factor of 2, factor of safety against surface failure and bending of 1.67 and 1.8 respectively. b/A = 0.8. Calculate dimensions of gears. Q8 **(12.5)**

How do you express the life of a bearing? What is an average or median life? Q9

Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load. **(12.5)**

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH] DECEMBER- 2016

Paper Code: ETME-307 ***Subject: Machine Design-I***

Time: 3 Hours ***Maximum Marks: 75***

Note: Attempt any five questions inlcludingQ.No1 which is compulsory. Select one question from each unit.

Q1 (a) Why 'Ergonomic' consideration is necessary in machine design? **(3)**

(b) The longitudinal riveted joint in a boiler is butt joint while the circumferential riveted joint is lap joint. Why? **(3)**

(c) What are different types of welded joints? Give their symbols. **(4)**

(d) Define 'stress concentration factor' and 'Fatigne stress concentration factor'. **(3)**

(e) What are different types of couplings? **(3)**

(f) Why are springs shot peened? **(3)**

(g) Why are v-threads not used in power screws? **(3)**

(h) In a gear speed reducer, why is the diameter of the output shaft greater than that of input shaft? **(3)**

UNIT-I

Q2 (a) What is 'Tolerance'? Why is it provided? Differentiate between 'Unilateral' and 'Bilateral' tolerance. What are different types of 'Fits'? **(7.5)**

(b) Briefly explain how are steels designated? **(5)**

Q3 (a) Sketch stress-time curve for **(5)**

(i) Fluctuating stress

(ii) Repeated stress

(iii) Reversed stress

(b) A rotating bar made of steel 45 C8 (S_{ut}=630 N/mm^2) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mn^2. Calculate the fatigue strength of the bar for a life of 80,000 cycles. **(7.5)**

UNIT-II

Q4 Discuss an example each where in the bolted joint, the bolts are subjected to

(a) Shear stress

(b) Tensile stress and shear stress

Explain how will you calculate the diameter of the bolt in these cases. **(12.5)**

Q5 (a) A double-riveted double strap butt joint is used to connect two plates, each of 12 mm thickness, by means of 16 mm diameter rivets having a pitch of 48 mm. The rivets and plates are made of steel. The permissible stress in tension, shear and compression are 80,60 and 120 N/mm^2 respectively. Determine the efficiency of the joint. **(7.5)**

(b) A circular beam 60 mm in diameter is welded to a support by means of a fillet weld. The length of the beam is 250 mm and a load of 15 kN acts at the free end of the beam. Determine the size of the weld if the permissible shear stress in the weld in limited to 100 N/mm^2. **(5)**

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UNIT-III

Q6 (a) A foot lever is 500 mm from the centre of the shaft to the point of application of the load whose magnitude is 700 N. Determine.
(i) The diameter of the shaft where the lever is fitted.
(ii) The dimensions of the key
(iii) Size of the cross-section of the arm of foot lever at the boss.
Assume that the depth of the arm is three times the width. Take the permissible stress in tension, shear and compression for the shaft, key and lever as 60,50 and 100 MPa. **(6)**

(b) A hollow transmission shaft having inside diameter 0.6 times the outside diameter is made of plain carbon steel 40C8 (S_{yt}=380N/mm^2) and the factor of safety is 3. A belt pulley 1200 mm in diameter is mounted on the shaft which overhangs the left hand bearing by 300 mm. The belt is vertical and transmits power to the machine shaft below the pulley. The tension on the tight side and slack side of the belt are 3.5 kN and 1.5kN respectively, while the weight of the pulley is 600 N. The angle of wrap of the belt on the pulley is 180^0. Calculate the diameters of the shaft. **(6.5)**

Q7 (a) What is Wahl's factor in helical springs? Why compression helical springs are commonly used as compared to extension helical springs? **(5)**

(b) A safety valve, 40 mm in diameter, is to blow off at a pressure of 1.2 MPa. It is held on its seat by means of a helical spring with initial compression of 20 mm. The maximum lift of the valve is 12 mm. The spring index is 6. The spring is made of cold drawn steel wire with ultimate tensile strength of 1400 N/mm^2. The permissible shear stress can be taken as 50% of tensile strength. Taking modulus of rigidity for the spring material as 81370 N/mm^2, determine. **(7.5)**
(i) Wire diameter
(ii) Mean coil diameter
(iii) Number of active coils

UNIT-IV

Q8 The pitch circle diameters of a pinion and gear are 100 and 300 mm respectively. The pinion is made of plain carbon steel 40 C 8 (S_{ut}=600 N/mm^2) While the gear is made of grey cost iron FG 300 (S_{ut}=300 N/mm^2. The pinion receives 5 kW at 500 r.p.m. through its shaft. The service factor and factor of safety can be taken as 1.5 each. The face width of the gear can be taken as ten times the module. Assume that velocity factor $c_v = \frac{3}{3+v}$ accounts for the dynamic load, where v is in m/s. The tooth from factor Y can be taken as $Y = 0.154 - \frac{0.912}{No.of\ teeth}$. Determine (a) module (b) number of teeth on pinion and gear. **(12.5)**

Q9 (a) What is 'Self Locking' of a power screw? **(5)**

(b) The following data refer to a machinist champ. **(7.5)**
Type of thread=single start, square
Nominal diameter= 20 mm
Pitch= 5 mm
Collar friction radius= 8 mm
Coeff. of friction at the threads and collar=0.15
The operator exerts a force of 50 N on the handle at a distance of 150 mm from the axis of the screw. Determine the maximum clamping force that can be developed

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END TERM EXAMINATION

Fifth Semester [B.Tech] December 2014-JANUARY 2015

Paper Code: ETME-303 Subject: Machine Design-I

Time: 3 Hours

(Please write your Exam Roll No.)

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH] DECEMBER 2014-JANUARY 2015

Paper Code: ETME-303 **Subject: Machine Design-I**

Time: 3 Hours **Maximum Marks: 75**

Note: Attempt any five questions including Q.no.1 which is compulsory. Assume suitably any data which not given. Use of chart/tables for fatigue design and gear design are permissible. Use of scientific calculator is allowed.

Q1 Choose the correct answer/answer briefly. **(1x25=25)**

(a) What do you understand by '50 H8-g7'?

(b) The property of a material which enables it to resist feature due to high impact load is known as:
(i) Endurance (ii) Ultimate strength (iii) Toughness (iv) Resilience

(c) Two coiled springs, each having stiffness K, are placed in parallel. The stiffness of the combination will be:
(i) 4K (ii) 2K (iii) K/2 (iv) K/4.

(d) Angle of twist of a shaft of diameter 'd' is inversely proportional to:
(i) d (ii) d^2 (iii) d^3 (iv) d^4

(e) The S-N curve for steel becomes asymptotic nearly at:
(i) 10^3 cycles (ii) 10^5 cycles (iii) 10^6 cycles (iv) 10^8 cycles.

(f) Define contact ratio of two mating gears and mention its importance in the design of gear drive.

(g) Why hollow shaft is preferred for large power transmission?

(h) Define fatigue stress concentration factor. How its value is obtained in practice?

(i) In a case of plane state of stress, the principal stresses σ_1 and σ_2 at a point are 80 MPa and 30 MPa respectively. The maximum shear stress is:
(i) 15 MPa (ii) 25 MPa (iii) 40 MPa (iv) 55 MPa.

(j) The taper in a key is provided on:
(i) Top side (ii) bottom side (iii) both side (iv) any side.

(k) What are the advantages of using 'standards' in design?

(l) In the design of flange coupling, the pitch circle diameter of bolts is taken as:
(i) 2d (ii) 3d (iii) 4d (iv) 5d.
where d is the diameter of the shaft.

(m) How are gears classified?

(n) In a fillet welded joint, the weakest area of weld is:
(i) toe (ii) root (iii) throat (iv) face.

(o) If 'pp is the pitch of a square thread, then the depth of thread 'd' is given by:
(i) 0.5p (ii) p (iii) 1.5p (iv) 2.0p

(p) Lewis equation in gears is used to fine:
(i) tensile stress in bending (ii) shear stress
(iii) compressive stress in bending (iv) fatigue stress

(q) The bolts in a rigid flange coupling connecting two shafts transmitting power are subjected to:
(i) sheer force and bending moment (ii) axial force
(iii) torsion and bending moment (iv) torsion

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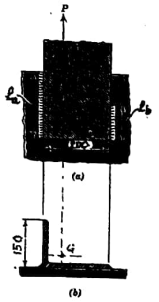
(r) Maximum shear stress theory of failure is applicable for:
(i) Ductile material (ii) brithle material
(iii)elastic material (iv) all the above
(s) What is the need of Wahl factor for the design of helical spring?
(t) What is 'interference' in involute profile gears? Give methods to avoid it?
(u) Show various stages of design process by a flow diagram.
(v) Define 'endurance limit'.
(w) Why we use factor of safety in design?
(x) Why are V threads not used in power screw?
(y) A cylinder is considered thin when the ratio of its inner diameter to the wall thickness is more than:
(i) 10 (ii) 15 (iii) 18 (iv) 20.

Q2 Two mild steel plates are to be joined by a butt joint with double cover to make it a tie bar. The plates are 12 mm thick and carry a load of 400 kN. Design a uniform strength joint assuming permissible values of stresses in tension, shear and compression, respectively, as 100 MPa, 70 MPa and 155 MPa. **(12.5)**

OR

Q3 An L200×150×20 steel angle is to be welded to a flat plate with long side of the angle against the plate (see fig.1.) Determine the minimum length l_a and l_b that will cause the angle to carry the maximum allowable axial load. The allowable tensile stress for the material in the angle is 125 MPa, and the allowable shear stress in the weld material is 95 MPa. Each lag of weld is 15 mm. **(12.5)**



Q4 (a) What are different manufacturing consideration in the design: (i) cast product (ii) forged component, and (iii) machine component? Explain each in detail with the help of suitable diagrams. **(6)**
(b) A sheer rod, having S_ut = 800 MPa, S_yt = 625 MPa, is subjected to a completely reversed axial load of 50 kN. Design the rod for infinite life assuming surface factor, K_a = 0.85, K_t = 1.5, q = 0.6 and factor of safety, N_f = 2. Neglect the column effect. K_t and q are respectively theoretical stress concentration factor and notch sensitivity factor. **(6.5)**

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OR

Q5 (a) Describe briefly various modifying factors employed for obtaining the endurance limit of a machine port at its critical location. **(4.5)**
(b) A 20 mm diameter shaft with 6 mm diameter transverse hole is made of cold-drawn steel having S_{ut} = 550 MPa and S_{yt} = 460 MPa. Suface in the vicinity of the hole have a machined finish. Estimate the factor of safety with respect to infinite fatigue life for a torque fluctuating between 0 and 100 N.m superimposed on a mean torque of 60 Nm. **(8)**

Q6 (a) Describe modes of failure for rotating shafts. Which materials you will suggest for the design of shaft? **(5)**
(b) A shaft supported in bearings placed 200mm apart carries a 20° pressure angle gear at the mid span. 4 kW of power is transmitted by the shaft at 150 rpm. The pitch circle diameter of the gear is 125 mm. The shaft is made in steel for which allowable sharing stress is 42 MPa. Calculate the shaft diameter. **(7.5)**

OR

Q7 (a) Differentiate between a 'shaft' and an 'axial'. **(2)**
(b) A bell-crank lever is subjected to a force of 7.5 kN at the short arm end. The lengths of the short and long arms are 100 and 500 mm respectively. The arms are at right angles to each other. The lever and pins are made of steel having S_{yt} = 300 MPa. The permissible bearing pressure at the pin is 10 MPa. The lever has rectangular cross-section and the ratio of width to thickness is 4:1. The length to diameter ratio of the fulcrum pin is 1.5:1. Calculate important dimensions for the lever assuming a suitable value of safety factor. **(10.5)**

Q8 (a) Discuss various modes of gear failure. **(4)**
(b) The load server of a lathe has single-start 150 metric trapezoidal threads of 52mm nominal diameter and 8mm pitch. The screw is required to exert and axial force of 2 kN in order to drive the tool carriage during turning operation. The thrust is carried on a collar of 100 mm outer diameter and 60mm inner diameter. The values of coefficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 30 rpm. Calculate:-
(i) The power required to drive the load screw, and
(ii) The efficiency of the screw. **(8.5)**

OR

Q9 (a) What is self-locking of power screw? State the applications where the self-locking is essential. **(2.5)**
(b) A 20° full-depth steel spur pinion rotates at 115 rev/min. It has a module of 6 mm, a face width of 75 mm, and 16 milled teeth. The ultimate tensile strength at the involute is 900 MPa exhibiting a Brinell hardness of 260. The gear, made in steel having identical material strengths, has 30 teeth. For a design factor of 1.3 find the power rating of the gear set based on the pinion and the gear resisting bending and wear fatigue. **(10)**

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH.] DECEMBER 2013

Paper Code: ETME303 **Subject: Machine Design-I**

Time : 3 Hours **Maximum Marks :75**

Note: Attempt all questions. Internal choice is indicated.

Q1 (a) Under what situation you use a cotter joint? Why is the cotter tapered on one side only and why is taper provided?

(b) Why spot facing is done on assemblies on the outer surfaces where bolt and nut rest? Why v-threads are not used in power transmission?

(c) Why are springs shot peened? What is the purpose of Wahl Factor in the design of dose coiled helical springs?

(d) What purpose is served by providing a step in the pin of a flexible coupling? What is the relation between the shaft diameter and pitch circle diameter of the bolts in a flange coupling?

(e) Why a riveted butt joint is preferred to a lap joint? What is the purpose of 'Initial Tightening' of bolts? **(5x5=25)**

Q2 Design a cotter joint to connect two mild steel rods of equal diameter transmitting an axial force of 25KN which is subjected to slow reversal of direction. Tensile stress in the material is limited to 50MPa. The shear stress has the value 4/5 of the permissible tensile stress. The crashing stress between the cotter and the rods is limited to 60MPa. **(12.5)**

OR

(a) A 150mmx100mmx12mm angle is to be welded to a steel plate by fillet welds along the edges of the 150mm leg. The welded joint is subjected to a tensile load of 200KN. The line of action of the load passes through the c.g. of the section. The permissible shear stress is $80N/mm^2$. Determine the length of weld required. **(6)**

(b) Two MS plates 200mmx12mm are to be joined together by means of a lap joint, using only four rivets. The plates are subjected to tension along their axes. Determine the size of the rivets and their arrangement to give strongest joint. The permissible stresses for MS in tension, shear and crushing are $80N/mm^2$, $60N/mm^2$ and $120N/mm^2$ respectively. **(6.5)**

Q3 A mild steel shaft has to transmit 74.6KW at 200 rpm. The maximum torque is likely to be 30% greater than the mean torque. Design and sketch a suitable coupling. Due to certain functional requirement, the angle of twist in the shaft must not excess 1^0 in a length of 20 diameters. The shafts are in correct alignment. The coupling must allow easy disassembly of the driver and driven machines. Permissible shear and crushing stresses for shaft and key material are 40MPa and 80MPa respectively. **(12.5)**

OR

P.T.O.

An over hung hollow shaft carries a 90cm diameter pulley, whose centre is 25cm from the centre of the nearest beaving. The weight of the pulley is 600N and the angle of cap is 180°. The pulley is driven by a motor vertically below it. If the permissible tension in the belt is 2650N and the coefficient of friction between the belt and the pulley is 0.3. Determine the diameters of the shaft. The internal diameter of the shaft is to be 0.6times the external diameter. **(12.5)**

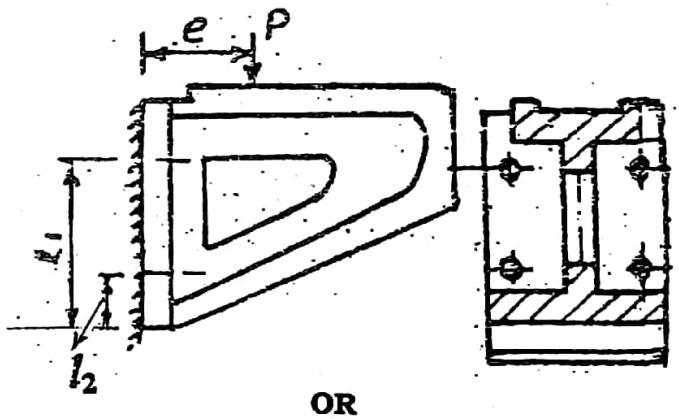
Q4 A steel wire is to be wound into close coiled helical spring with index 6 and to carry an axial force of 2KN. The steel has a permissible shear stress of 450N/mm². The spring is allowed to deflect through 3.1mm under the load. Taking G=0.84x10⁵N/mm². Find the wire diameter and number of coils. If the spring is under compression and required to have squared and ground ends, what will be the actual number of turns? **(12.5)**

OR

A machine slide weighing 3KN is elevated by a double start ACME threaded screw at the rate of 840mm/min., if the coefficient of friction is 0.12. Calculate the power to drive the slide. The end of the screw is carried on a thrust collar of 32mm inside diameter and 58mm outside diameter. Pitch of the screw thread is 6mm and the outside diameter of the screw is 40mm. If the screw is of C45 steel, is it strong enough to sustain the load? **(12.5)**

Q5 (a) A bracket shown in fig.1 carries a load P=20KN. The distance e is 450mm. The bracket is fastened to the wall using four bolts. The distances l_1 and l_2 are 550mm and 50mm respectively. Determine the size of the bolt made of low carbon steel having permissible tensile strength of 42N/mm². **(8.5)**

(b) What will be the maximum tensile and shear stresses in the bolt when the bolt size is M20x3.0. **(4)**



OR

Design a bell-crank lever to apply a load of 5KN (vertical) at the end A of a horizontal arm of length 400mm. The end of the vertical arm C and the fulcrum B are to be fixed with the help of pins inside forked shaped supports. The end A is itself forked. Determine the cross-section of the arms and dimension of the pins. The lever has a mechanical advantage of 4 with a shorter vertical arm BC. The ultimate stresses in shear, tension for the lever and pins are 400 and 500N/mm² respectively and an allowable bearing pressure for the pins is 12N/mm². Sketch the lever and show all the dimensions. **(12.5)**

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH.] DECEMBER-2010

Paper Code: ETME303 **Subject: Machine Design -I**

Time : 3 Hours **Maximum Marks :75**

Note: Q.1 is compulsory. Internal choice is indicated.

Q1 Choose the correct answer/answer briefly. **(1x25=25)**

(a) The type of fit resulting from the combination of H6 hole and j5 shaft is-
(i) Shrink fit (ii) Push fit (iii) Clearance fit (iv) Transition fit

(b) The screw of screw jack has square threads and the lead angle of the threads is α. The jack will be self-locking when-
(i) $\mu < \tan\alpha$ (ii) $\mu = \tan\alpha$ (iii) $\mu > \tan\alpha$ (iv) None of the above

(c) A close coiled helical spring is cut in two equal parts along its length. Stiffness of the two springs so obtained will be-
(i) Double of that of the original spring (ii) Same as that of the original spring
(iii) Half of the that of the original spring
(iv) One-fourth of that of the original spring

(d) Bolts in the flanged end of pressure vessel are usually pre-tensioned. Indicate which of the following statements is not true-
(i) Pre-tensioning helps to seal the pressure vessel.
(ii) Pre-tensioning increases the fatigue life of the bolts.
(iii) Pre-tensioning reduces the maximum tensile stress in the bolts.
(iv) Pre-tensioning helps to reduce the effect of pressure pulsation in the pressure vessel.

(e) In terms of theoretical stress concentration factor (K_t) and fatigue stress concentration factor (K_f), the notch sensitivity 'q' is expressed as-
(i) $\frac{K_f - 1}{K_t - 1}$ (ii) $\frac{K_f - 1}{K_t + 1}$ (iii) $\frac{K_t - 1}{K_f - 1}$ (iv) $\frac{K_f + 1}{K_t + 1}$

(f) The S-N curve for steel becomes asymptotic nearly at-
(i) 10^3 cycles (ii) 10^4 cycles (iii) 10^6 cycles (iv) 10^9 cycles

(g) The percentage of carbon in grey cast iron is in the range of-
(i) 0.25 to 0.75% (ii) 1.25 to 1.75% (iii) 3 to 4 % (iv) 8 to 10%

(h) Define contact ratio of two mating gears and mention its importance in design of gear drive.

(i) "Hollow shafts are preferred for large power transmission". Why?

(j) Transverse fillet welded joints are designed for-
(i) Tensile strength (ii) Compressive strength
(iii) Bending strength (iv) Shear strength

(k) Function of washer is-
(i) To fill the axial gap (ii) To provide bearing area
(iii) To provide cushioning effect (iv) To absorb shocks and vibrations

(l) In a cotter joint, the cotter has-
(i) Taper on one side (ii) Taper on both sides (iii) No taper

(m) Why are springs shot peened?

(n) Maximum shear stress induced in the wire of a circular cross section of a helical spring depends upon-
(i) Wire diameter (ii) Material of wire (iii) Spring index (iv) all of the above

(o) For ductile materials, theory of failure generally applied is-
(i) Maximum principal stress theory (ii) Maximum shear stress theory
(iii) Maximum strain theory (iv) Maximum strain energy theory

(p) Taper in key is provided on-
(i) Top side (ii) Bottom side (iii) Both side (iv) Any side

(q) The cross-section of the arm of a bell crank lever is-
(i) Rectangular (ii) Elliptical (iii) I-section (iv) Any one of the above

(r) Lewis equation in gears is used to find the-
(i) Tensile stress in bending (ii) Shear stress
(iii) Compressive stress in bending (iv) Fatigue stress

(s) What is the need for Wahl factor for helical springs?

(t) What is 'Interference' in involute profile gears? Give different methods to avoid it.

(u) An imaginary circle which by pure rolling action gives the same motion as the actual gear is called-

P.T.O.

P1 P2

(i) Addendum circle (ii) Dendendum circle
(iii) Pitch circle (iv) None of the above

(v) In an interchangeable assembly, shafts of size $25.000^{-0.040}_{-0.010}$ *mm* mate with holes of size $25.000^{+0.020}_{-0.000}$ *mm*. The maximum possible clearance in the assembly will be-

(i) 10microns (ii) 20microns (iii) 30microns (iv) 60microns

(w) In the design of flange coupling, the pitch circle diameter of the bolts is taken as
(i) 2d (ii) 3d (iii) 4d (iv) 5d (d=diameter of the shaft)

(x) What are the advantages of using 'standards' in design?

(y) How are gears classified?

Q2 Design a Knuckle joint to transmit 150KN load. The design stresses may be taken as 75MPa in tension, 60MPa in shear and 150MPa in compression. **(12.5)**

OR

A triple riveted lap joint with zig-zag riveting is to be designed to connect two plates of 6mm thickness. Determine the diameter of the rivet, pitch of the rivets and distance between the rows of rivets. Indicate how the joint will fait. The stresses in tension, shear and crushing may be taken as 120N/mm², 100N/mm² and 150N/mm² respectively. **(12.5)**

Q3 What are different manufacturing considerations in the design of (a) a cast product (b) a forged component (c) a machined component? What are different ergonomic considerations in design? Explain with examples. How do you decide the size range of a product to be manufactured with the help of 'Preferred Numbers'? **(12.5)**

OR

(a) A steel rod, having σ_u=1000MN/m² and σ_y=900MN/m², is subjected to a completely reversed axial load of 50KN. Assuming load factor=0.85, size factor=0.9, surface factor=0.82 and factor of safety=2. Determine the size of the rod. Take K_t=1.5 and q=0.6 and neglect any column effect. **(6)**

(b) A machine component is subjected to bending stress which fluctuates between +300MN/m² and -150MN/m². Determine the value of the minimum ultimate strength according to- (i) Soderberg line (ii) Goodman line (iii) Gerber parabola. Take factor of safety as 2. **(6.5)**

Q4 (a) Differentiate between a 'shaft' and an 'axle'.

(b) An overhung hollow shaft carries a 90cm diameter pulley, whose centre is 25cm from the centre of the nearest bearing. The weight of the pulley is 600N and the angle of lap is 180°. The pulley is driven by a motor vertically below it. If the permissible tension in the belt is 2650N and the coefficient of friction between the belt and the pulley is 0.3, determine the diameters of the shaft. The internal diameter of the shaft is to be 0.6 times the external diameter. **(12.5)**

OR

Design a crank lever for the following dimensions:-
Length of the handle=320mm, length of the lever arm=450mm, overhang of the journal=120mm. The lever if operated by a single person exerting a maximum force of 400N at a distance of 1/3 length of the handle from its free end. The permissible stresses may be taken as 50MPa for the lever material and 40MPa for the shaft material. **(12.5)**

Q5 A machine slide weighing 3000N is elevated by a double start acme threaded screw at a rate of 840mm/min. If the coefficient of friction is 0.12, calculate the power required to drive the slide. The end of the screw is carried on a thrust collar of 32mm inside diameter and 58mm outside diameter. Pitch of the screw is 6mm and outside diameter of the screw is 40mm. If the screw is of C45 steel, is it strong enough to sustain the load? Sketch the system. **(12.5)**

OR

Design a pair of spur gears with 14.5° full depth involute teeth to transmit 75KW from a pinion rotating at 1000rpm to a gear at 250rpm. The gear is to be made of high grade cast iron with an allowable static stress of 10.5KN/cm² and the pinion is to be made of steel with an allowable static stress of 17.5KN/cm². Take facewidth=15xmodule and the pitch line velocity of 450m/min. **(12.5)**

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P2/P2

(Please write your Exam Roll No.)

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH.] DECEMBER 2009

Paper Code: ETME-303
Paper ID: 36303
Time : 3 Hours
Subject: Machine Design-I
(Batch: 2004-2007)
Maximum Marks :75

Note: Q.1 is compulsory. Internal choice is indicated in other questions.

Q.1 (i) Why is the cotter tapered on one side only and why is taper provided.

(ii) Why spot facing is done on assemblies on the outer surfaces where bolt and nut rest?

(iii) What do these symbols represent: 20C4 and F∈220?

(iv) Why are machine shafts usually stepped?

(v) Suggest suitable design to reduce/prevent the loosening of bolts of assemblies subjected to fatigue loads.

(vi) In which situations serrations are preferred to keyways on shafts?

(vii) Two springs have stiffness K_1 and K_2. What is the combined stiffness when they are used in series?

(viii) Suggest the method of reducing wear of a pin used in a lever.

(ix) What shape of cross-section in preferable in a lever and why?

(x) Why is the use of tensile spring avoided if it is possible to use a compression spring in that situation?

(xi) Why is a V-thread not used in power transmission?

(xii) In which situation ACME thread is more suitable than a square thread even though its efficiency is lower?

(xiii) Draw a curve indicating the variation of efficiency with respect to lead angle for a square thread for a coefficient of friction of about 0.15.

(xiv) In which application, the use of ball bearing screws is preferable?

(xv) Why is the factor of safety for design of tommy bar of screw jack lowest?

(xvi) Why is a riveted butt joint preferable to a lap joint?

(xvii) Why is register provided in a rigid flange coupling?

(xviii) What purpose is served by providing gasket in a pipe joint carrying a fluid?

(xix) Why is an involute profile preferred in gears?

(xx) What surface treatment can be used for increasing fatigue life of gears?

(xxi) What purpose is served by providing a step in pin of a flexible coupling?

(xxii) What is indicated by 50H8/g8?

(xxiii) What is the range of clearance fits in terms of alphabets?

(xxiv) What is the range of interference fits in terms of alphabets?

(xxv) What is most comfortable visual range in standing position?

(1×25 = 25)

Q.2 (a) Describe with sketches 8 (eight) considerations for a good design of parts to be produced by casting. (8)

P.T.O.

(b) Derive an expression for dynamic stress in the case of pulley having radius r and having a constant peripheral speed v. **(4.5)**

OR

(a) List 8 factors to be considered for selecting a factor of safety. **(8)**

(b) Make schematic sketch to show the following for a shaft (i) Zeroline (ii) Lower deviation (iii) Upper deviation (iv) tolerance (v) actual size. **(4.5)**

Q.3 Design a double riveted butt joint with double strap for connecting two plates 18mm thick for maximum efficiency. The allowable stresses are: tensile stress 70 N/mm², shear stress 55N/mm², compression stress 110 N/mm². **(12.5)**

OR

Design the size of a fillet weld used to join a hub to a gear web. The hub diameter at which weld is to be provided is 60 mm. The gear is subjected to a maximum torque of 2 kNm. The allowable shear stress in the weld is 95 N/mm².

Q.4 Design a bushed pin flexible coupling to transmit 20 kN at 1000 rpm. The shaft diameters are 50 mm each. The allowable stress in the pin is limited to 65N/mm². The allowable stress in keys are: shear stress 15Nmm², compression stress 20N/mm². The allowable bearing pressure for rubber bushes is 0.3 N/mm². **(12.5)**

OR

Design a pipe joint for joining steel pipes subjected to internal fluid pressure of 14N/mm². The allowable tensile stress in pipes, flanges and bolts is 75N/mm².

Q.5 Design close coiled helical spring for the buffers of a train wagon weighing 220 kN. The wagon is to be brought to rest from a speed of 1.5 km/hr by using four such buffers (two on each wagon). The approximate inside diameter of buffer housing is 300 mm and each spring undergoes a maximum deflection of 120 mm. The allowable shear stress in spring is limited to 500 N/mm². Find also the length of housing for the springs. Use a Wahl factor $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$ where C is spring index. G = 8500 N/mm². **(12.5)**

OR

A pair of spur gears with 20° full depth involute profile transmits 20 kW at 960 rpm of pinion. The speed reduction is 3.5:1. The material of pinion has a static strength of 300 N/mm² and that of gear has a static strength of 200 N/mm². Determine the necessary module, pitch and face width for minimum weight of gears. Take $y = 0.154 - \frac{0.912}{Z}$ where Z is number of teeth and velocity factor C = $\frac{3}{3+v}$ where v is m/s. If both the gears are overhanging beyond the bearings by 70 mm, find the shaft diameters if the allowable shear stress for unkeyed shaft is 55N/mm².

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH.]– DECEMBER 2008

Paper Code: ETME303
Paper ID: 36303
Time : 3 Hours

Subject : Machine Design-I
(Batch: 2004-2006)

Maximum Marks :75

Note: Attempt any five questions.

Q.1 What information do you obtain from Soderberg Line, Goodman's line and Gerber parabola? Give their specific applications. Determine the diameter of a circular cross-section member from the following data. (15)

Maximum tensile load	= 10 KN
Maximum compressive load	= 5 KN
Ultimate tensile strength	= 600 MN/m^2
Yield point	= 380 MN/m^2
Endurance limit	= 290 MN/m^2
Factor of safety	= 4
Stress concentration factor	= 2.2

Q.2 (a) "The material of a shaft is changed from C-40 steel to alloy steel to increase the rigidity". Give your comment. (5)

(b) "By increasing the moment of inertia without increasing the material content, the ratio of weight of the component to the load carried is always reduced for any type of load, tensile, compressive, bending and torsional". Put forward your argument for or against the statement. (5)

(c) What is meant by "Endurance strength" of a material? How do size and surface finish affect the endurance strength? (5)

Q.3 (a) What purpose is served by providing clearance between cotter and spigot, cotter and socket? (2)

(b) Design a knuckle joint to transmit a tensile or compressive load of 60 KN. The allowable stress in the material are (13)

tensile	= 65 N/mm^2
compression	= 80 N/mm^2
shear	= 50 N/mm^2

$\rho = \frac{I}{y} d^2 \times t$ $d_1 = d$ $t = 1.25d$
$d_2 = 2d$ $t_1 = .75d$
$d_3 = 1.5d$ $t_2 = .5d$
$d = ?$

Q.4 Two lengths of mild steel tie rod having width 200 mm are to be connected by means of Lozenge joint with two cover plates to withstand a tensile load of 180 KN. Completely design the joint if the permissible stresses are 80 N/mm^2 in tension, 65 N/mm^2 in shear and 160 N/mm^2 in crushing. Draw a neat sketch of the joint. (15)

Q.5 Design a bushed-pin type flexible coupling for connecting a motor shaft to a pump shaft for the following service conditions: -

Power to be transmitted	= 20 KW
R.P.M. of the motor shaft	= 1000
Diameter of the motor shaft	= 50 mm
Diameter of the pump shaft	= 45 mm
Bearing pressure on rubber bush	= 0.4 N/mm^2
Allowable stress in the pin	= 26 N/mm^2
Thickness of rubber bush	= 6 mm
Thickness of brass sleeve	= 4 mm

P.T.O.

Assume the length of rubber bush in the flange to be greater than half of the shaft diameter and p.c.d. of pins as 3.5 times the shaft diameter. Give a neat sketch of the coupling. (15)

Q.6 A hot rolled steel shaft is subjected to a torque that varies from 360 N-m clockwise to 100 N-m counter clockwise. The bending moment at the critical section varies from +400 N-m to -200 N-m. If the shaft is uniform in cross-section, determine its diameter. For the shaft material, ultimate strength is 550 MPa and yield strength is 375 MPa The following data may be used:
Factor of safety = 2
Size factor = 0.8
Surface finish factor = 0.5
Theoretical stress concentration factor due to keyway at the critical section of the shaft = 2.1
Notch sensitivity index for the shaft material = 0.6 (15)

Q.7 (a) Compare square and trapezoidal threads for power screws. Give their applications. (3)

(b) A double start, square threaded power screw is used to raise a load of 5 KN. The nominal diameter of the screw is 50 mm and the pitch is 8 mm. the coefficient of friction in screw threads and collar may be taken as 0.15 and 0.10 respectively. The inner and outer diameters of the collar are 50 and 80 mm respectively. (i) What should be the length and diameter of the lever rod, if the operator is expected to apply a force of 200 N while raising the load? Allowable tensile stress for the lever material is 100 N/mm^2. (ii) Find the required number of threads on the nut, if the permissible bearing pressure for the nut material is 6 MPa. (8+4)

Q.8 (a) What informations are to be indicated to completely specify a close coiled helical spring? How many types of ends are possible in compression springs? (5)

(b) Design the valve spring for an automobile engine. When the valve is closed the spring should produce a force of 45 N and when open, a force of 55 N. The spring must fit over the valve bush which has an outside diameter of 20 mm and must go inside a space of 35 mm, the valve lift is 6 mm. Use silicon-manganese steel with an allowable static stress in shear as 33 KN/cm^2. For rapid stress change it may be taken as 22 KN/cm^2. (10)

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11/12/08

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH.] DECEMBER-2008

Paper Code: ETME303
Paper Id: 36303
Subject: Machine Design-I
(Batch: 2001-2003)
Time : 3 Hours
Maximum Marks :75

Note: Attempt any five questions. All questions carry 15 marks each.

Q1 (a) Define endurance strength. Name four parts subjected to fatigue loads.

(b) Define stress concentration and stress concentration factor. Describe different causes of stress concentration. Give two situations where stress concentration is of advantage.

(c) Explain with sketches, eight considerations for design of good castings.

Q2 (a) What is the most important property which a rivet material must possess?

(b) Why is a butt joint preferable to a lap joint?

(c) What type of failures would be caused in a riveted joint if the margin or edge distance is less than 1.5d, d being diameter of rivet?

(d) Determine the maximum load P that can be carried by the joint shown in Fig1(a) if the permissible stresses in shearing and bearing are 45N/mm^2 and 65N/mm^2 respectively. Assume the diameter of each of the three rivets to be equal to 24mm and their centres are at a distance of 15cm from one another. If alternate patterns of riveting are shown in fig 1(b) and fig1(c), which of the three patterns is the best? Give reasons. The position C.G remains same.

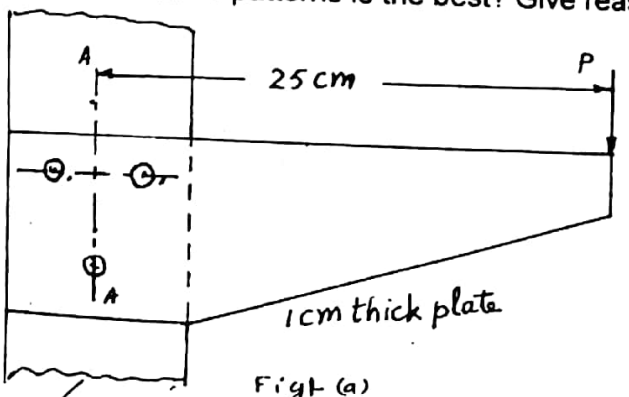

Fig1 (a)

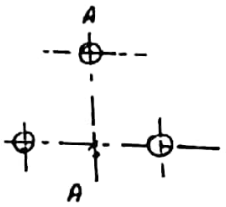

Fig1 - (b)

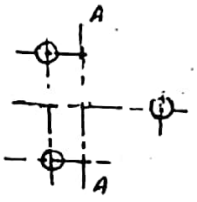

Fig1 - (c)

Q3 (a) In what way is a hollow shaft preferable to a solid shaft? Why are they not so commonly used?

(b) Why is the allowable stress in a keyed shaft taken as 0.75x allowable stress for an unkeyed shaft?

(c) A 60cm diameter pulley driven by a horizontal belt transmits power through a solid steel shaft to a 25cm diameter which drives a meting gear. The pulley weighs 1500N. The arrangement of elements, the belt tensions and component of gear reactions on the pinion are shown in fig.2. Assuming an allowable shear stress of 45N/mm^2, find the diameter of the shaft. Take K_b=2.0 and K_t=1.5. Pulley and pinion are both keyed to the shaft.

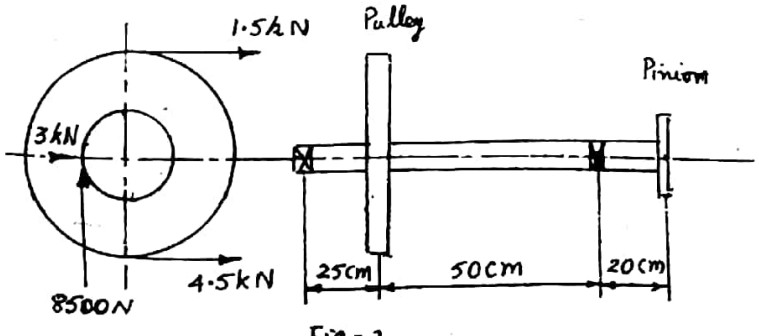

Fig - 2

P.T.O.

Q4 (a) What is the advantage of using hard washers in bolted assemblies subjected to fatigue loads?

(b) Sketch a uniform strength bolt.

(c) Design a pipe joint for connecting two pipes carrying water under a pressure of 8N/mm^2. The bore of pipe is 50mm. The allowable stress in the pipe material is 60N/mm^2. The allowable stress in the flange and bolt material is 80N/mm^2. Make a proportionate sketch of the joint.

Q5 Design a screw cap, nut and tommybar of a screw jack for lifting a load of 20kN with a possible eccentricity of 1.0mm. The maximum compressive strength of 45C8 steel is 750 N/mm^2. The allowable bearing pressure between nut and screw is 16N/mm^2. The coefficient of friction between nut and screw is 0.14 and for cap collar and screw top is 0.2. The tommy bar is of 20C8 steel having a U.T.S of 460 N/mm^2.

Q6 (a) Why is Wahl's factor used in the design of springs?

(b) Make a sketch of a compression spring to be used for tensile loads.

(c) Design a spring balance to measure 1000N.The scale length is 100mm. The spring is to be housed inside a tube of bore 40mm. Assume the allowable shear stress in the spring wire to be 450N/mm^2. The value of G=82kN/mm^2 and Wahl's stress factor $k = \frac{4C-1}{4C-4} + \frac{0.615}{C}$ where C is spring index. Show by a sketch, the arrangement of balance.

Q7 (a) State the law of gearing.

(b) State the advantages of using involute profile for gear teeth as compared to cycloidal profile.

(c) A pair of spur involute gears is used for reducing the speed of a shaft transmitting 18kw at 1200rpm. The velocity ratio is 3.5: 1.0. The static stress of pinion material is 120N/mm^2 and that of gear material is 100N/mm^2. Find the module face width no. of teeth and diameters of gears. Assume the form factor $y = 0.154 - \frac{0.912}{z}$ where z is no. of teeth. The Barth's velocity factor $C = \frac{3}{3+V}$ where v is in m/s. The pressure angle is 20^0.

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