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# E-554

## B. E. Vth Semester Examination, December – 2017

### DYNAMICS OF MACHINE AND VIBRATION

### Branch : ME

*Time : Three Hours ]* *[ Maximum Marks : 75*

***Note :*** Attempt *all* questions from *Section – A, Four* questions from *Section –B* and *Three* questions from *Section – C.*

**SECTION – A** [ Marks : 1.5 × 10 = 15

**(Objective Type Questions)**

**1.** When there is a reduction in amplitude over every cycle of vibration, then the body is said to have :

(a) Free vibration (b) Forced vibration

(c) Damped vibration (d) None of the above

**2.** When a body is subjected to transverse vibrations, the stress induced in a body will be :

(a) Shear stress (b) Tensile stress

(c) Compressive stress (d) Both (a) and (c)

**3.** A Hartnell governor is a

(a) Pendulum type governor (b) Spring loaded governor

(c) Dead weight governor (d) Inertia governor

**4.** A Hunting governor is :

(a) More stable (b) Less sensitive

(c) More sensitive (d) None of these

**5.** The module is the reciprocal of

(a) Diametral pitch (b) Circular pitch

(c) Pitch diameter (d) None of these

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6. The contact ratio for gears is

(a) Zero (b) Less than one

(c) Greater than one (d) None of these

7. A differential gear in an automobile is a :

(a) Simple gear train (b) Compound gear train

(c) Reverted gear train (d) Epicyclic gear train

8. The rotor of a ship rotates in clockwise direction when viewed from the stem and the ship takes a left turn. The effect of gyroscopic couple acting on it will be :

(a) To raise the bow and stem (b) To lower the bow and stem

(c) To raise the bow and lower the stem (d) None of these

9. A shaft carrying two rotors at its ends will have

(a) No node (b) One node

(c) Two nodes (d) Three nodes

10. At a nodal point in a shaft, the amplitude of torsional vibration is :

(a) Zero (b) Minimum-

(c) Maximum (d) None of these

## SECTION – B

[ Marks : 6 × 4 = 24

### (Short Answer Types Questions)

1. State and prove law of gearing. Show that involute profile satisfies the conditions for correct gearing.

2. Show that the ratio of two successive amplitudes of oscillations is constant in a damped vibrating system. What is logarithmic decrement ?

3. What do you understand by gyroscopic couple ? Derive a formula for its magnitude.

4. What is the function of a governor ? How does it differ from that of a flywheel ?

5. A Hartnell governor having a central sleeve spring and two right-angled bell crank levers moves between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine :

   (a) loads on the spring at the lowest and the highest equilibrium speeds and

   (b) stiffness of the spring.

6. What do you understand by gear train ? Discuss the various types of gear trains.

## SECTION – C

[ Marks : 12 × 3 = 36

### (Long Answer Types Questions)

1. A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm is in mesh. The number of teeth on pinion is 16 and its rotational speed is 240 rpm. When the gear ratio is 1.75, find in order that the interference is just avoided,

   (a) the addenda on pinion and gear wheel,

   (b) the length of path of contact and

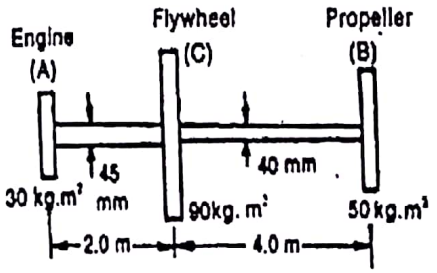
   ( c) the maximum velocity of sliding of teeth on either side of the pitch point.

2. A machine weighs 18 kg and is supported on springs and dashpots. The total stiffness of the springs as 12 N/mm and the damping is 0.2 N/mm/s. The system is initially at rest and a velocity of 120 mm/s is imparted to the mass. Determine :

   (a) Displacement and velocity of mass as a function of time.

   (b) Displacement and velocity after 0.4 sec.

3. A torsional system is shown in the Figure. Find the frequencies of the torsional vibrations and the position of nodes. Also, find the amplitude of vibrations. $G = 84 \times 109\ N/m^2$.




4. (a) Derive an expression for minimum number of teeth required on a pinion in order to avoid interference in involute gear teeth.

(b) Define and explain the following terms relating to governor : sensitiveness, finite power and effect stability.

**5.** The turbine rotor of a ship has a mass of 3500 Kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise when looking from stem. Determine the gyroscopic couple and its effect upon the ship :

(a) When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h.

(b) When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.

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# E-867

## B.E. V Semester (Main & Re-Exam.) Examination, Dec. 2018

## DYNAMICS OF MACHINE AND VIBRATION

## Branch : ME

*Time : Three Hours ]* *[ Maximum Marks : 75*

*[Minimum Marks : 30*

**Note :** Attempt **all** questions from Section-A, **four** questions from Section-B and **three** questions from Section-C.

**Section-A** [Marks : 1.5×10=15]

**(Objective Type Questions)**

1. The product of the diametrical pitch and circular pitch is equal to:

   (a) 1 (b) $\frac{1}{\pi}$

   (c) $\pi$ (d) $2\pi$

2. The air screw of an aeroplane is rotating clockwise when looking from the front, if it makes a left turn, the gyroscopic effect will:

   (a) Tend to depress the nose and raise the tail

   (b) Tend to raise the nose and depress the tail

   (c) Tilt the aeroplane

   (d) None of the above

3. A governor is said to hunting, if the speed of the engine:

   (a) Remains constant at the mean speed

   (b) Is above the mean speed

   (c) Is below the mean speed

   (d) fluctuates continuously above and below the mean speed

P.T.O.

4. When there is a reduction in amplitudes over every cycle of vibration, then the body is said to have:

(a) Free vibration
(b) Forced vibration
(c) Damped vibration.
(d) None of the above

5. Law of gearing is satisfied if:

(a) Two surface slide smoothly
(b) Common normal at the point of contact passes through the pitch point on the line joining the centre of rotation.
(c) Number of teeth $= \frac{PCD}{Modue}$
(d) Addendum is greater than dedendum

6. In an automobile, if the vehicle makes a left turns the gyroscopic torque:

(a) Increase the forces on the outer wheels.
(b) Decreases the forces on the outer wheels
(c) Does not affect the forces on the outer wheels
(d) None of the above

7. When the sleeve of a porter Governor moves upwards the governor speed.

(a) Increase.
(b) Decrease
(c) Remain unaffected
(d) Any of the above

8. In which type of vibrations, amplitude of vibration goes on decreasing every cycles?

(a) Damped vibrations.
(b) Undamped vibrations
(c) Both (a) and (b)
(d) None of the above

9. The module is the reciprocal of :

(a) Diametral pitch.
(b) Circular pitch
(c) Pitch diameter
(d) None of these

10. The train value of a gear train is:

(a) Equal to velocity ratio of a gear train

(b) Reciprocal of velocity ratio of a gear train

(c) Always greater than unity

(d) Always less than unity

## Section-B

[Marks : 6×4=24]

### (Short Answer Type Questions)

1. Derive an expression for natural frequency of free vibration by Energy and Rayleigh method.
2. Two gears of module 4mm have 24 and 33 teeth. The pressure angle is $20^0$ and each gear has a standard addendum of one module. Find the length of arc of contact and the maximum velocity of sliding if the pinion rotates at 120rpm.
3. Discuss the effect of gyroscopic couple on a two wheeled vehicle when taking a turn.
4. How the velocity ratio of epicyclic gear train is obtained by Tabular method?
5. Define and explain the following terms relating to governors

   (a) Stability

   (b) Isochronism

   (c) Hunting
6. A body of 5 kg is supported on a spring of stiffness 200 n/m and has dashpot connected to if which produces a resistance of 0.002 N at a velocity of 1 cm/sec. In what ratio will be at a velocity of amplitude of vibration be reduced after 5 cycles.

## Section-C

[Marks : 12×3=36]

### (Long Answer Types Questions)

1. A spring loaded governor of the Hartnell type has arms of equal length. The masses rotates in a circle of 130 mm diameter when the sleeve is in the mid position and the ball arms are vertical. The equilibrium speed for this position is 450 rpm, neglecting friction The maximum sleeve movement is to be 25 mm and the maximum variation of speed taking in account the friction to be 5% of

the mid position speed. The mass of the sleeve is 4kg and the friction may be considered equivalent to 10N at the sleeve. The power of the governor must be sufficient to overcome the friction by one per cent change of speed either way at mid position. Determine, neglecting obliquity effect of arms:

(1) The value of each rotating mass,

(2) The spring stiffness in N/mm and the initial compression of spring.

2. (a) Derive an expression for minimum number of teeth required on a pinion in order to avoid interference in involute gear teeth.

(b) Differentiate between cycloidal and involute tooth form.

3. The mass of the turbine rotor of a slip is 20 tonnes and has a radius of gyration of 0.60m. Its speed is 2000 rpm. The ship pitches $6^0$ above and $6^0$ below the horizontal position. A complete oscillation takes 30 seconds and the motion is simple harmonic. Determine the following:

(1) Maximum gyroscopic couple

(2) Maximum angular acceleration of the ship during pitching and

(3) The direction in which the bow will tend to turn when rising, if the rotation of the rotor is clockwise when looking from the left.

4. (a) Derive the expression of free torsional vibrations for single degree of freedom.

(b) What is meant by under damping, over damping and critical damping.

5. Two gear wheels mesh externally and arc to give a velocity ratio of 3 to 1. The teele are of involute form: module=6mm, addendum=one module, pressure angle $=20^0$. The pinion rotates at 90 rpm. Determine.

(1) The number of teeth on the pinion to avoid inference on it and the corresponding number of teeth on the wheel

(2) The length of path and arc of contact

(3) The number of pairs of teeth in contact and

(4) The maximum velocity of sliding