# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**

Dundigal, Hyderabad - 500 043

## MECHANICAL ENGINEERING

## DEFINITIONS AND TERMINOLOGY QUESTION BANK

| Course Name | : | DESIGN OF MACHINE MEMBERS |
|---|---|---|
| Course Code | : | AME012 |
| Program | : | B.Tech |
| Semester | : | V |
| Branch | : | MechanicalEngineering |
| Section | : | A& B |
| Academic Year | : | 2019- 2020 |
| Course Faculty | : | Dr. GVR Sheshagiri Rao,Professor<br>Mr. VKVS Krishnam Raju, Associate professor |

## COURSE OBJECTIVES:

| | The course should enable the students to: |
|---|---|
| I | Develop an ability to apply knowledge of mathematics, science, and engineering Outcomes |
| II | Knowledge of various design standards, safety, reliability, importance of dimensional parameters and manufacturing aspects in mechanical design. |
| III | Understanding the concepts of stresses, theories of failure and material science to analyze, design and/or select commonly used machine components. |
| IV | To develop an ability to identify, formulate, and solve various machine members problems |

## COURSE OUTCOMES (COs):

| CO1 | Understanding design and analysis of power transmitting elements, selection of suitable materials and manufacturing processes. |
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| CO2 | Analyzing the forces acting on various joints and their design. |
| CO3 | To develop an ability to identify, formulate, and solve various machine members problems |
| CO4 | Ability to design and analyze shafts with different geometrical features under various loading conditions. |
| CO5 | Ability to analyze and design of different Springs for required application. |

| S.No | QUESTION | ANSWER | Blooms Level | CO | CLO | CLO Code |
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| | | | **UNIT-I** | | | |
| 1 | What is Couple? | The two equal and opposite parallel forces, whose lines of action are different form a couple. | Remember | CO 1 | CLO 1 | AME012.01 |
| 2 | What is the meaning of grey cast iron designated by 'FG 200'? | Minimum tensile strength is 200 N/mm$^2$ | Remember | CO 1 | CLO 2 | AME012.02 |
| 3 | What is 18/8 | 18 per cent chromium and 8 per | Remember | CO 1 | CLO 2 | AME012.02 |

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| | steel | cent nickel | | | | |
| 4 | What steel is used for manufacturing of Ball bearings? | Medium carbon steel | Remember | CO 1 | CLO 3 | AME012.03 |
| 5 | What are thermoplastic materials? | They do not become hard with the application of heat and pressure and no chemical change occurs | Remember | CO 1 | CLO 1 | AME012.01 |
| 6 | What is Interchangeability? | The term interchangeability is normally employed for the mass production of identical items within the prescribed limits of sizes. | Remember | CO 1 | CLO 2 | AME012.02 |
| 7 | What is Nominal size? | It is the size of a part specified in the drawing as a matter of convenience. | Remember | CO 1 | CLO 1 | AME012.01 |
| 8 | What is Basic size? | It is the size of a part to which all limits of variation (i.e. tolerances) are applied to arrive at final dimensioning of the mating parts. | Remember | CO 1 | CLO 2 | AME012.02 |
| 9 | What is Actual size? | It is the actual measured Dimension of the part. | Remember | CO 1 | CLO 3 | AME012.03 |
| 10 | Define Fit? | The degree of tightness or looseness between the two mating parts is known as a fit of the parts | Remember | CO 1 | CLO 1 | AME012.01 |
| 11 | What is Hole basis system? | When the hole is kept as a constant member then the limit system is said to be on a hole basis | Remember | CO 1 | CLO 2 | AME012.02 |
| 12 | What is Shaft basis system? | When the shaft is kept as a constant member then the limit system is said to be on a shaft basis. | Remember | CO 1 | CLO 2 | AME012.02 |
| 13 | What are the commonly used fits according to Indian standards? | Clearance fit, Interference Fit, Transition fit | Remember | CO 1 | CLO 3 | AME012.03 |
| 14 | Define live or variable load | A load is said to be a live or variable load, when it changes continually | Remember | CO 1 | CLO 2 | AME012.02 |
| 15 | According to Indian standard specification, 100 H6/g5 means that | Tolerance grade for the hole is 6 and for the shaft is 5. | Remember | CO 1 | CLO 3 | AME012.03 |
| 16 | What are different theories of failures? | 1. Maximum principal stress theory 2.Maximum shear stress theory 3.Maximum principal strain theory 4. Maximum strain energy theory 5.Maximum distortion energy theory. | Remember | CO 1 | CLO 4 | AME012.04 |
| 17 | Define Maximum principal stress theory? | According to this theory, the failure or yielding occurs at a point in a member when the maximum principal or normal stress in a bi-axial stress system reaches the limiting strength of the material in a simple tension | Remember | CO 1 | CLO 4 | AME012.04 |

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| | | test. | | | | |
| 18 | Define Maximum principal stress theory? | According to this theory, the failure or yielding occurs at a point in a member when the maximum principal or normal stress in a bi-axial stress system reaches the limiting strength of the material in a simple tension test. | Remember | CO 1 | CLO 4 | AME012.05 |
| 19 | Define Maximum Shear stress theory? | According to this theory, the failure or yielding occurs at a point in a member when the maximum shear stress in a bi-axial stress system reaches a value equal to the shear stress at yield point in a simple tension test. | Remember | CO 1 | CLO 4 | AME012.04 |
| 20 | Define Maximum Strain Energy theory? | According to this theory, the failure or yielding occurs at a point in a member when the strain energy per unit volume in a bi-axial stress system reaches the limiting strain energy (*i.e.* strain energy at the yield point ) per unit volume as determined from simple tension test | Remember | CO 1 | CLO 5 | AME012.05 |
| | **UNIT-II** | | | | | |
| 1 | What is tearing resistance of plate? | The resistance offered by the plate against tearing is known as tearing resistance or tearing strength or tearing value of the plate. | Remember | CO 2 | CLO 6 | AME012.06 |
| 2 | What is crushing of rivets? | Sometimes, the rivets do not actually shear off under the tensile stress, but are crushed. rivet hole becomes of an oval shape and hence the joint becomes loose. | Remember | CO 2 | CLO 6 | AME012.06 |
| 3 | What is the equation for tearing resistance of the plate | $Pt = ( p - d ) \, t \times \sigma t$ | Remember | CO 2 | CLO 7 | AME012.07 |
| 4 | What is the equation for shearing resistance of the rivet? | $Ps = 4 \, \pi \times d^2 \times \tau$ | Remember | CO 2 | CLO 6 | AME012.06 |
| 5 | What is the equation for Crushing resistance of the rivet? | $Pc = d \times t \times \sigma c$ | Remember | CO 2 | CLO 7 | AME012.07 |
| 6 | What is Eccentric Load? | An external load, whose line of action is parallel but does not coincide with the centroidal axis of the machine component, is | Remember | CO 2 | CLO 6 | AME012.06 |

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| | | known as an eccentric load. The distance between the centroidal axis of the machine component and the eccentric load is called eccentricity | | | | |
| 6 | What is caulking? | The process, a narrow blunt tool called caulking tool. The tool is moved after each blow along the edge of the plate, | Remember | CO 2 | CLO 7 | AME012.07 |
| 7 | What is Fullering? | A fullering tool with a thickness at the end equal to that of the plate is used in such a way that the greatest pressure due to the blows occur near the joint | Remember | CO 2 | CLO 7 | AME012.07 |
| 8 | What is the equation for number of rivets for the joint? | $n = P_t$ / least of $P_s$ or $P_c$ | Remember | CO 2 | CLO 7 | AME012.07 |
| 9 | What is tensile strength of single Parallel fillet weld? | P = Throat area × Allowable tensile stress = $0.707\, s \times l \times \sigma t$ | Remember | CO 2 | CLO 8 | AME012.08 |
| 10 | Shear strength of the joint for single parallel fillet weld? | P = Throat area × Allowable shear stress = $0.707\, s \times l \times \tau$ | Remember | CO 2 | CLO 9 | AME012.09 |
| 11 | What is welding? | It is a permanent joint which is obtained by the fusion of the edges of the two parts to be joined together. | Remember | CO 2 | CLO 9 | AME012.09 |
| 12 | What is fusion welding? | The process that use heat alone. | Remember | CO 2 | CLO 9 | AME012.09 |
| 13 | What is forge welding? | The process that use combination of heat and pressure. | Remember | CO 2 | CLO10 | AME012.10 |
| 14 | What are different lap joints? | 1. Single transverse fillet 2. Double transverse fillet. 3. Parallel fillet joints. | Remember | CO 2 | CLO 10 | AME012.09 |
| 15 | What is tearing resistance of plate I welding? | The resistance offered by the plate against tearing is known as tearing resistance or tearing strength or tearing value of the plate. | Remember | CO 2 | CLO 10 | AME012.10 |
| **UNIT-III** | | | | | | |
| 1 | What is Key? | A key is a piece of mild steel inserted between the shaft and hub or boss of the pulley to connect these together in order to prevent relative motion between them. | Remember | CO 3 | CLO 11 | AME012.11 |
| 2 | What are Different keys? | 1. Sunk keys, 2. Saddle keys, 3. Tangent keys, 4. Round keys and 5. Splines. | Remember | CO 3 | CLO 11 | AME012.11 |
| 3 | What is Gib-head key? | It is a rectangular sunk key with a head at one end known as gib head. | Remember | CO 3 | CLO 11 | AME012.11 |

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| 4 | What feather key? | A key attached to one member of a pair and which permits relative axial movement is known as *feather key*. | Remember | CO 3 | CLO 12 | AME012.12 |
| 5 | What is Woodruff key? | A woodruff key is capable of tilting in a recess milled out in the shaft by a cutter having the same curvature as the disc from which the key is made. | Remember | CO 3 | CLO 13 | AME012.13 |
| 6 | What are different saddle keys? | 1. Flat saddle key, and 2. Hollow saddle key | Remember | CO 3 | CLO 12 | AME012.12 |
| 7 | What are spines? | Sometimes, keys are made integral with the shaft which fits in the keyways broached in the hub. Such shafts are known as splined shafts. | Remember | CO 3 | CLO 13 | AME012.13 |
| 8 | What are forces acting in sunk key? | 1. Forces ($F_1$) due to fit of the key in its keyway. 2. Forces (F) due to the torque transmitted by the shaft. | Remember | CO 3 | CLO 12 | AME012.12 |
| 9 | What is Cotter? | A cotter is a flat wedge shaped piece of rectangular cross-section and its width is tapered (either on one side or both sides) from one end to another for an easy adjustment. | Remember | CO 3 | CLO 13 | AME012.13 |
| 10 | What are different cotters? | 1. Socket and spigot cotter joint, 2. Sleeve and cotter joint, and 3. Gib and cotter joint. | Remember | CO 3 | CLO 13 | AME012.13 |
| 11 | What is knuckle joint | A knuckle joint is used to connect two rods which are under the action of tensile loads. | Remember | CO 3 | CLO 14 | AME012.14 |
| 12 | What is sleeve and cotter joint | It is used to connect two round rods or bars. | Remember | CO 3 | CLO 14 | AME012.14 |
| 13 | What is round key? | These are circular in section and fit into holes drilled partly in the shaft and partly in the hub | Remember | CO 3 | CLO14 | AME012.14 |
| 14 | What is parallel key? | The parallel sunk keys may be of rectangular or square section uniform in width and thickness throughout. | Remember | CO 3 | CLO 15 | AME012.15 |
| 15 | What is tangent key? | The tangent keys are fitted in pair at right angles. Each key is to withstand torsion in one direction only. These are used in large heavy duty shafts. | Remember | CO 3 | CLO 15 | AME012.15 |
| | | **UNIT-IV** | | | | |
| 1 | Define Shaft? | A shaft is a rotating machine element which is used to transmit power from one place to another. | Remember | CO 4 | CLO16 | AME012.16 |
| 2 | What are the material properties of shaft? | 1.high strength 2.good machinability 3.low notch sensitivity factor 4. good heat treatment properties. 5. high wear resistant | Remember | CO 4 | CLO16 | AME012.16 |

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| 3 | What is the manufacturing process of shafts? | Shafts are generally manufactured by hot rolling and finished to size by cold drawing or turning and grinding. | Remember | CO 4 | CLO 15 | AME012.15 |
| 4 | What are stresses in shafts? | 1. Shear stresses due to the transmission of torque (*i.e.* due to torsional load). 2. Bending stresses (tensile or compressive) due to the forces acting upon machine elements like gears, pulleys etc. as well as due to the weight of the shaft itself. 3. Stresses due to combined torsional and bending loads | Remember | CO 4 | CLO 15 | AME012.15 |
| 5 | What cases are considered while designing shaft on the basis of strength. | (*a*) Shafts subjected to twisting moment or torque only, (*b*) Shafts subjected to bending moment only, (*c*) Shafts subjected to combined twisting and bending moments, and (*d*) Shafts subjected to axial loads in addition to combined torsional and bending loads. | Remember | CO 4 | CLO 16 | AME012.16 |
| 6 | What is the equation when the shaft is subjected to bending moment only? | $$\frac{M}{I} = \frac{\sigma_b}{y}$$ | Remember | CO 4 | CLO 17 | AME012.17 |
| 7 | What is the equation when the shaft is subjected to twisting moment only? | $$\frac{T}{J} = \frac{\tau}{r}$$ | Remember | CO 4 | CLO 16 | AME012.16 |
| 8 | What is the equation when the shaft is subjected to bending moment and twisting moment? | $$\tau_{max} = \frac{1}{2}\sqrt{(\sigma_b)^2 + 4\tau^2}$$ | Remember | CO 4 | CLO 18 | AME012.18 |
| 9 | What is the equivalent twisting moment when shaft subjected to fluctuating bending and torsional loads? | $$T_e = \sqrt{(K_m \times M)^2 + (K_t + T)^2}$$ | Remember | CO 4 | CLO18 | AME012.18 |
| 10 | What is the equivalent bending moment when shaft subjected to fluctuating bending and torsional loads? | $$M_e = \frac{1}{2}\left[K_m \times M + \sqrt{(K_m \times M)^2 + (K_t \times T)^2}\right]$$ | Remember | CO 4 | CLO18 | AME012.18 |

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| 11 | What is shaft coupling? | In order to have a greater length, it becomes necessary to join two or more pieces of the shaft by means of a coupling. | Remember | CO 4 | CLO 20 | AME012.20 |
| 12 | What are different Rigid couplings? | (*a*) Sleeve or muff coupling. (*b*) Clamp or split-muff or compression coupling, and (*c*) Flange coupling. | Remember | CO 4 | CLO 19 | AME012.19 |
| 13 | What are different Flexible couplings? | (*a*) Bushed pin type coupling, (*b*) Universal coupling, and (*c*) Oldham coupling. | Remember | CO 4 | CLO 19 | AME012.19 |
| 14 | What is the use of Oldham coupling? | Is shafts have which have lateral misalignment | Remember | CO 4 | CLO 19 | AME012.19 |
| 15 | What are the uses of Shaft couplings? | 1. To provide for the connection of shafts of units that are manufactured separately such as a motor and generator and to provide for disconnection for repairs or alternations. 2. To provide for misalignment of the shafts or to introduce mechanical flexibility. | Remember | CO 4 | CLO 20 | AME012.20 |
| | | **UNIT-V** | | | | |
| 1 | Define spring? | A spring is defined as an elastic body, whose function is to distort when loaded and to recover its original shape when the load is removed. | Remember | CO 5 | CLO 21 | AME012.21 |
| 2 | What are different types of springs? | 1. Helical springs 2. Conical and volute springs 3. Torsion springs 4. Laminated or leaf springs 5. Disc or Belleville springs. 6. Special purpose springs. | Remember | CO 5 | CLO 22 | AME012.22 |
| 3 | What are the materials used for spring? | The springs are mostly made from oil-tempered carbon steel wires containing 0.60 to 0.70 per cent carbon and 0.60 to 1.0 per cent manganese. Music wire is used for small springs. Non-ferrous materials like phosphor bronze, beryllium copper, monel metal, brass etc., may be used in special cases to increase fatigue resistance, temperature resistance and corrosion resistance. | Remember | CO 5 | CLO 21 | AME012.21 |
| 4 | What are important properties of spring material? | The material of the spring should have high fatigue strength, high ductility, high resilience and it should be creep resistant | Remember | CO 5 | CLO 22 | AME012.22 |
| 5 | What is the solid length of spring? | $L_S = n'.d$ where $n'$ = Total number of coils, and $d$ = Diameter of the wire. | Remember | CO 5 | CLO 21 | AME012.21 |
| 6 | What is the free length of spring? | $L_F$ = Solid length + Maximum compression + Clearance | Remember | CO 5 | CLO 22 | AME012.22 |

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| | | between adjacent coils (or clash allowance) $= n'.d + \delta_{max} + 0.15\,\delta_{max}$ | | | | |
| 7 | Define spring index? | The spring index is defined as the ratio of the mean diameter of the coil to the diameter of the wire. Spring index, $C = D / d$ | Remember | CO 5 | CLO 22 | AME012.22 |
| 8 | Define spring rate? | The spring rate (or stiffness or spring constant) is defined as the load required per unit deflection of the spring. | Remember | CO 5 | CLO 23 | AME012.23 |
| 9 | Define Pitch | The pitch of the coil is defined as the axial distance between adjacent coils in uncompressed state. | Remember | CO 5 | CLO 23 | AME012.23 |
| 10 | What are stresses in helical springs of circular wire? | Torsional shear stress, Direct shear stress, stress due to curvature of wire. | Remember | CO 5 | CLO 23 | AME012.23 |
| 11 | What is Wahl is stress factor | To consider the effects of both direct shear as well as curvature of the wire. $K = \dfrac{4C - 1}{4C - 4} + \dfrac{0.615}{C}$ | Remember | CO 5 | CLO 24 | AME012.24 |
| 12 | What is the stiffness of the spring? | $\dfrac{W}{\delta} = \dfrac{G.d^4}{8\,D^3.n} = \dfrac{G.d}{8\,C^3.n}$ | Remember | CO 5 | CLO 24 | AME012.24 |
| 13 | What is the equation for Buckling of compression spring? | $W_{cr} = k \times K_B \times L_F$ $K_B =$ Buckling factor depending upon the ratio $L_F / D$. | Remember | CO 5 | CLO 24 | AME012.24 |
| 14 | What is equation for energy stored in the spring? | $U = \dfrac{1}{2}\,W.\delta$ | Remember | CO 5 | CLO 24 | AME012.24 |
| 15 | What are different end connections for compression helical springs? | 1. Plain ends 2. Ground ends 3. Squared ends 4. Squared and ground ends. | Remember | CO 5 | CLO 25 | AME012.25 |

**Signature of the Faculty**                                             **HOD, ME**