

**E-3234****B.E. V Semester Examination, December 2013****Mechanical Engg.****Dynamics of machine and vibrations.****Time: Three Hours****[Maximum Mark : 75]****Section - A**

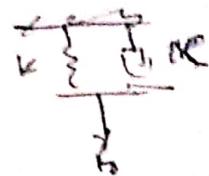
1. The maximum Length of Arc of contact for two mating gears, In order to avoid interference is
  - (a)  $(r + R) \sin \phi$
  - (b)  $(r+R) \cos \phi$
  - (c)  $(r+R) \tan \phi$**
  - (d)  $(r+R) \cot \phi$

r – Pitch circle radius of Pinion  
R – Pitch circle radius of drives  
 $\phi$  – Pressure angle
2. Addendum is the radial distance between
  - (a) Pitch circle and the dedendum circle
  - (b) Pitch circle and the addendum circle**
  - (c) Addendum circle and dedendum circle
  - (d) None of the above
3. The axis of rotation on the gears are non-Parallel and non-intersecting in
  - (a) Bevel Gears
  - (b) Spiral Gears**
  - (c) Spur Gears
  - (d) Helical Gears
4. In gears, the contact ratio is
  - (a) Infinity
  - (b) Zero
  - (c) Less than unity**
  - (d) Greater than unity

**P.T.O.**

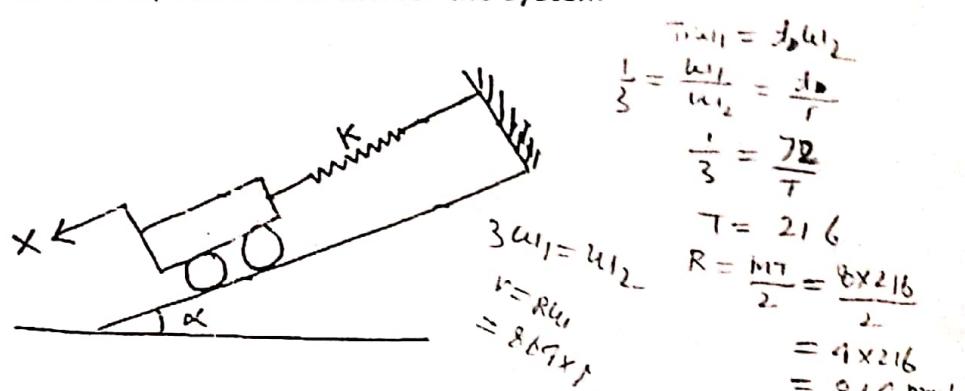
5. In a Hartnell governor, If a spring of greater stiffness is used, then the governor will be
- (a) More Sensitive
  - (b) Less Sensitive
  - (c) Isochronous
  - (d) Hunt
6. The quality of a governor can be judged by its
- (a) Stability
  - (b) Sensitivity
  - (c) Effort and Power
  - (d) None of the above
7. For a governor running at constant speed, the force acting on the sleeve is
- (a) Constant
  - (b) Zero
  - (c) Maximum
  - (d) Minimum
8. The difference between dedendum and addendum is known as
- (a) Clearance
  - (b) Backless
  - (c) Tooth space
  - (d) Flank
9. Annulus is
- (a) Toothed wheel
  - (b) Toothed wheel having external teeth
  - (c) Toothed wheel having internal teeth
  - (d) Simply a wheel
10. Working depth of two mating gears is
- (a)  $1.157m$
  - (b)  $0.157m$
  - (c)  $m+1.157m$
  - (d)  $2m$
- M-module

### Section-B



1. Derive the differential equation for a two degree system.
2. Prove that the sensitiveness of a Proell governor is greater than that of a Porter governor.
3. Two spur gears have a velocity ratio of 1/3. The driven gear has 72 teeth of 8mm module and rotates at 300 rpm. Calculate the number of teeth & the speed of the driver. What will be the pitch line velocities?
4. State and prove the law of Gearing. Show the involute profile satisfies the condition for correct gearing.
5. Write down the differential equation of motion for the system

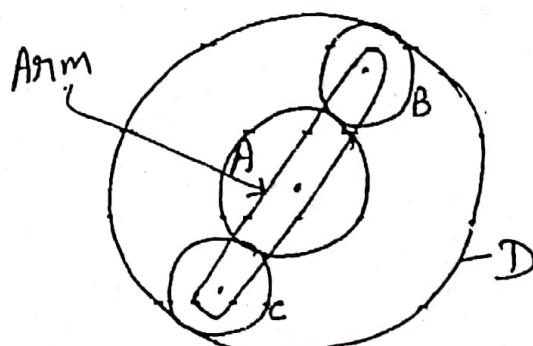
$$V = R \omega_1$$



6. Make a comparison of cycloidal and involute tooth forms.

### Section-C

1. In an Epicyclic gear train, How many revolutions does the arms, to which the Pinions B and C are attached make:
  - When A makes one revolution clockwise and D makes half a revolution anticlockwise
  - When A makes one revolution clockwise & D is stationary? The number of teeth on the gear A and D are 40 & 90 respectively



2. In a spring loaded Hartnell type governor, the extreme radii of rotation of the balls are 80 mm and 120 mm. The ball arm and the sleeve arm of the bell-crank lever and equal in length. The mass of each ball is 2 kg. If the speeds at the two extreme positions are 400 & 420 rpm. Find the initial compression of the central spring and spring constant.

~~3.~~ For the system

$$K_1 = 2000 \text{ N/m}$$

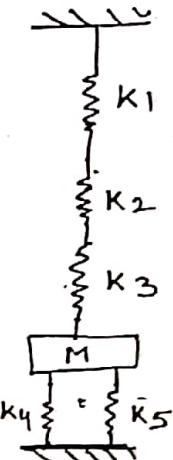
$$K_2 = 1500 \text{ N/m}$$

$$K_3 = 3000 \text{ N/m}$$

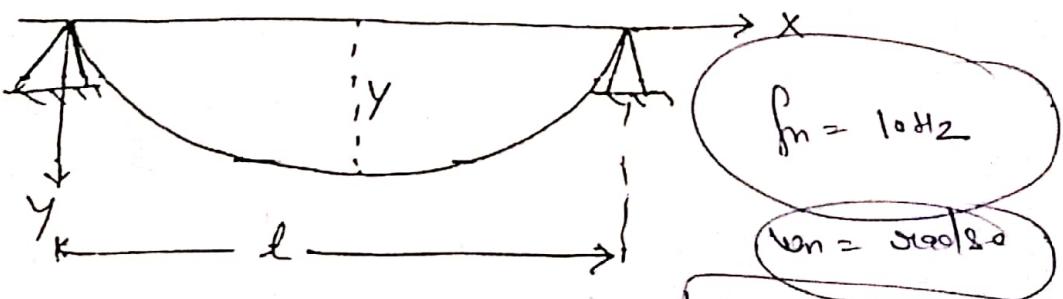
$$K_4 = K_5 = 500 \text{ N/m}$$

Find M such that the system

has a natural frequency of 10 Hz.



4. For a simply supported beam of length  $l$  and of uniform cross-section. Find the first natural frequency of transverse vibration by Rayleigh's method



5. Attempt any three

- (a) Viscous damping and coulomb damping
- (b) Stability, Sensitiveness, Isochronism, Hunting in Governor
- (c) Explain sun and planet wheel with sketch
- (d) Explain Gear terminology
- (e) Explain Stodola's method or Hohler method.

$$m = 0.92 \cdot k_y$$

(60)

**E - 3483****B. E. V<sup>th</sup> Semester (Main & Re-Exam) December, 2014****DYNAMICS OF MACHINE & VIBRATION**

Branch : Mechanical Engg.

[ Maximum Marks : 75 ]

Time : Three Hours ]

[ Minimum Marks : 30 ]

Note : Attempt all the questions of Section - A, Four from Section - B and Three questions from Section - C.

**SECTION - A**  
**(Objective Type Questions)**

1.5 × 10 = 15

(13)

1. Double helical gears are also known :
  - (a) Spiral gear
  - (b) Skew gear
  - (c) Bevel gear
  - (d) Herring-bone gear
  
2. Whole depth of two mating gears is :
  - (a) 1.157 m
  - (b) 0.157 m
  - (c) m + 1.157 m
  - (d) 2 m
  
3. In involute gears meshing together, the path of contact of pair of teeth is :
  - (a) A hyperbolic curve
  - (b) An elliptical curve
  - (c) A circular Arc
  - (d) A straight line
  
4. Idle gear are used in :
  - (a) Spur gear only
  - (b) Bevel gear only
  - (c) Both in spur & Bevel
  - (d) Neither in spur gear, nor in bevel gear
  
5. Which of the following is spring controlled governor ?
  - (a) Hartnell
  - (b) Hartung
  - (c) Pickering
  - (d) All



P.T.O.

6. The amount of damping, necessary for a system to be critically damped, is known as :
- Damping factor
  - Magnification factor
  - Critical damping coefficient
  - None of these
7. The shaft with two rotors at its end will have :
- 3 nodes
  - 2 nodes
  - 1 nodes
  - 0 nodes
8. The gyroscopic acceleration depends on :
- Instantaneous value of  $w$
  - The rate at which the axis of spin changes its speed
  - Both (a) & (b)
  - None of above
9. The rate at which the axis of rotation (about which a disc is rotating) changes its position is known as :
- Angular velocity
  - Sliding velocity
  - Linear velocity
  - Angular velocity of precession
10. The height of a watt's governor is :
- $h = gw^2$
  - $h = \frac{w^2}{g}$
  - $h = \frac{g}{w^2}$
  - $h = \frac{1}{gw^2}$

### SECTION - B

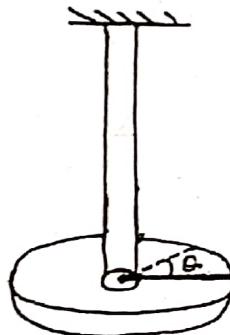
(Short Answer Type Questions)

$6 \times 4 = 24$

- ✓ 1. Discuss the effect of friction on the functioning of a porter governor. Discuss its governing equation taking into account the friction at the sleeve.

$$\left( \frac{2\pi n}{\omega} \right)^{\frac{1}{2}} = \frac{\partial}{h} \quad (2)$$

2. Discuss the effect of damping on vibratory systems. What is meant by under-damping, over-damping and critical damping? (5)
3. Two  $20^\circ$  involute spur gears mesh externally and give a velocity ration of 3. The module is 3 mm and the addendum is equal to 1.1 module. If the Piston rotates at 120 rpm. Determine. (4)
- Minimum number of teeth on each wheel to avoid interference.
  - Contact ratio.
4. Calculate the natural frequency of vibration of a torsional pendulum with the following dimensions length of rod = 1 m Diameter of the rod = 5 mm Diameter of the rotor = 0.2 m, Mass of rotor = 2 kg the modulus of rigidity for the material of the rod =  $0.83 \times 10^{11}$  N/M<sup>2</sup> (6)



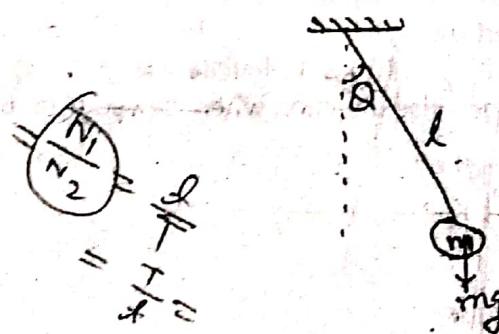
5. Explain Epicyclic gear train & compound Epicyclic gear train with neat sketches. (4)
6. Make a comparison of cycloidal and involute tooth form.

### SECTION - C

( Long Answer Type Questions )

$12 \times 3 = 36$

1. (a) Determine the natural frequency of a simple Pendulum, taking the mass of the rod into consideration. (10)

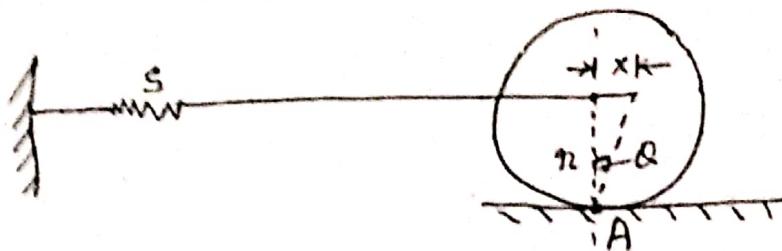


$$3.7 \\ 2.33 \times 0.33 \quad (3)$$

$$0.764$$

P.T.O.

- (b) Find the natural frequency of the oscillation for given figure.



2. A machine mounted on spring and fitted with a dashpot has a mass of 60 kg. There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity determine the :
  - (a) Damping coefficient
  - (b) Ratio of frequencies of damped & undamped vibrations.
  - (c) Periodic time of damped vibrations.
3. Sketch two teeth of a gear and show the following face, flank, top and bottom land addendum, Dedendum, tooth thickness, space width, face width, circular pitch. Explain also these terms.
4. In a spring loaded Hartnell type governor, the mass of each ball is .4 kg and the lift of sleeve is 40 mm. The governor begins to float at 200 rpm when the radius of the ball path is 90 mm. The mean working speed of the governor is 16 times the range of speeds when friction is neglected. The length of the ball and roller arms of the bell-crank lever are 100 mm and 80 mm respectively. The Pivot centre and the axis of governor are 115 mm apart. Determine the initial compression of the spring, taking in to account the obliquity of arms. Assuming the friction at the sleeve to be equivalent to a force of 15 N. Determine the total alteration in speed before the sleeve begins to move from the mid position.
5. A propeller plane is flying at 600 km/hr along a circular path in the horizontal plane. The radius of the path is 5 km. Each propeller rotates at 1800 rpm and can be considered to be a 2-m long uniform rod of mass 40 kg. Calculate the gyroscopic moment. The propeller rotates in the counter clockwise direction when viewed from front.

(4)

**E-196**

**B.E. V Semester (Main & RE) Examination, Dec. 2015**

# **Dynamics of Machine and Vibration**

**Branch : M.E.**

### *Time: Three Hours /*

/ Max. Marks : 75

[Min. Marks : 30]

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

## **Section-A**

### **(Objective Type Questions)**

**Note :** This section will contain ten objective type questions. They may be fill in the blanks, True/False or Multiple Choice Type.  $1.5 \times 10 = 15$



P.T.O.

5. The controlling force curve is a graph between controlling force and
- Speed of rotation
  - Radius of rotation
  - Range of speed
  - Lift of governor
6. If the particles of a body vibrates along a circular arc, whose centre lies on the axis of the shaft, then the body is said to have
- Transverse vibration
  - Longitudinal vibration
  - Torsional vibration
  - None of the above
7. When damping is negligible and frequency ratio  $\frac{w}{w_n} > \sqrt{2}$ , the transmissibility is given by

(a)  $\frac{1}{1 - \left(\frac{w}{w_n}\right)^2}$

(b)  $\frac{1}{\left(\frac{w}{w_n}\right)^2 - 1}$

(c)  $1 - \left(\frac{w}{w_n}\right)^2$

(d)  $\left(\frac{w}{w_n}\right)^2 - 1$

8. The natural period of the free longitudinal vibrations is given by

(a)  $2\pi\sqrt{\frac{m}{k}}$

(b)  $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$

(c)  $\frac{1}{2\pi}\sqrt{\frac{g}{\sigma}}$

(d) None of the above

9. A system is said to be over damped if the damping factor for the system is

(a) More than one

(b) Equal to one

(c) Less than one

(d) Equal to zero

10. The gyroscopic acceleration is given by

(a)  $\frac{\delta w}{\delta t}$

(b)  $w \cdot \frac{\delta \theta}{\delta t}$

(c)  $r \cdot \frac{\delta \theta}{\delta t}$

(d)  $r \cdot \frac{\delta w}{\delta t}$

### Section-B

#### (Short Answer Type)

**Note :** This section will contain six questions. Students will ask to attempt any four questions out of six questions.  $6 \times 4 = 24$

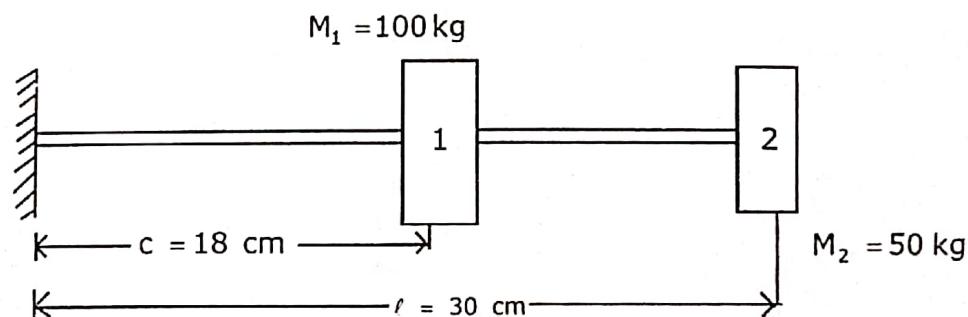
1. Prove that the sensitiveness of a Proell governor is greater than that of a Porter governor.

2. Prove that for two involute gear wheels in mesh, the angular velocity ratio does not change if the centre distance is increased within limits, but the pressure angle increases. 6
3. Derive an expression for the natural frequency of free longitudinal vibration by Equilibrium method. 6
4. Explain the effect of the gyroscopic couple on the reaction of the four wheels of a vehicle negotiating a curve. 6
5. In a spring loaded governor, of a Hartnell type, the mass of each ball is 1 kg, length of vertical arm of the bell-crank lever is 100mm and that of the horizontal arm is 50 mm. The distance of fulcrum of each bell crank lever is 80 mm from the axis of rotation of the governor. The extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 5 percent greater than the minimum equilibrium speed which is 360 rpm. Find, neglecting obliquity of arms, initial compression of springs & equilibrium speed corresponding to the radius of rotation of 100mm. 6
6. Discuss the effect of damping on vibratory system. What is meant by under-damping, over-damping and critical damping? 6

### Section-C (Long Answer Type)

**Note :** This section will contain **five** questions. Students will ask to attempt any **three** questions out of five questions.  $12 \times 3 = 36$

1. Find the lower natural frequency of vibration for the system shown in figure by Stodala's methods,  $E = 1.96 \times 10^{11} \text{ N/m}^2$ ,  $I = 4.0 \times 10^{-7} \text{ m}^4$ . 12



2. A pair of gears, having 40 & 20 teeth respectively, are rotating in mesh, the speed of the smaller being 2000 rpm,

Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are twenty degree Involute form, addendum length is 5 mm and the module is 5mm. Also find the angle through which the pinion runs while any pairs of teeth are in contact. 12

3. A pair of locomotive driving wheels with the axle, have a moment of inertia of  $180 \text{ kg-m}^2$ . The diameter of wheel treads is 1.8m and the distance between wheels centres is 1.5 m. When the locomotives is travelling on a level track at 95 km/hr, defective ballasting causes one wheel to fall 6 mm and to rise again in a total time of 0.1 sec. If the displacement of the wheel takes place with simple harmonic motion. Find
  - (i) The gyroscopic couple setup
  - (ii) The reaction between the wheel and rail due to this couple. 6
4. (a) Derive an expression for the centre distance of a pair of Spiral gear. 6  
(b) A spring mass system  $k_1, m$  has a natural frequency of  $f_1$ . If the second spring  $k_2$  is added in series with the first spring, the natural frequency is lowered to  $\frac{1}{2}f_1$ . Determine  $k_2$  in terms of  $k_1$ . 6
5. (a) Define and explain the following term relating to governor; stability, sensitiveness, Isochronism, Hunting, effort & power. 6  
(b) Explain the term, sun and planet gears, with a neat sketch. Explain the working of an epicyclic gear train with a sun and planet gear. 6

**E-325****B. E. V Semester (Main & Re-Exam.) Examination – December, 2016****DYNAMICS OF MACHINE AND VIBRATION****Branch : ME***Time : Three Hours ]**[ Maximum Marks : 75**[ Minimum Marks : 30*

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

**SECTION – A****[ Marks :  $1.5 \times 10 = 15$** **(Objective Type Questions)**

1. The Two parallel and coplanar shafts are connected by gears having teeth parallel to the axis of the shaft. This arrangement is called :
  - (a) Spur gearing
  - (b) Helical gearing
  - (c) Bevel gearing
  - (d) Spiral gearing
  
2. The contact ratio for gears is :
  - (a) Zero
  - (b) Less than one
  - (c) Greater than one
  - (d) None of these
  
3. The size of gear is usually specified by :
  - (a) Pressure angle
  - (b) Circular pitch
  - (c) Diametral pitch
  - (d) Pitch circle diameter
  
4. The height of Watt's governor in meters is equal to :
  - (a)  $8.95/N^2$
  - (b)  $89.5/N^2$
  - (c)  $895/N^2$
  - (d)  $8950/N^2$

**P. T. O.**

5. In a Hartnell governor, if a spring of greater stiffness is used, then the governor will be :
- (a) More sensitive
  - (b) Less sensitive
  - (c) Isochronous
  - (d) None of these
6. In a vibration isolation system if  $w/w_n > 1$  then the phase difference between the transmitted force and the disturbing force is :
- (a)  $0^\circ$
  - (b)  $90^\circ$
  - (c)  $180^\circ$
  - (d)  $270^\circ$
7. A system is said to be overdamped if the damping factor for the system is :
- (a) more than one
  - (b) Equal to one
  - (c) Less than one
  - (d) Equal to zero
8. The natural frequency (in Hz) of free longitudinal vibrations is equal to :
- (a)  $\frac{1}{2\pi} \sqrt{\frac{s}{m}}$
  - (b)  $\frac{1}{2\pi} \sqrt{\frac{g}{\delta}}$
  - (c)  $\frac{0.4985}{\sqrt{\delta}}$
  - (d) Any one of the above
  - (e) None of the above

Where  $m$  = Mass of body in kg,  $S$  = Stiffness of the body in N/m and  $\delta$  = Static deflection of the body in meters.

9. The particles of a body vibrates along a circular arc, whose centre lies on the areas of the shaft, then the body is said to have :
- (a) Transverse Vibration
  - (b) Longitudinal Vibration
  - (c) Torsional Vibration
  - (d) None of the above
10. A disc is spinning with an angular velocity  $\omega$  rad/sec about the axis of spin. The couple applied to the disc causing precession will be :
- (a)  $1/2 I w^2$
  - (b)  $I w^2$
  - (c)  $\frac{1}{2} I \cdot W \cdot W_p$
  - (d)  $I \cdot W \cdot W_p$

When  $I$  = Mass moment of inertia of the disc and  $W_p$  = Angular velocity of precession of the axis of spin.

**SECTION – B**[ Marks :  $6 \times 4 = 24$  ]**(Short Answer Type Questions)**

1. What do you understand by an isochronous Governor ? Also show that a Porter governor cannot be isochronous.
2. State and prove the law of gearing. Show that involute profile satisfies the conditions for correct gearing.
3. Explain the terms, under damping, critical damping and overdamping.
4. Explain the effect of gyroscopic couple on the reaction of the 4 wheels of a vehicle negotiating a curve.
5. In a spring loaded Hartnell type governor, the extreme radii of rotation of the balls are 80 mm and 120 mm. The ball arm and the sleeve arm of the bell crank lever are equal in length. The mass of each ball is 2 Kg. If the speeds at the two extreme positions are 400 and 420 rpm, find; (i) The initial compression of the central spring and (ii) the spring constant.
6. Discuss the effect of inertia of the shaft in longitudinal and transverse vibration.

**SECTION – C**[ Marks :  $12 \times 3 = 36$  ]**(Long Answer Type Questions)**

1. A steel shaft 1.5 m long is 95 mm in diameter for the first 0.6 m of its length, 60 mm in diameter for the next 0.5 m of the length and 50 mm is diameter for the remaining 0.4 m of its length. The shaft carries two flywheels at two ends, the first having a mass of 900 kg and 0.85 m radius of gyration located at the 95 mm diameter end and Second having a mass of 700 kg and 0.55 m radius of gyration Located at the other end. Determine the location of the node and the natural frequency of tree torsional vibration of the system. The modulus of rigidity of shaft natural may be taken as  $80 \text{ GN/m}^2$ .
2. A pair of involute spur gears with  $16^\circ$  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; (i) the addenda on pinion and gear wheel; (ii) the length of loath of contact and (iii) the maximum velocity of sduty of teeth on either side of the pitch point.

3. A pair of Locomotive driving wheels with the axle, have a moment of inertia of  $180 \text{ kg-m}^2$ . The diameter of wheel treads is 1.8 m and distance between wheels centre is 1.5 m. When the Locomotives is travelling on a level mach at 95 km/hr. defective ballasting causes one wheel to fall 6 mm and to rise again in a total time of 0.1 sec. If the displacement of the wheel takes place with simple harmonic motion. Find :
- The gyroscopic couple set-up
  - The reaction between the wheel and rail due to this couple
4. (a) Show that in a pair of spiral gears connecting inclined shafts, the efficiency is maximum when the spiral angle of the driving wheel is half the sum of the shaft and friction angles.
- (b) Define (i) normal pitch and (ii) axial pitch relating to helical gears.
5. (a) Derive an expression for minimum number of teeth required on a pinon 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.
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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 :  $1.5 \times 10 = 15$** **(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

**P. T. O.**

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 :  $6 \times 4 = 24$  ]

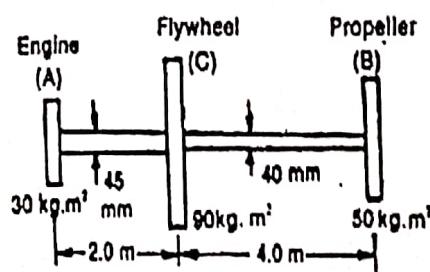
### **(Short Answer Types Questions)**

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 :
- loads on the spring at the lowest and the highest equilibrium speeds and
  - stiffness of the spring.
6. What do you understand by gear train ? Discuss the various types of gear trains.

**SECTION – C**[ Marks :  $12 \times 3 = 36$  ]**(Long Answer Types Questions)**

- A pair of involute spur gears with  $16^\circ$  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,
  - the addenda on pinion and gear wheel,
  - the length of path of contact and
  - the maximum velocity of sliding of teeth on either side of the pitch point.
- 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 :
  - Displacement and velocity of mass as a function of time.
  - Displacement and velocity after 0.4 sec.
- 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.  $G = 84 \times 10^9 \text{ N/m}^2$ .



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

( 3 )

P. T. O.

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

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 :  $1.5 \times 10 = 15$ ]

### **(Objective Type Questions)**



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 surfaces 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 =  $\frac{PCD}{\text{Modue}}$
  - (d) Addendum is greater than dedendum

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

  - (a) Increases 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 :  $6 \times 4 = 24$ ]

**(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  $20^\circ$  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 it 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 :  $12 \times 3 = 36$ ]

**(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 ship is 20 tonnes and has a radius of gyration of 0.60m. Its speed is 2000 rpm. The ship pitches  $6^\circ$  above and  $6^\circ$  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 teeth are of involute form: module=6mm, addendum=one module, pressure angle = $20^\circ$ . 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