DOM-UNIT-I SHORT ANSWER QUESTIONS

Static force analysis, Dynamic force analysis, Gyroscope

1. What are the conditions for a body to be in static and dynamic equilibrium?

Necessary and sufficient conditions for static and dynamic equilibrium are

1. Vector sum of all forces acting on a body is zero.

2. The vector sum of the moments of all forces acting about any arbitrary point or axis is zero. First condition is the sufficient condition for static equilibrium together with second condition is necessary for dynamic equilibrium.

2. Define static force analysis.

If components of a machine accelerate, inertia is produced due to their masses. However, the magnitudes of these forces are small compared to the externally applied loads. Hence inertia effect due to masses are neglected. Such an analysis is known as static force analysis.

3. Define force and applied force.

Force is a push or pull, which acts on a body changes or tends to change, the state of rest or of uniform motion of the body. A force is completely characterized by its point of application, its magnitude and direction.

The external force acting on a system of body from outside the system are called applied force. The applied forces are classified as active and reactive force.

4. Rate of change of momentum of a body is directly proportional to Force acting on it.

5. Which law helps to measure a force quantitatively?

Newton’s second law helps us to measure a force quantitatively.

6. Distinguish between space diagram and free body diagram.

A space diagram is a graphical description of the system. It generally shows the shape and size of the system, the weight, the externally applied loads, the connection and the supports of the system.

A free body diagram is a sketch of the isolated or free body which shows all the pertinent weight forces, the externally applied loads, and the reaction from its supports and connections acting upon it by the removed elements.

7. When will the two force member is in equilibrium?

The member under the action of two force will be in equilibrium if,

1. The two forces are of same magnitude,

2. The forces act along the same line, and

3. The forces are in opposite direction

8. Give any three advantages of free body diagram.

1. Free body diagram assist in seeing and understanding all aspects of problem.

2. They help in planning the approach to the problem.

3. They make mathematical relations easier to the problem.

9. When will the three force member is in equilibrium.

A body or member will be in equilibrium under the action of three forces if,

1. the resultant of the forces is zero, and

2. the line of action of the forces intersect at a point.

10. Differentiate between static force analysis and dynamic force analysis.

If components of a machine accelerate, inertia forces are produced due to their masses. If the magnitude of these forces are small compared to the externally applied loads, they can be neglected while analyzing the mechanism. Such an analysis is known as static force analysis.

11. What do you mean by inertia?

The property of matter offering resistance to any change of its state of rest or of uniform motion in a straight line is known as inertia.

12. State D'Alembert's principle.

D'Alembert's principle states that the inertia forces and torques, and the external forces and torques acting on a body together result in statical equilibrium.

In other words, the vector sum of all external forces acting upon a system of rigid bodies is zero. The vector sum of all external moments and inertia torques acting upon a system of rigid bodies is also separately zero.

13. How you will reduce a dynamic analysis probloem into an equivalent problem of static equilibrium?

By applying D'Alembert's principle to a dynamic analysis problem, we can reduce it into an equivalent problem of static equilibrium.

14. What do you mean by Equivalent offset inertia force?

Equivalent offset inertia force is the force which can replace both inertia force and inertia torque.

15. State the principle of super position.

The principle of super position states that for linear systems the individual responses to several disturbances or driving functions can be superposed on each other to obtain the total response of the system.

16. Give one example each for linear and non-linear system.

Linear system: Example: Spring system.

Non-linear system: Example: Systems with static or coulomb friction, backlash.

17. Principle of super position has a limitation that it cannot be applied for non-linear systems.

18. When the connecting rod is large the piston executes simple harmonic motion.

19. What are the requirements of an equivalent dynamical system?

1. The mass of the rigid body must be equal to the sum of masses of two concentrated masses. i.e. m1 + m2 = m

2. The centre of gravity of the two masses must coincide with the centre of gravity of the rigid body. i.e. m1 l1 = m2 l2

3. The sum of mass moment of inertia of two masses about their centre of gravity is equal to the mass moment of inertia of the rigid body. i.e. l1 . l2 = (kG)2

20. Define Inertia force.

The inertia force is an imaginary force, which when acts upon a rigid body, brings it in an equilibrium position.

Inertia force = - Accelerating force = - ma

21. Write the importance of Balancing?

If the moving part of a machine are not balanced completely then the inertia forces are set up which may cause excessive noise, vibration, wear and tear of the system. So balancing of machine is necessary.

22. Give the application of gyroscopic principle.

It is used a) in instrument or toy known as gyroscope,

b) in ships in order to minimize the rolling and pitching effects of waves, and

c) in aeroplanes, monorail cars, gyrocompasses, etc.

23. Define steering, pitching and rolling.

Steering is the turning of a complete ship in a curve towards left or right, while it moves forward.

Pitching is the movement of a complete ship up and down in a vertical plane about transverse axis.

Rolling is the movement of a ship in a linear fashion.

24. Explain gyroscopic couple?

If a body having moment of inertia I and rotating about its own axis at ω rad/sec is also caused to turn at ωp rad/sec about an axis perpendicular to axis of spin, then it experiences a gyroscopic couple of magnitude(ω ωp) in an axis which is perpendicular to both the axis of spin and axis of precission.

25. The fore end of the ship is called bow and the rear end is known as stern or aft.

26. Define the term system.

A system is an assembly of components and linkages designed to fulfill some particular function.

DOM-UNIT-II SHORT ANSWER QUESTIONS

GOVERNORS AND FLY WHEELS

1. Explain the function of Governor?

The function of a governor is to maintain the speed of an engine within specified limits whenever there is a variation of load. Governors control the throttle valve and hence the fuel supply to cater the load variation in engines.

2. What is the principle of inertia governors?

In inertia governors, the balls are so arranged that the inertia forces caused by an angular acceleration or retardation of the shaft tend to alter their positions.

3. What is equilibrium speed?

The speed at which the governor balls arms, sleeve, etc., are in complete equilibrium and there is no upward or downward movement of the sleeve on the spindle is known as equilibrium speed.

4. Explain controlling force?

An equal and opposite force to the centrifugal force acting radially inwards (i.e.centripetal force) is termed as controlling force of a governor.

5. Explain the governor effort?

The mean force acting on the sleeve for a given percentage change of speed for lift of the sleeve is known as the governor effort.

6. Define power of a governor?

The power of a governor is the work done at the sleeve for a given percentage change of speed. It is the product of the mean value of the effort and the distance through which the sleeve moves.

7. Explain sensitiveness of governors?

The sensitiveness is defined as the ratio of the mean speed to the difference between the maximum and minimum speeds.

8. What is meant by hunting?

The phenomenon of continuous fluctuation of the engine speed above and below the mean speed is termed as hunting. This occurs in over sensitive governors.

9. Explain the term stability of the governor?

A governor is said to be stable if there is only one radius of rotation for all equilibrium speeds of the balls within the working range. If the equilibrium speed increases the radius of governor ball must also increase.

10. Explain isochronism.

A governor with zero range of speed is known as an isochronous governor.

11.Define maximum fluctuation of speed.

The difference between maximum and minimum during a cycle is called as maximum fluctuation of speed.

E = Max energy – Min Energy.

12.List out few machines in which flywheel are used.

A) Punching Machines B) Shearing Machines C) Rivetting Machines D) Crushing Machines.

13.Why smaller fly wheels is used in multi cylinder engines.

In a multi cylinder engine, there are one or more number of power strokes per revolution of the crank shaft. So lesser energy is to be stored in the flywheel. Hence smaller flywheel is sufficient.

14.Differentiate the functions of flywheel and governor.

S. No	Flywheels	Governors
1	The function of flywheel is to reduce the fluctuations of speed during a cycle above and below the mean value for constant load from the prime mover.	Its function is to control the mean speed over a period for output load variations
2	It works continuously from cycle to cycle.	Its works intermittently i.e. only when there is change in the load.
3	It has no influence on mean speed of the prime mover.	It has no influence over cyclic speed Fluctuations

15.Define turning moment diagram.

It is the graphical representation of the turning moment or crank effort for various position of the crank. The turning moment is taken in Y-Axis and crank angle is taken in X-Axis for plotting the turning moment diagram.

16.Define the principle of superposition.

It states that for linear systems the individual responses to several disturbances or driving functions can be superposed on each other to obtain the total response of the system.

17.Define turning moment.

In all reciprocating engines, force acting on piston due to expansion of charges or gases, develops a torque on crank shaft, by means of connecting rod and crank mechanism. This torque is called as turning moment or crank effort.

18.Define coefficientt of maximum fluctuation of energy.

It is the ratio between max fluctuation of energy and the work done per cycle. CE = Maximum Fluctuation of energy/Work done per cycle

19.Define coefficient of maximum fluctuation of speed.

The ratio of maximum fluctuation of speed to the mean speed is called as coefficient of maximum fluctuation of speed.
$CS = N1 – N2 = 2(N1 – N2)$
$N (N1+N2)$
N1 – Max Speed : N2 – Min Speed

20.Define crank pin effort.

The component of FQ perpendicular to crank is known as crank pin effort.

21.Define crank effort.

Crank effort is the product of crank pin effort (FT) and crank pin radius (r).

22.State the function of a flywheel.

The function of flywheel is to reduce the fluctuations of speed during a cycle above and below the mean value for constant load from the prime mover.

23.How will you reduce a dynamic analysis problem into an equivalent problem of staticequilibrium?

By applying D'Alembert's principle to a dynamic analysis problem, we can reduce it into an equivalent problem of static equilibrium.

DOM-UNIT-III SHORT ANSWER QUESTIONS

BALANCING OF FORCES

1. Write the importance of balancing?

If the moving part of a machine are not balanced completely then the inertia forces are set up which may cause excessive noise, vibration, wear and tear of the system. So the balancing of machine is necessary.

2. Why balancing of dynamic forces are necessary?

If dynamic forces are not balanced, they will cause worse effects such as wear and tear on bearings and excessive vibrations on machines. It is very common in cam shafts, steam turbine rotors, engine crank shafts and centrifugal pumps etc.

3. Write the different types of balancing.

- Balancing of rotating masses
1. Static Balancing
2. Dynamic balancing
- Balancing of reciprocating masses.

4. Define static balancing.

A system of rotating masses is said to be in static balance if the combined mass centre of the system lies on the axis of rotation.

5. State the condition for static balancing.

The net dynamic force acting on the shaft is equal to zero. This requires that the line of action of their centrifugal forces must be same.

6. Dynamic balancing implies static balancing. Justify.

Condition for dynamic balancing are
1. The net dynamic force acting on the shaft is equal to zero. This is the condition for static balancing.
2. The net couple due to dynamic forces acting on the shaft is zer

From the above it is understood that dynamically balanced system must be initially statically balanced one.

7. Write the condition for complete balancing.

1. The resultant centrifugal force must be zero.
2. The resultant couple must be zero.

8. Differentiate static and dynamic balancing

S. No	Static Balancing	Dynamic Balancing
1	The dynamic forces as a result of the unbalanced masses are balanced by introducing balancing masses in the plane of rotation or diff planes The net dynamic force acting on the shaft is made zero.	The arrangement made in static balancing gives rise to a couple which tends to rock the shaft in the bearing. Dynamic balancing considers the net couple as well as net dynamic force to do complete balancing.
2	It deals with only balancing of dynamic forces.	It deals with balancing of dynamic force and balancing couple due to dynamic force.

9. The product of rotating mass and perpendicular distance between the rotating mass and reference plane is called as ---------- -. (Ans: Mass Moment)

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10. Write the equation for balancing a single rotating mass by a single mass.

$m_1r_1 = m_2r_2$

11. Define Dalby's method of balancing masses.

Dalby's method is used for balancing several masses rotating in different planes. In this method several forces acting on several planes are transferred to a single reference plane.

12. Write the phenomenon of transferring forces from one plane to another.

Transferring a force (F) from one plane to another plane having a distance 'l' is equivalent to transfer of same force 'F' in magnitude and direction in the reference plane is accompanied by a couple of magnitude 'Fl'.

13. Whether grinding wheels are balanced or not. If so Why?

Yes. The grinding wheels are properly balanced by inserting some low density materials. If not the required surface finish won't be obtained and the vibration will cause much noise.

14.Whether your watch needles are properly balanced?

Yes my watch needles are properly balanced by providing some extra projection in the opposite direction.

15.Why complete balancing is not possible in reciprocating masses?

Balancing of reciprocating masses is done by introducing the balancing mass opposite to the crank. The vertical component of the dynamic force of this balancing mass gives rise to hammer blow. In order to reduce hammer blow, a part of the reciprocating mass is balanced. Hence complete balancing is not possible.

16. What are the various cases of balancing revolving masses?

1. Balancing of single rotating mass by a single mass rotating in the same plane.
2. Balancing of single rotating mass by a two masses rotating in the diff plane.
3. Balancing of several rotating masses in single plane.
4. Balancing of several rotating masses in different plane.

17. Why cranks of a locomotive are generally at right angles to one another?

In order to facilitate the starting of locomotive in any position the cranks of a locomotive are generally at right angles to one another.

18. What are the effects of unbalanced primary force along the line of stroke of two cylinder locomotive?

1. Variation in tractive force along the line of stroke
2. Swaying couple.

19. Define tractive force.

The resultant unbalanced force due to the 2 cylinders along the line of stroke, is known as tractive force.

20.Define swaying couple.

The unbalanced force acting at a distance between the line of stroke of 2 cylinders constitute a couple in the horizontal direction. This couple is called as swaying couple.

21.What is the effect of hammer blow and what is the cause it?

The effect of hammer blow is to cause the variation in pressure between the wheel and the rail, such that vehicle vibrates vigorously. Hammer blow is caused due to the effect of unbalanced primary force acting perpendicular to the line of stroke.

22. What are in-line engines?

Multi-cylinder engines with the cylinder centre lines in the same plane and on the same side of the centre line of the crankshaft are known as in-line engine.

23. Give the reason for selecting different firing orders.

In multi cylinder engines there are several possibilities of the order in which firing takes place. To overcome the problems of vibration, fuel distribution, exhaust distribution etc. the designers select different firing orders.

24. What are the conditions to be satisfied for complete balance of in-line engine?

1. The algebraic sum of the primary and secondary forces must be zero.
2. The algebraic sum of the couples due to primary and secondary forces must be zero.

25. Why radial engines are preferred?

In radial engines the connecting rods are connected to a common crank and hence the plane of rotation of the various cranks is same, therefore there are no unbalanced primary or secondary couples. Hence radial engines are preferred.

DOM-UNIT-IV SHORT ANSWER QUESTIONS

FREE VIBRATIONS

1. What are the causes of vibration?

The causes of vibration are unbalanced forces, elastic nature of the system, self excitations, winds and earthquakes.

2. Define period and cycle of vibration.

Period: It is the time interval after which the motion is repeated itself.
Cycle: It is defined as the motion completed during one time period.

3. Define frequency of vibration.

It is the number of cycles described in one second. Unit-Hz.

4. How will you classify vibration?

A) Free vibrations
a) Longitudinal vibration b) Transverse vibration c) Torsional vibration d) Forced vibrations **e)** Damped vibrations.

5. What is free vibration?

When no external force acts on the body, after giving it an initial displacement, then the body is said to be under free vibrations.

6.What do you mean by damping and damped vibration?

Damping: The resistance against the vibration is called damping.
Damped vibration: When there is a reduction in amplitude over every cycle of vibration, then the motion is said to be damped vibrations.

7.Define resonance.

When the frequency of external force is equal to the natural frequency of a vibrating body, the amplitude of vibration becomes excessively large. This phenomenon is known as resonance.

8.What do you mean by a degree of freedom or movability?

The number of independent coordinates required to completely define the motion of a system is known as degree of freedom of the system.

9. A cantilever beam has----------number of degree of freedom. (Ans: infinite).

10. Define steady state vibration.

In ideal systems, the free vibration indefinitely as there is no damping. Such vibration is termed as steady state vibration.

11. List out methods of finding the natural frequency of free longitudinal vibration.

a) Energy method
b) Equilibrium method
c) Rayleigh's method.

12. What is the principle of Rayleigh's method of finding natural of vibrations?

The principle of Rayleigh's method is "the maximum kinetic energy at the mean position is equal to the maximum potential energy (or strain energy) at the extreme postion.

13. A shaft supported in long bearing is assumed to have ---------- for solving transverse vibration problems. (Ans: Both ends fixed)

14. The damping force per unit velocity is known as----------. (Ans: damping coefficient)

15. Define critical or whirling or whipping speed of shaft.

The speed at which resonance occurs is called critical speed of the shaft. In other words, the speed at which the shaft runs so that the additional deflection of the shaft from the axis of rotation becomes infinite is known as critical speed.

16.What are the factors that affect the critical speed of a shaft?

The critical speed essentially depends on
a) The eccentricity of the C.G of the rotation masses from the axis of rotation of the shaft,
b) Diameter of the disc
c) Span (length) of the shaft
d)Type of supports connections at its ends.

17. What are the causes of critical speed?

a) Eccentric mountings.
b) Bending due to self weight
c) Non-Uniform distribution of rotor material.

18. Define vibration.

Any motion which repeats itself after as interval of time is called as vibration or oscillation.

19. Define forced vibration.

When the body vibrates under the influence of external force, then the body is said to be under forced vibrations.

20. What is longitudinal vibration?

When the particles of the shaft or disc moves parallel to the axis of the shaft, then the vibrations are known as longitudinal vibrations.

21. Define transient vibration.

In real systems, the amplitude of vibration decays continuously because of natural damping and vanishes finally. Such vibration in real system is called transient vibration.

22. Define amplitude.

The maximum displacement of a vibrating body from the mean position is amplitude.

23. What is simple harmonic motion?

The motion of a body to and fro about a fixed point is simple harmonic motion.

24. What are transverse vibrations?

When the particles of the shaft or disc move approximately perpendicular to the axis of the shaft, then the vibrations are known as transverse vibrations.

25. What are torsional vibrations?

When the particles of the shaft or disc move in a circle about the axis of the shaft, then the vibrations are known as torsional vibrations.

UNIT – IV FORCED VIBRATION

1. A vibrating system consist of a mass of 7 kg and a spring stiffness 50 N/cm and damper of damping coefficient 0.36 Ncm-1 sec. Find the damping factor.

M= 7kg, s=50 N/cm, c= 0.36 Ncm-1 sec= 36N/m/sec ωn
= √(s/m) = √(5000/7) = 26.72 rad/sec
cc = 2m = 2x7x26.72 = 374.16 N/m/s
Damping factor = c/ cc = 0.0962.

2. What is the relationship between frequencies of undamped and damped vibrations? fd/fn =

(ωd / 2π) / (ωn / 2π) = (ωd / ωn)

3. What is meant by transmissibility?

When a machine is supported by a spring, the spring transmits the force applied on the machine to the fixed support or foundation. This is called as transmissibility.

4. Define transmissibility ratio or isolation factor

The ratio of force transmitted (Ft) to the applied force (F) is known as transmissibility ratio.

5. Briefly explain elastic suspension.

When machine components are suspended from elastic members, the vibrational force produced by the machine components will not be transmitted to the foundation. This is elastic suspension.

6. Specify any 2 industrial applications where the transmissibility effects of vibration are important.

1. All machine tools 2. All turbo machines.

7. Specify the importance of vibration isolation.

When an unbalanced machine is installed on the foundation, it produces vibration in the foundation. So, in order to prevent these vibrations or to minimize the transmission of forces to the foundation, vibration isolation is important.

8. What are the methods of isolating the vibration?

1. High speed engines/machines mounted on foundation and supports cause vibrations of excessive amplitude because of the unbalanced forces. It can be minimized by providing spring damper.
2. The materials used for vibration isolation are rubber, felt cork etc. These are placed between the foundation and vibrating body.

9. Define forced vibration.

When the body vibrates under the influence of external force, then the body is said to be under forced vibrations.

10. Give some examples of forced vibration.

1. Ringing of electrical bell where the vibration is by means of electrical means.
2. The vibrations of air compressors, IC engines, machine tools and various other machinery.

11. What are the various types of external forces that cause vibration?

1. Periodic forces
2. Impulsive type forces
3. Random forces

12. Define transient vibration.

In real systems, the amplitude of vibration decays continuously because of natural damping and vanishes finally. Such vibration in real system is called transient vibration.

13. Define magnification factor or dynamic magnifier.

The ratio of the maximum displacement(X max) to the static deflection under static force F0 (x0) is known as magnification factor.

$$X_{max} = M.F \times X0$$

14. Define frequency response curve.

A curve between the magnification factor and frequency ratio ( ) is known as frequency response curve

15. What is phase response cuϕrve?

A curve between phase angle ( ) and frequency ratio ( ) is known as phase frequency curve.

16. What are the types isolation?

1. Force isolation
2. Motion isolatioin

17. What is force isolation?

Vibrations produced in unbalanced machines should be isolated from the foundation so that the adjoining structure is not set into vibrations. This type is force isolation

18. What is motion isolation?

The unbalanced machines are isolated from their foundation so that there should not be any damage either to the machines or the foundation. This is motion isolation.

19. Define force transmissibility.

It is defined as the ratio of the force transmitted FT (to the foundation) to the force applied on the F0.

20. Define logarithmic decrement.

Logairthmic decrement is defined as the natural logarithm of the amplitude reduction factor.
The amplitude reduction factor is the ratio of any two successive amplitudes on the same side of the mean position.

22. What is meant by harmoninc forcing?

The term harmoninc forcing refers to a spring mass system with viscous damoing, excited by a sinusoidal harmonic force.

23. What is vibration isolation?

The term vibration isolation refers to the prevention or minimisation of vibrations and theirtransmission due to unbalanced machines.

DOM-UNIT-V SHORT ANSWER QUESTIONS

TORSIONAL VIBRATIONS

1. Specify the importance of vibration isolation?

When an unbalanced machine is installed on the foundation, it produces vibration in the foundation. So, in order to prevent these vibrations or to minimize the transmission of forces to the foundation, vibration isolation is important.

2. What are the methods of isolating the vibration?

1. High speed engines/machines mounted on foundation and supports cause vibrations of excessive amplitude because of the unbalanced forces. It can be minimized providing spring-damper,etc.

2. The materials used for vibration isolation are rubber, felt cork, etc. These are placed between the foundation and vibrating body.

3. Define torsional vibration.

When the particles of a shaft or disc move in a circle about the axis of the shaft, then the vibrations are known as torsional vibrations.

4. Differentiate between transverse and torsional vibration.

1. In transverse vibrations, the particles of the shaft move approximately perpendicular to the axis of the shaft. But in torsional vibrations, the particles of the shaft move in a circle about the axis of the shaft.

2. Due to transverse vibrations, tensile and compressive stresses are induced. Due to torsional vibrations, torsional shear stresses are induced in the shaft.

5. Define node in torsional vibration.

Node is the point or the section of the shaft at which amplitude of the torsional vibration is zero. At nodes, the shaft remains unaffected by the vibration.

6. Define torsional equivalent shaft.

A shaft having variable diameter for different lengths can be theoretically replaced by an equivalent shaft of uniform diameter such that they have the same total angle of twist when equal opposing torques are applied at their ends. Such a theoretically replaced shaft is known as torsionally equivalent shaft.

7. What are the conditions to be satisfied for an equivalent system to that of geared system in torsional vibrations?

1. The kinetic energy of the equivalent system must be equal to the kinetic energy of the original system.

2. The strain energy of the equivalent system must be equal to the strain energy of the original system.