

Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH/(AUE-NEW)/SEM-5/AUE-501/2013-14
2013

DYNAMICS OF MACHINES

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following .

10 × 1 = 10

- i) In an engine work done by inertia forces per cycle is
- a) positive b) negative
- c) zero d) none of these.
- ii) The maximum fluctuation of energy of a flywheel is equal to
- a) $1.\omega (\omega_1 - \omega_2)$ b) $1.\omega.C_s$
- c) $2.E.C_s$ d) all of these.

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- iii) In vibration isolation system if $\frac{\omega}{\omega_n} > 1$, then phase difference between transmitted and disturbing force is
- a) 0° b) 90°
- c) 180° d) 270° .
- iv) Brake commonly used for automobile is
- a) shoe brake
- b) band brake
- c) internal expanding brake
- d) none of these.
- v) When crank is at the inner dead centre, in a horizontal reciprocating steam engine then the velocity of piston will be
- a) minimum b) maximum
- c) zero d) none of these.
- vi) In underdamped vibrating system if X_1 and X_2 are the values of successive amplitude on the same side, the logarithmic decrement is equal to
- a) X_1 / X_2
- b) $\log (X_1 / X_2)$
- c) $\log_e (X_1 / X_2)$
- d) $\log (X_1 . X_2)$.

vii) A governor is said to be 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.

viii) The ratio of height a Porter governor (when the lengths of arm and links are equal) to the height of Watt governor is

- a) $\frac{m}{(m+M)}$
- b) $\frac{M}{(m+M)}$
- c) $\frac{(m+M)}{m}$
- d) $\frac{(m+M)}{M}$

ix) For a governor, if F_c is the controlling force, r is the radius of rotation of the balls the stability of the governor will be ensured when

- a) $\frac{dF_c}{dr} > \frac{F_c}{r}$
- b) $\frac{dF_c}{dr} < \frac{F_c}{r}$
- c) $\frac{dF_c}{dr} = \frac{F_c}{r}$
- d) $\frac{dF_c}{dr} = 0$

x) A governor rotates at 60 r.p.m. then its height will be

- a) 0.24 m
- b) 0.42 m
- c) 4.2 m
- d) none of these.

GROUP - B

(Short Answer Type Questions)

Answer any three of the following. $3 \times 5 = 15$

2. A vertical shaft 100 mm in diameter and 1 m in length has its upper end fixed at the top. At the other end it carries 5000 N weight. Young's Modulus is 2×10^5 N/mm². Neglecting the weight of shaft find out the frequencies of longitudinal and transverse vibrations.
3. What is the function of flywheel?
4. What do you mean by fluctuation of energy and fluctuation of speed of crank shaft? Define 'coefficient of fluctuation of energy' and 'coefficient of fluctuation of speed'.
5. Prove that the whirling speed for a rotating shaft is same as the natural frequency of transverse vibration but its unit is r.p.s.
6. Prove that maximum variation of tractive force is obtained when $\theta = 135^\circ$ or 315° .

GROUP - C

(Long Answer Type Questions)

Answer any three of the following. $3 \times 15 = 45$

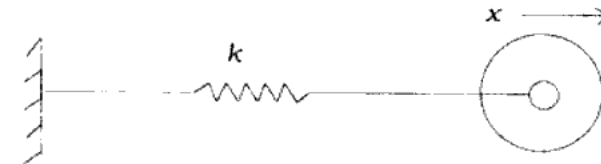
7. The lengths of crank and connecting rod of a horizontal reciprocating engine are 200 mm and 1.0 m respectively. The crank is rotating at 400 r.p.m. When the crank has turned 30° from the inner dead centre, the difference of pressure between the cover end and the piston end is 0.4 N/mm^2 . If the mass of the reciprocating parts is 100 kg and cylinder bore is 0.4 m, then calculate
 - a) Inertia force

- b) Force on piston
- c) Piston effort
- d) Thrust on the sides of cylinder walls
- e) Thrust on the connecting rod
- f) Crank effort
- g) Turning moment on the crank shaft.

(Neglect the effect of piston rod diameter and frictional resistance)

8. a) A constant torque 4 kW motor drives a rivetting machine. A flywheel of mass 140 kg and radius of gyration of 0.5 m is fitted to the rivetting machine. Each rivetting operation takes 1 second and requires 9000 Nm of energy. If the speed of flywheel is 420 r.p.m. before rivetting then find —
- i) the fall of speed of the flywheel after rivetting
 - ii) the number of rivets closed per hour. 10
- b) A horizontal cross compound steam engine develops 400 H.P. at 90 r.p.m. The coefficient of fluctuation of energy, found from turning moment diagram is 0.1 and speed is to be kept within 5% of the mean speed. Find the weight of flywheel required if radius of gyration is 2 m. 5
9. a) Explain the concepts of 'self locking brake' and 'self energized brake'. 5
- b) Find the logarithmic decrement and the ratio of any two consecutive amplitude of a vibrating system, which consists of a mass of 3.5 kg, a spring of stiffness 2.5 N/mm and damper of damping coefficient 0.018 N/mm². 5

- c) A circular cylinder of mass 4 kg and radius 15 cm is connected by a spring of stiffness 4000 N/m as shown in the figure. It is free to roll on horizontal rough surface without slipping. determine the natural frequency. 5



10. a) A simple band brake is applied to a rotating drum of diameter 500 mm. The angle of lap of the band on the drum is 270°. One end of the band is attached to a fulcrum pin of the lever and other end is to a pin 100 mm from the fulcrum. If the coefficient of friction is 0.25 and a braking force of 90 N is applied at a distance of 600 mm from the fulcrum, find the braking torque when the drum rotates in (i) anti-clockwise direction, (ii) clockwise direction. 10
- b) The wheels of a bicycle are of diameter of 800 mm. The rider on this bicycle is travelling at a speed of 16 km/hr on a level road. Total mass of rider and cycle is 110 kg. A brake is applied at the rear wheel. The pressure applied on the brake is 100 N and COF is 0.6. Find out the —
- i) distance travelled by the cycle after braking
 - ii) number of turns on the wheel. 5

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11. a) The arms of a porter governor are 30 cm long. The upper arms are pivoted on the axis of rotation. The lower arms are attached to the sleeve at a distance of 4 cm from the axis of rotation. The mass of load on the sleeve is 70 kg and the mass of each ball is 10 kg. Determine the equilibrium speed when radius of rotation of balls is 20 cm. If the friction is equivalent to 19.62 N at sleeve, what will be the range of speed for this position ? 9

- b) A single cylinder reciprocating engine has the following data :

Speed of the engine is 120 r.p.m., Stroke is 320 mm, mass of the reciprocating parts are 45 kg, mass of revolving parts are 3 kg at crank radius. If 60% of the reciprocating parts and all the revolving parts are to be balanced, then find —

- i) the balanced mass required at radius 300 mm. and
- ii) the unbalanced force when the crank has rotated 60° from the top dead centre. 6

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