

## Quiz = 1

Time : 50 Minutes

Marks = 10

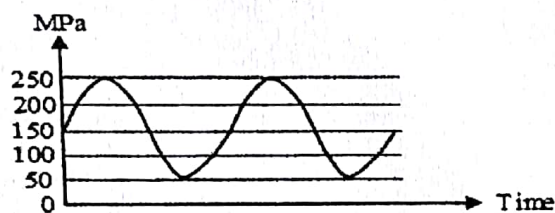
Q. (i) A cylindrical shaft is subjected to an alternating stress of 100 MPa. Fatigue strength to sustain 1000 cycles is 490 MPa. If the corrected endurance strength is 70 MPa, estimated shaft life will be

Q. (ii)

A rotating steel shaft is supported at the ends. It is subjected to a point load at the center. The maximum bending stress developed is 100 MPa. If the yield, ultimate and corrected endurance strength of the shaft material are 300 MPa, 500 MPa and 200 MPa, respectively, then the factor of safety for the shaft is \_\_\_\_\_

Q. (iii)

For the given fluctuating fatigue load, the values of stress amplitude and stress ratio are respectively



(A) 100 MPa and 5

(B) 250 MPa and 5

(C) 100 MPa and 0.20

(D) 250 MPa and 0.20

A machine component is subjected to a flexural stress, which fluctuates between  $+300 \text{ MN/m}^2$  and  $-150 \text{ MN/m}^2$ . If yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and factor of safety = 2. Determine the value of minimum ultimate strength according

Q. (iv) Goodman relation;

Q. (v) Soderberg relation

Q. (vi) Gurber relation

A 15mm thick and 50 mm wide plate made of steel (160 BHN) is subjected to axial force of 10 kN. If a hole of diameter 10 mm is made at the centre of the plate, determine

Q. (vii) The maximum stress induced in the plate.

Q. (viii) The endurance strength for steel, if notch sensitivity factor is 0.85 surface finish factor is 0.84, size factor 0.89, reliability factor 0.875.

Q. (ix) The effect on endurance strength and on maximum stress induced, if the hole is to be replaced by an ellipse having major axis parallel to direction of load.

Q. (x) The effect on endurance strength and on maximum stress induced If the hole is to be replaced by an ellipse having major axis perpendicular to direction of load.

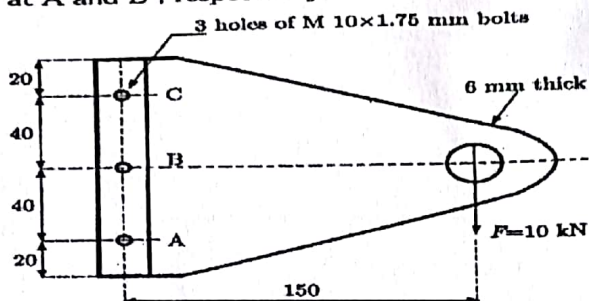
For ellipse major and minor diameter's are twice and equal to hole diameter respectively

## Quiz # 2

[1.5 Marks]

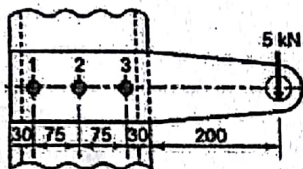
Q. 1

A bolted joint is shown below. The maximum shear stress, in MPa in the bolts at A and B, respectively are

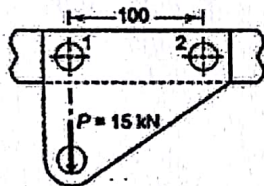


Q. 2 A cast iron cylinder head is fastened to a cylinder of 500 mm bore with 8 stud bolts. The maximum pressure inside the cylinder is 2 Mpa. The stiffness of parts is thrice of the bolt. What should be initial tightening load so the joint is leak proof at maximum pressure? Also, choose a suitable bolt for above application. [1.5 Marks]

Q. 3 Find the size of the bolt. If for bolt material  $S_{yt} = 300 \text{ N/mm}^2$  and factor of safety is 3. [1 Marks]



Q. 4 A riveted joint, consisting of two rivets, is subjected to an eccentric load of 15 kN as shown in Fig. Determine the diameter of rivets, if the permissible shear stress is 60 MPa. [1 Marks]



Q. 5 Two plates of 10 mm thickness each are to be joined by means of a single riveted double strap butt joint. Determine the rivet diameter; rivet pitch and efficiency of the joint. Take the working stresses in tension, shearing and crushing are as 80, 60 and 120 MPa respectively. [1.5 Marks]

Q. 6 If the tearing efficiency of a riveted joint is 50%, then ratio of diameter of rivet hole to the pitch of rivets is..... [0.5 Marks].

Q. 7 A bolt M20 X 2.5 ISO metric thread is subjected to a fluctuating load of 0 to 12000N. Endurance strength = 210 Mpa. Bolt and parts are of same material and length. Yield stress = 490 Mpa, Stress concentration factor 3.85, component area 362 mm<sup>2</sup>. Calculate [3 Marks]

1. Factor of safety without preload
2. Minimum initial load to prevent joint opening
3. Factor of Safety with 10 kN preload, Comment on it
4. Minimum force in the part for a given loading and a preload of 10 kN.



**The LNM Institute of Information Technology**  
**Department of Mechanical and Mechatronics Engineering**

**Machine Design I**  
**Mid Term Exam**

Time: 1.5 Hrs

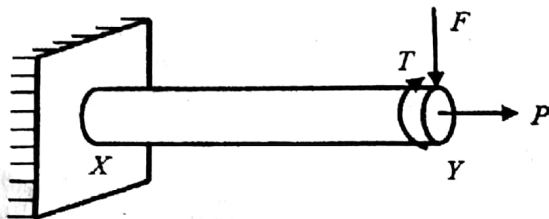
Date: 21/02/2018

Max. Marks: 50

[2 X 5]

Q.1 Choose the correct one with explanation

- (i) A machine element XY fixed at end X, is subjected to an axial load  $P$ , transverse load  $F$ , and a twisting moment  $T$  at its free end Y. The most critical point from strength point of view is



- (A) a point on the circumference at location Y  
 (B) a point at the center at location Y  
 (C) a point on the circumference at location X  
 (D) a point at the center at location X

(ii)

In the specification of dimensions and fits.

- (a) allowance is equal to bilateral tolerance.  
 (b) allowance is equal to unilateral tolerance.  
 (c) allowance is independent of tolerance.  
 (d) allowance is equal to the difference between maximum and minimum dimension specified by the tolerance.

(iii)

Two shafts A and B have their diameters specified as  $100 \pm 0.1$  mm and  $0.1 \pm 0.0001$  mm, respectively. Which of the following statements is/are true?

- (a) Tolerance in the dimension is greater in shaft A.  
 (b) The relative error in the dimension is greater in shaft A.  
 (c) Tolerance in the dimension is greater in shaft B.  
 (d) The relative error in the dimension is greater in shaft B.

(iv)

A shaft is subjected to pure torsional moment. The maximum shear stress developed in the shaft is 100 MPa. The yield and ultimate strengths of the shaft material in tension are 300 MPa and 450 MPa, respectively. The factor of safety using maximum distortion energy (von-Mises) theory is \_\_\_\_\_

(v)

The principal stresses at a point inside a solid object are  $\sigma_1 = 100$  MPa,  $\sigma_2 = 100$  MPa and  $\sigma_3 = 0$  MPa. The yield strength of the material is 200 MPa. The factor of safety calculated using Tresca (maximum shear stress) theory is  $n_T$  and the factor of safety calculated using von Mises (maximum distortional energy) theory is  $n_V$ . Which one of the following relations is TRUE?

- (A)  $n_T = (\sqrt{3}/2)n_V$
- (B)  $n_T = (\sqrt{3})n_V$
- (C)  $n_T = n_V$
- (D)  $n_V = (\sqrt{3})n_T$

Q. 2 A steel member is subjected to a 3 D stress system and the resultant principal stresses are 120 N/mm<sup>2</sup> tensile, 80 N/mm<sup>2</sup> and 40 N/mm<sup>2</sup> compressive. If the proportional limit of material in simple tension is 280 N/mm<sup>2</sup>, determine the factor of safety according to (i) Maximum principal stress theory (ii) Maximum shear stress theory (iii) Von -Mises stress theory [6 Marks]

Q. 3 (a) what do you mean by factor of safety? List the important factors that influence the magnitude of factor of safety. [3 Marks]

(b) It is required to standardize load carrying capacities of dumpers in a company. The minimum and maximum capacities of dumpers are 40 and 630 kN respectively. The company is interested in developing seven models in this range. Specify their load carrying capacities. [3 Marks]

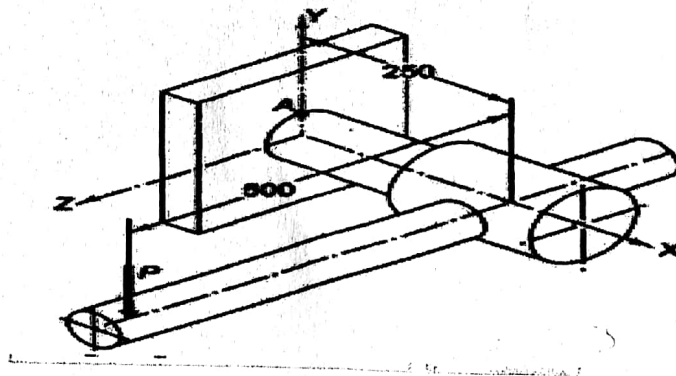
Q. 4 (a) Compare grain structure of crankshaft manufactured by casting, forging and machining processes. [3 Marks]

(b) Write down the various principles of Design for Manufacture and Assemblies. [3 Marks]

Q. 5 (a) What is the necessity of having different theories of failure? Explain the graphical representation of Maximum shear stress theory. [6 Marks]

(b) A hole and shaft have a basic size of 25 mm, and are to have a clearance fit with a maximum and minimum clearance of 0.04 and 0.02 respectively. The hole tolerance is to be 2.5 times the shaft tolerance. Determine limit for both shaft and hole using a hole basis system. [6 Marks]

Q. 6 The shaft of an overhang crank subjected to a force P of 1 kN is shown in Fig.1. The shaft is made of plain carbon steel 45C8 and the tensile yield strength is 380 MPa. The factor of safety is 2. Determine the diameter of the shaft using (i) maximum principal stress theory (ii) maximum shear stress theory and (iii) maximum distortion energy theory. [10 marks]



# The LNM Institute of Information Technology

## Department of Mechanical and Mechatronics Engineering

### Machine Design I End Term Exam

Time: 3 Hrs

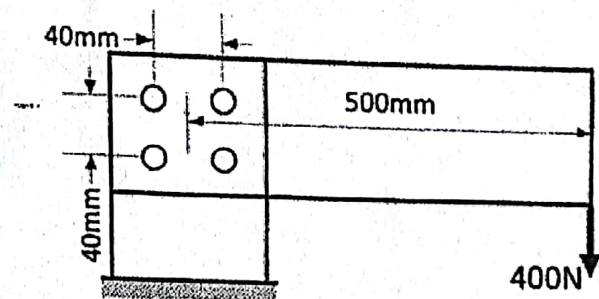
Date: 02/05/2018

Max. Marks: 100

#### Q.1 Short- Answer Questions

[10 X 2 = 20]

- (i) Two helical tensile springs of the same material and having identical mean coil diameter and weight, have wire diameters  $d$  and  $d/2$ . The ratio of their stiffness is...?
- (ii) If the wire diameter of a closed coil helical spring subjected to compressive load is increased from 1cm to 2cm, other parameters remaining same, the deflection will decrease by a factor of....
- (iii) The threaded bolts A and B of the same material and length are subjected to identical load. If the elastic strain energy stored in bolt A is four times that of bolt B and if the mean diameter of bolt A is 12 mm, the mean diameter of bolt B will be.....
- (iv) Which of the following stresses are associated with the tightening of a nut on a stud?
1. Tensile stresses due to stretching of stud.
  2. Bending stresses of stud.
  3. Transverse shear stresses across threads.
  4. Torsional shear stresses in threads due to frictional resistance.
- Select the correct answer using the codes given below:
- (a) 1, 2 and 3 (b) 1, 2 and 4 (c) 2, 3 and 4 (d) 1, 3 and 4
- (v) A thin spherical pressure vessel of 200 mm diameter and 1 mm thickness is subjected to an internal pressure varying from 4 to 8 MPa. Assume that the yield, ultimate, and endurance strength of material are 600, 800 and 400 MPa respectively. The factor of safety as per Goodman's relation is
- (vi) Two closed coil helical springs A and B made of the same wire show axial compression of 8 mm and 3 mm respectively, when they are subjected to same axial load. Spring A has 9 coils of mean diameter of 80 mm, while Spring B has 8 coils. The mean diameter of Spring B will be.....
- (vii) A horizontal plate has been joined to a vertical post using four rivets arranged as shown in Fig. The Magnitude of load on the worst loaded rivet will be



- (viii) What is nip of leaf spring? Explain the objective of nipping of leaf spring.

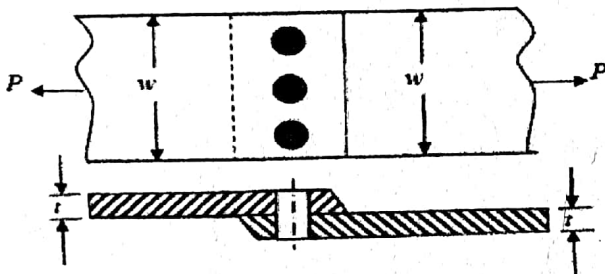


(ix) Assertion (A): Endurance limits for all materials are always less than the ultimate strength of the corresponding materials.

Reason (R): Stress concentration in a machine part due to any dislocation is very damaging when the part is subjected to variable loading.

- (a) Both A and R are individually true and R is the correct explanation of A
- (b) Both A and R are individually true but R is not the correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

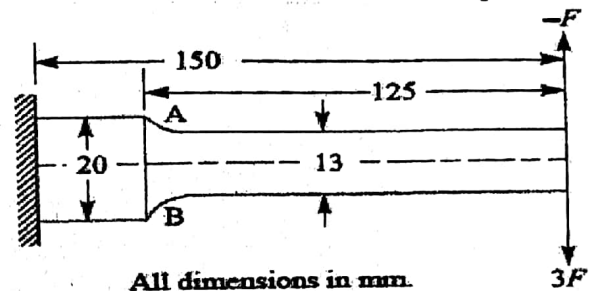
(x) A single riveted lap joint of two similar plates as shown in Fig. has the following geometrical and material details: Width of plate = 200 mm, thickness of plate = 5 mm, diameter of rivets = 10 mm, allowable tensile, shear and crushing stress of rivets are 150, 100 and 200 MPa respectively. To avoid the failure of riveted joint, the maximum permissible value of load P will be....



Q. 2 (a) A compression spring made of alloy steel of coil diameter 2.5 mm and spring index 5, number of active coils 8. If  $G = 80$  GPa. Calculate (i) spring stiffness and compliance (ii) load it can take, for a deflection of 10 mm (iii) free length, if gap between coils has to be 2 mm after deflection of 10 mm. [8 marks]

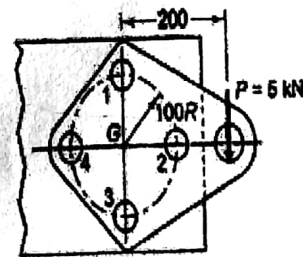
(b) What are the various stresses in a helical compression spring? How do you account for the curvature of the wire? [6 marks]

Q. 3 (a) A cantilever beam made of cold drawn carbon steel of circular cross-section as shown in Fig., subjected to a load, which varies from  $-F$  to  $3F$ . Determine the maximum load that this member can withstand for an indefinite life using a factor of safety as 2. The theoretical stress concentration factor is 1.42 and the notch sensitivity is 0.9. Assume the following values: Ultimate stress = 550 MPa Yield stress = 470 MPa Endurance limit = 275 MPa Size factor = 0.85 Surface finish factor = 0.89 [8 marks]

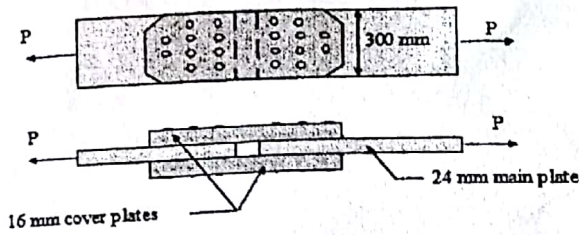


(b) A machine component subjected to fluctuating stress that varies from 40 to 100 N/mm<sup>2</sup>. The corrected endurance limit stress for the machine component is 270 N/mm<sup>2</sup>. The ultimate tensile strength and yield strength are 600 and 450 N/mm<sup>2</sup> respectively. Find the factor of safety using: (i) Gerber theory (ii) Soderberg line (iii) Goodman line [6 marks]

Q. 4 (a) A riveted joint, consisting of four identical rivets, is subjected to an eccentric force of 5 kN as shown in Fig. Determine the diameter of rivets, if the permissible shear stress is 60 N/mm<sup>2</sup>. [6 marks]



(b) Determine the allowable tensile force that the multi-riveted joint shown in Fig. can transmit. All rivets are nominally 24 mm in diameter. The allowable stresses are in tension  $\sigma_t = 160$  MPa in shear  $\tau = 110$  MPa and in crushing  $\sigma_c = 350$  MPa [8 marks]

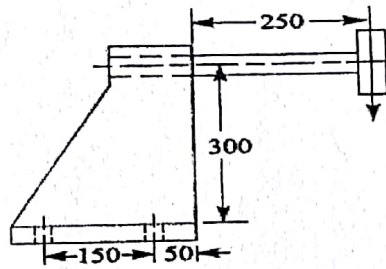


Q. 5 (a) A bolted assembly is subjected to an external force, which varies from 0 to 15 kN. The combined stiffness of the parts held together by the bolt is three times the bolt stiffness. The bolt is initially so tighten that at 50% overload condition, the parts held together by bolt are just about to separate. The bolt material has yield strength of  $450 \text{ N/mm}^2$  and ultimate strength of  $650 \text{ N/mm}^2$ . Fatigue stress concentration factor is 2.5 and reliability factor is 0.868. Assume, FOS 2, determine the bolt size. [8 marks]

(b) The head of a steam engine cylinder 60 cm diameter is subjected to a steam pressure of 1.3 MPa. The head is placed by 16, M 39 bolts. A copper gasket is used to make joint steam tight. Determine the probable stress in the bolt. The combined stiffness of the assembly is 0.25. [6 marks]

Q. 6 (a) A truck leaf spring bearing a load of 6 kN has a span of 1.2 meter with U bolts 110 mm apart. It has two extra full length and nine graduated leaves, including the master leaf. Total spring depth is three times the width of leaves. Allowable stress is 380 MPa. Calculate (i) Width and thickness of leaves (ii) Deflection at full load, (iii) Nip (iv) Preload, if  $E = 210 \text{ GPa}$  [8 marks]

(b) A cast iron bracket to carry a shaft and a belt pulley shown in Fig. The bracket is fixed to the main body by means of four standard bolts. The tensions in the slack and tight sides of the belt are 2.2 kN and 4.25 kN respectively. Find the size of the bolts, if the safe tensile stress for bolts is 50 MPa. [8 marks]



(c) A helical compression spring of a mechanism subjected to an initial preload of 50 N and the maximum force during the load cycle is 300N. The wire diameter is 5mm, while the spring index is 5. The spring is made of oil hardened and tempered steel of SW grade. Determine the factor of safety against fluctuating stresses. [8 marks]

Table: Properties of oil hardened and tempered steel

Wire Diameter d (mm)	Minimum Tensile strength ( $\text{N/mm}^2$ )	
	SW	VW
1.0	1760	1670
1.2	1720	1620
1.5	1670	1570
2.0	1620	1520
2.5	1570	1470
3.0	1520	1430
4.0	1480	1400
4.5	1440	1370
5.0	1440	1370
6.0	1400	1340
7.0	1360	1300
8.0	1290	-