ii.   Write the procedure for designing a wire rope.   **5**

iii. A pulley used to transmit power by means of ropes has a diameter of   **5**
3.8 metres and has 15 grooves of 40° angle. The angle of contact is
160° and the coefficient of friction between the ropes and the groove
sides is 0.27. The maximum possible tension in the ropes is 960 N and
the mass of the rope is 1.6 kg per metre length. Determine the speed
of the pulley in r.p.m. and the power transmitted if the condition of
maximum power prevails.

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Enrollment No....................................

Faculty of Engineering

End Sem (Even) Examination May-2019

AU3CO07 / ME3CO08 Machine Design-I

Programme: B.Tech.   Branch/Specialisation: AU/ME

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: (a) All questions are compulsory. Internal choices, if any, are indicated. Answers
of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

(b) Use of design data hand book is permitted in the examination hall. Assume
and mention suitable data if not given.

Q.1   i.   Design of an aluminium member is strongly based on   **1**
(a) Yield stress   (b) Elastic limit stress
(c) Proof stress   (d) Ultimate stress

ii.   The residual compressive stress, when a material is surface treated   **1**
subjected to fatigue loading
(a) Improves the fatigue life
(b) Deteriorates the fatigue life
(c) Does not affect the fatigue life
(d) Immediately fractures the specimen

iii. The preferred material for the key in most of the applications is   **1**
(a) Heavier than shaft material
(b) Heavier than gear material
(c) Heavier than flange material
(d) None of these

iv.   The sleeve or muff coupling is designed for the criteria of   **1**
(a) Thin cylinder   (b) Misalignment of flanges
(c) Misalignment of shafts   (d) Hollow shaft

v.   Two shafts will have equal strength, on the basis of torsional rigidity,   **1**
if
(a) Diameter of both the shafts is same
(b) Angle of twist of both the shafts is same
(c) Material of both the shafts is same
(d) All of these

P.T.O.

vi. The design of shafts made of brittle materials is based on **1**
(a) Coulomb's theory   (b) Rankine's theory
(c) St. Venant's theory   (d) Von Mises theory

vii. When two concentric coil springs made of the same material, having **1** same length are compressed equally by an axial load, the load shared by the two springs will be _____ to the square of the diameters of the wires of the two springs.
(a) Directly proportional   (b) Inversely proportional
(c) Equal to   (d) None of these

viii. A main purpose of the leaf spring in automobiles is **1**
(a) To balance forces   (b) To calculate forces
(c) To absorb shocks   (d) To store strain energy

ix. Which of the criteria is included in chain design? **1**
(a) Velocity ratio   (b) Teeth on smaller sprocket
(c) Service factor   (d) All of these

x. The main function of core in wire ropes is to **1**
(a) Reduce friction   (b) Increase strength
(c) Reduce cost   (d) None of these

Q.2   i. Give the formula of factor of safety for brittle and ductile material. **2**

ii. What are the three basic modes of failure of mechanical components? **3**

iii. A rod of steel 40Cr1 (Sut=550 N/mm^2) is subjected to a completely **5** reversed axial load of 100 KN. The rod is machined on lathe and the expected reliability is 95%. There is no stress concentration. Determine the diameter of the rod using a factor of safety of 2 for an infinite life condition.

OR   iv. What is the difference between Gerber curve and Soderberg and **5** Goodman lines?

Q.3   i. Give two differences between splines and keys. **2**

ii. A 50 mm diameter shaft is made of steel with yield strength of 410 **8** MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with yield strength of 350 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2.

OR   iii. Design a protective type of cast iron flange coupling for a steel shaft **8** transmitting 18 kW at 250 r.p.m. and having an allowable shear stress of 45 MPa. The working stress in the bolts should not exceed 32 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The shear stress for cast iron is 15 MPa.

Q.4   i. Write three advantages of hollow shaft over solid shaft. **3**

ii. Find the diameter of a solid steel shaft to transmit 22 kW at 250 r.p.m. **7** The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 6. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.4.

OR   iii. A shaft made of mild steel is required to transmit 110 kW at 350 **7** r.p.m. The supported length of the shaft is 3 metres. It carries two pulleys each weighing 1600 N supported at a distance of 1 metre from the ends respectively. Assuming the safe value of stress, determine the diameter of the shaft.

Q.5   i. Explain the term surging and nipping in relation to springs. **4**

ii. Design a spring for a balance to measure 0 to 1050 N over a scale of **6** length 85 mm. The spring is to be enclosed in a casing of 30 mm diameter. The approximate number of turns is 40. The modulus of rigidity is 85 kN/mm^2. Also calculate the maximum shear stress induced.

OR   iii. A truck spring has 14 number of leaves, two of which are full length **6** leaves. The spring supports are 1.08 m apart and the central band is 95 mm wide. The central load is to be 5.6 kN with a permissible stress of 290 MPa. 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. Taking E=210 x 10^3 N/mm^2.

Q.6   Attempt any two:

i. Give five differences between rope drives, chain drives and belt **5** drives.

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Marking Scheme
AU3CO07 / ME3CO08 Machine Design-I

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Q.1   i.   Design of an aluminium member is strongly based on   **1**
(a) Yield stress

ii.   The residual compressive stress, when a material is surface treated   **1**
subjected to fatigue loading
(a) Improves the fatigue life

iii.   The preferred material for the key in most of the applications is   **1**
(d) None of these

iv.   The sleeve or muff coupling is designed for the criteria of   **1**
(d) Hollow shaft

v.   Two shafts will have equal strength, on the basis of torsional rigidity,   **1**
if
(b) Angle of twist of both the shafts is same

vi.   The design of shafts made of brittle materials is based on   **1**
(b) Rankine's theory

vii.   When two concentric coil springs made of the same material, having   **1**
same length are compressed equally by an axial load, the load shared
by the two springs will be _____ to the square of the diameters of the
wires of the two springs.
(a) Directly proportional

viii.   A main purpose of the leaf spring in automobiles is   **1**
(c) To absorb shocks

ix.   Which of the criteria is included in chain design?   **1**
(d) All of these

x.   The main function of core in wire ropes is to   **1**
(a) Reduce friction

Q.2   i.   Formula of factor of safety for   **2**
Brittle   1 mark
Ductile material.   1 mark

ii.   Three basic modes of failure of mechanical components   **3**
1 mark for each mode   (1 mark * 3)

iii.   Determine the diameter of the rod using a factor of safety of 2 for an   **5**
infinite life condition.
Endurance limit stress   3 marks
Amplitude   1 mark
Diameter   1 mark

OR   iv.   Difference between Gerber curve and Soderberg and Goodman lines   **5**
Diagrammatically difference   2 marks
Explanatory difference   3 marks

Q.3   i.   Two differences between splines and keys.   **2**
1 mark for each difference   (1 mark * 2)

ii.   Use maximum shear stress theory and assume a factor of safety of 2.   **8**
Maximum Torque   4 marks
Length for shear   2 marks
Length of crushing   2 marks

OR   iii.   Design a protective type of cast iron flange coupling   **8**
Hub design   2 marks
Key design   2 marks
Flange Design   2 marks
Bolts design   2 marks

Q.4   i.   Three advantages of hollow shaft over solid shaft.   **3**
1 mark for each advantage   (1 mark * 3)

ii.   Find the diameter of a solid steel shaft   **7**
Allowable shear stress   1 mark
Diameter of solid shaft   3 marks
Diameter of hollow shaft   3 marks

OR   iii.   Assuming the safe value of stress, determine the diameter of the shaft.   **7**
Twisting moment   1 mark
Bending Moment   3 marks
Equivalent Twisting moment   1 mark
Diameter of shaft   2 marks

Q.5   i.   Surging in relation to springs.   2 marks   **4**
Nipping in relation to springs.   2 marks

ii.   Also calculate the maximum shear stress induced.   **6**
Spring design   4 marks
Shear stress   2 marks

OR   iii.   Determine the thickness and width of the steel spring leaves.   **6**
Width   2 marks
Thickness   2 marks
Deflection   2 marks

Q.6   Attempt any two:

     i.   Give five differences between rope drives, chain drives and belt drives.   **5**
            1 mark for each difference   (1 mark * 5)

     ii.   Procedure for designing a wire rope.   **5**
            1 mark for each difference   (1 mark * 5)

     iii.   Determine the speed of the pulley in r.p.m. and the power transmitted   **5**
            if the condition of maximum power prevails.
            Speed   2 marks
            Maximum power   3 marks

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