

CS/B.Tech/AUE/Odd/Sem-5th/AUE-501/2015-16



**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY,  
WEST BENGAL**

**AUE-501**

**DYNAMICS OF MACHINES**

Time Allotted: 3 Hours

Full Marks: 70

*The questions are of equal value.  
The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**GROUP A  
(Multiple Choice Type Questions)**

1. Answer all questions.

10×1 = 10

- (i) In reciprocating engines, the primary unbalanced force
- (A) cannot be balanced (B) can be fully balanced  
(C) can be partially balanced (D) none of these
- (ii) Static balancing involves balancing of
- (A) forces (B) couples  
(C) forces as well as couples (D) masses
- (iii) Effort of a governor is the force exerted by the governor on the
- (A) balls (B) sleeve  
(C) upper links (D) lower links

5133

1

Turn Over

CS/B.Tech/AUE/Odd/Sem-5th/AUE-501/2015-16

- (iv) The condition of isochronisms can be realized in a \_\_\_\_\_ governor.
- (A) Watt (B) Porter  
(C) Proell (D) Hartnell
- (v) A reduction in amplitude of successive oscillation indicates \_\_\_\_\_ vibrations.
- (A) free (B) force  
(C) damp (D) natural
- (vi) The frequency of damped vibrations is always \_\_\_\_\_ the natural frequency.
- (A) equal to (B) more than  
(C) less than (D) double
- (vii) The maximum fluctuation of energy in a flywheel is equal to
- (A)  $I\omega(\omega_1 - \omega_2)$  (B)  $I\omega K$   
(C)  $2KE$  (D) all of these
- (viii) In a light or under damped vibrating system, the natural logarithm of the ratio of any two successive amplitudes is known as
- (A) damping factor (B) magnification factor  
(C) logarithmic decrement (D) critical damping co-efficient
- (ix) The effort of Hartnell governor (where the moments due to weight of the ball and arms are neglected) is equal to
- (A) C/S (B) CS  
(C) 1/CS (D) S/C
- (x) At certain speed, the rotating shaft tends to vibrate violently in the transverse direction, then speed is called
- (A) whirling speed (B) critical speed  
(C) whipping speed (D) all of these

5133

2

CS/B.Tech/AUE/Odd/Sem-5th/AUE-501/2015-16

**GROUP B**  
(Short Answer Type Questions)

Answer any three questions.

3×5 = 15

2. Show that Porter Governor cannot be isochronous.
3. Prove the relation that hammer blow =  $\pm m_h \times r \times \omega^2$
4. Explain Hunting of governor and its effect of the engine.
5. What do you mean by Dynamically Equivalent System?
6. Prove that maximum variation of tractive effort is obtained when  $\theta = 135^\circ$  or  $315^\circ$ .

**GROUP C**  
(Long Answer Type Questions)

Answer any three questions.

3×15 = 45

7. For any crank single  $\theta$  the turning moment T is given by the expression  
 $T = 750 + 1000 \sin 2\theta - 600 \cos 2\theta$  kg-m.  
 If the resisting torque is uniform and mean speed is 150 r.p.m find  
 (i) The power of engine  
 (ii) Percentage of fluctuation of speed if the weight of flywheel is 200 N at 1 m radius.
8. A single cylinder vertical engine has a bore of 600 mm and a stroke of 800 mm. The connecting rod is 1 m long. The mass of the reciprocating parts is 280 kg. On the expansion stroke with the crank at  $30^\circ$  from the top dead centre the gas pressure is 0.7 MPa. If the engine runs at 250 r.p.m., determine  
 (a) net force acting on the piston;  
 (b) resultant load on the gudgeon pin;  
 (c) thrust on the cylinder walls;  
 (d) speed above which, the other thing remaining same, the gudgeon pin load would be reversed in direction.

5133

3

Turn Over

CS/B.Tech/AUE/Odd/Sem-5th/AUE-501/2015-16

9. A punching machine operates at the rate of 600 holes/hr. It does 45 Nm of work per sq. mm of sheared area in cutting 25 mm diameter hole in a 3 mm thick plate. The machine is operated by a constant torque motor. The speed of the machine fluctuates between 250 and 230 r.p.m. The frictional losses are 20% of the work done during punching and actual punching time per hole is 2 seconds. Find  
 (i) The power required to drive punching machine  
 (ii) The maximum fluctuation energy  
 (iii) The mass of the flywheel required to keep the speed fluctuation in the given range. Radius of gyration of flywheel is 500 mm.

- 10.(a) A simply supported shaft of length 800 mm carries a mass of 250 mm from one end. If  $E = 200 \text{ GN/m}^2$  and the diameter of shaft is 50 mm then find the natural frequency of transverse vibration.
- (b) A Barrel of a large gun recoils against a spring on firing. At the end of recoil, a dashpot is engaged that allows the barrel to return to its initial position in the minimum time without oscillation. A gun barrel has a mass of 400 kg and the initial velocity of the gun barrel at the instant of firing is 20 m/s. The barrel recoils 1 m on firing. Find  
 (i) proper spring stiffness in N/mm  
 (ii) damping co-efficient of the dashpot.
- (c) What is meant by vibration isolation?

- 11.(a) A two cylinder engine with the cranks at  $180^\circ$  and the cylinders on the same side of the crank shaft centre line, if the crank of the first cylinder, makes an angle of  $60^\circ$  with IDC and the reciprocating masses, crank lengths and connecting rod lengths are identical for each cylinder, then to what extent the engine is balanced for  
 (i) primary and secondary forces  
 (ii) primary and secondary couples.
- (b) A shaft is rotating at a uniform angular speed. Four masses  $m_1, m_2, m_3, m_4$  of magnitudes 300 kg, 450 kg, 360 kg and 390 kg respectively are attached rigidly to the shaft. The corresponding radii of rotation are 200 mm, 150 mm, 250 mm, and 300 mm respectively. The angles made by the masses with the horizontal are  $0^\circ, 45^\circ, 120^\circ$  and  $255^\circ$  respectively. Find :  
 (i) the magnitude of the balancing mass  
 (ii) the position of the balancing mass if its radius of rotation is 200 mm.

5133

4