Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH (AUE)(N)/SEM-5/AUE-501/2012-13

2012

DYNAMICS OF MACHINE

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

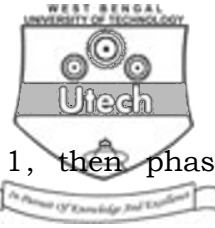### (Multiple Choice Type Questions)

1.   Choose the correct alternatives for the following : $10 \times 1 = 10$

   i)   Brake commonly used for railway train is

      a)   shoe brake

      b)   band brake

      c)   internal expanding brake

      d)   band and block brake.

   ii)   In an engine work done by inertia forces per cycle is

      a)   positive   b)   negative

      c)   zero   d)   none of these.

iii) In vibration isolation system if $\dfrac{\omega}{\omega_n} > 1$, then phase difference between transmitted and disturbing force is

a) 0°   b) 90°

c) 180°   d) 270°.

iv) 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.

v) In underdamped vibrating system if X_1 and X_2 is the values of successive amplitude on the same side, then logarithmic decrement is equal to

a) $\dfrac{X_1}{X_2}$ b) $\log\left(\dfrac{X_1}{X_2}\right)$

c) $\log_e\left(\dfrac{X_1}{X_2}\right)$ d) $\log\left(\dfrac{X_1}{X_2}\right)$.

vi) The maximum fluctuation of energy of a flywheel is equal to

a) $I\omega(\omega_1 - \omega_2)$ b) $I\omega C_s$

c) $2EC_s$ d) all of these.

vii) A governor is said to be hunting, if the speed of the engine is

    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 of a Porter governor (when the lengths of arm and links are equal) to the height of Watt's governor is

    a) $\dfrac{m}{m+M}$ b) $\dfrac{M}{m+M}$

    c) $\dfrac{m+M}{m}$ d) $\dfrac{m+M}{M}$.

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) $\dfrac{dF_c}{dr} > \dfrac{F_c}{r}$ b) $\dfrac{dF_c}{dr} < \dfrac{F_c}{r}$

    c) $\dfrac{dF_c}{dr} = \dfrac{F_c}{r}$ d) $\dfrac{dF_c}{dr} = 0$.

x) A governor rotates at 61 r.p.m. Then its height will be

    a) 0·24 m   b) 0·42 m

    c) 4·2 m   d) 0·024 m.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following   3 × 5 = 15

2. Prove that maximum variation of tractive force is obtained when $\theta = 135°$ or $315°$.

3. What is the difference between absorption and transmission dynamometer ? What are torsion dynamometers ?

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. Using Rayleigh's method derive an expression for natural frequency of longitudinal vibrations.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.   3 × 15 = 45

6. a) A vertical petrol engine 100 mm of diameter and 120 mm stroke has a connecting rod 250 mm long. The mass of the piston is 1·1 kg. The speed is 2000 rpm. On the expansion stroke with a crank 20° from TDC, the gas pressure is 700 kN/m². Determine

   i)   Net force on the piston

   ii) Resultant load on the gudgeon pin

   iii) The speed above which other things remaining same. The gudgeon pin load would be reversed in direction.
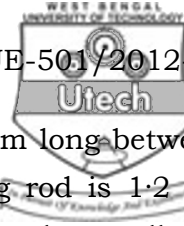
b) A connecting rod of an engine is 225 mm long between its centers. The mass of the connecting rod is 1·2 kg. The distance of the centre of gravity from the small end is 150 mm and radius of gyration about an axis through the centre of gravity is 95 mm. Find the equivalent dynamical system if one of the masses coincides in the position with the small end centre. (3 + 2 + 4) + 6

7. a) A punching press is required to punch 40 mm diameter holes in a plate of 30 mm thickness at the rate of 4 holes per minute. It requires 6 N-m of energy per mm^2 of sheared area. The punch has a stroke of 100 mm. The r.p.m. of the flywheel varies from 320 to 280. If the radius of gyration of flywheel is 1 m, find

   i) mass of the flywheel

   ii) power of the motor for punching machine.

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. 10 + 5

8. a) 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 a disc of weight 5000 N. The modulus of elasticity of the material of the shaft is 2×10^5 N/mm^2. Neglecting the weight of the shaft, determine the frequency of longitudinal vibration and transverse vibrations.
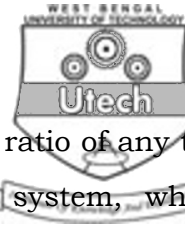
b) Find the logarithmic decrement and the ratio of any two consecutive amplitude of a vibrating system, which consists of a mass of 3·5 kg, a spring of stiffness 2·5 N/mm and damper of damping coefficient 0·018 N/mm^2.

c) A circular cylinder of mass 4 kg and radius 15 cm is connected by a spring of stiffness 400 N/m as shown in the figure. It is free to roll on horizontal rough surface without slipping, determine the natural frequency.
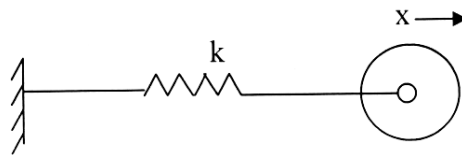

5 + 5 + 5

9. a) Given figure shows the differential band brake of drum diameter 400 mm. The two ends of the band are fixed to the points on the opposite side of the fulcrum of the lever at a distance of 50 mm and 160 mm from the fulcrum as shown in the figure. The break is to sustain a torque of 300 Nm. The coefficient of friction between band and the brake is 0·2. The angle of contact is 210° and the length of lever from the fulcrum is 600 mm. Determine :

   i) The force required at the end of the lever for the clockwise and anti-clockwise rotation of the drum.

ii) Value of *OB* for the brake to be self-locking for clockwise rotation.
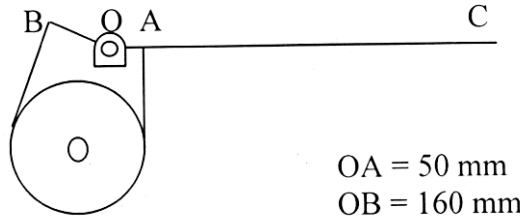
OA = 50 mm
OB = 160 mm

b) Explain 'Self locking brake' and 'Self energized brake'.

10 + 5

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