A   **Reg. No. :** ☐☐☐☐☐☐☐☐☐☐☐☐

Question Paper Code: 55701

B.E./B.Tech. DEGREE EXAMINATION, NOV 2018

Fifth Semester

Mechanical Engineering

15UME501 -DYNAMICS OF MACHINERY

(Regulation 2015)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In an engine, the work done by inertia forces in a cycle is   CO1- R

    (a) Positive   (b) Zero   (c) Negative   (d) None of these

2. The ratio of the maximum fluctuation of speed to the mean speed is   CO1- R
    called

    (a) Fluctuation of speed   (b) Maximum fluctuation of speed

    (c) Coefficient of fluctuation of speed   (d) None of these

3. For static balancing of a shaft   CO2- R

    (a) The net dynamic force acting on the shaft is equal to zero

    (b) The net couple due to the dynamic forces acting on the shaft is equal to zero

    (c) Both (a) and (b)

    (d) None of these

4. The partial balancing means   CO2- R

    (a) Balancing partially the revolving masses

    (b) Balancing partially the reciprocating masses

    (c) Best balancing of engines

    (d) All of the above

5. Frequency of vibrations is usually expressed in   CO3- R

   (a) Number of cycles per hour   (b) Number of cycles per minute

   (c) Number of cycles per second   (d) None of these

6. When there is a reduction in amplitude over every cycle of vibration,   CO3- R
   then the body is said to have

   (a) Free vibration   (b) Forced vibration   (c) Damped vibration   (d) None of these

7. The ratio of the maximum displacement of the forced vibration to the   CO4- R
   deflection due to the staticforce, is known as

   (a) Damping factor   (b) Damping coefficient

   (c) Logarithmic decrement   (d) Magnification factor

8. In vibration isolation system, if $\omega/\omega n > 1$, then the phase difference   CO4- R
   between the transmitted forceand the disturbing force is

   (a) 0°   (b) 90°   (c) 180°   (d) 270°

9. When the sleeve of a Porter governor moves upwards, the governor   CO5- R
   speed

   (a) Increases   (b) Decreases   (c) Remains unaffected (d) None of these

10. When the pitching of a ship is upward, the effect of gyroscopic couple   CO5- R
    acting on it will be

    (a) To move the ship towards port side   (b) To move the ship towards star-board

    (c) To raise the bow and lower the stern   (d) To raise the stern and lower the bow

PART – B (5 x 2= 10Marks)

11. Explain inertia force and inertia torque.   CO1- R

12. What is partial balancing of reciprocating masses?   CO2- R

13. Define damped vibration.   CO3- R

14. Define vibration isolation.   CO4- R

15. What is the function of governor?   CO5- R

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16. (a) The crank-pin circle radius of a horizontal engine is 300 mm. The   CO1-App   (16)
mass of the reciprocating parts is 250 kg. When the crank has
travelled 60° from I.D.C., the difference between the driving and
the back pressures is 0.35 N/mm2. The connecting rod length
between centres is 1.2 m and the cylinder bore is 0.5 m. If the
engine runs at 250 r.p.m. and if the effect of piston rod diameter
is neglected, calculate:
1. Pressure on slide bars,
2. Thrust in the connecting rod,
3. Tangential force on the crank-pin, and
4. Turning moment on the crank shaft.

Or

(b) A multi-cylinder engine is to run at a speed of 600 r.p.m. On   CO1- App   (16)
drawing the turning moment diagram to a scale of
1 mm = 250 N-m and 1 mm = 3°, the areas above and below the
mean torque line in mm2 are : +160, – 172, + 168, – 191, + 197,
– 162, The speed is to be kept within ± 1% of the mean speed of
the engine. Calculate the necessary moment of inertia of the
flywheel. Determine the suitable dimensions of a rectangular
flywheel rim if the breadth is twice its thickness. The density of
the cast iron is 7250 kg/m^3 and its hoop stress is6 MPa. Assume
that the rim contributes 92% of the flywheel effect.

17. (a) A shaft carries four masses in parallel planes A, B, C and D in   CO2- App   (16)
this order along its length. The masses at B and C are 18 kg and
12.5 kg respectively, and each has an eccentricity of 60 mm. The
masses at A and D have an eccentricity of 80 mm. The angle
betweenthe masses at B and C is 100° and that between the
masses at B and A is 190°, both being measured in the same
direction. The axial distance between the planes A and B is 100
mm andthat between B and C is 200 mm. If the shaft is in
complete dynamic balance, determine:
1. The magnitude of the masses at A and D;
2. The distance between planes A and D; and3. the angular
position of the mass at D.

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(b) The following data refer to two cylinder locomotive with cranks at 90°: Reciprocating mass per cylinder = 300 kg; Crank radius = 0.3 m; Driving wheel diameter = 1.8 m; Distance between cylinder centre lines = 0.65 m; Distance between the driving wheel central planes = 1.55 m. Determine: CO2- App (16)

1. The fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 km/hr.;

2. The variation in tractive effort; and 3. the maximum swaying couple.

18. (a) In a single degree damped vibrating system, a suspended mass of 3.75 kg makes 12 oscillations in 7 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.33 of its initial value after four oscillations. Determine: CO3- Ana (16)
 (i) stiffness of the spring,
 (ii) logarithmic decrement,
(iii) damping factor, and
(iv) the damping co-efficient.

Or

(b) A shaft of length 1.25 m is 75 mm in diameter for the first 275 mm of its length, 125 mm in diameter for the next 500 mm length, 87.5 mm in diameter for the next 375 mm length and 175 mm in diameter for the remaining 100 mm of its length. The shaft carries two rotors at two ends. The mass moment of inertia of the first rotor is 75 kg m^2 whereas of the second rotor is 50 kgm^2. Find the frequency of natural torsional vibrations of the system. The modulus of the rigidity of the shaft material may be taken as 80 GN/m^2. CO3- Ana (16)

19. (a) A mass of 10 kg is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is 10 N/mm. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four complete oscillations. If a periodic force of 150Cos50t N is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance? CO4 -Ana (16)

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(b) The mass of an electric motor is 120 kg and it runs at 1500 r.p.m. CO4 Ana (16)
The armature mass is 35 kg and its C.G. lies 0.5 mm from the
axis of rotation. The motor is mounted on five springs of
negligible damping so that the force transmitted is one-eleventh
of the impressed force. Assume that the mass of the motor is
equally distributed among the five springs. Determine:
1. Stiffness of each spring;
2. Dynamic force transmitted to the base at the operating speed;
   and
3. natural frequency of the system.

20. (a) A Porter governor has equal arms each 250 mm long and pivoted CO5-App (16)
on the axis of rotation. Each ball has a mass of 5 kg and the mass
of the central load on the sleeve is 25 kg. The radius of rotation of
the ball is 150 mm when the governor begins to lift and 200 mm
when the governor is at maximum speed. Find the minimum and
maximum speeds and range of speed of the governor.

Or

(b) An aero plane makes a complete half circle of 50 metres radius, CO5-App (16)
towards left, when flying at 200 km per hour. The rotary engine
and the propeller of the plane have a mass of 400 kg with a radius
of gyration of 300 mm. The engine runs at 2400 rpm clockwise,
when viewed from the rear. Find the gyroscopic couple on the
aircraft and state its effect on it. What will be the effect, if the
aero plane turns to its right instead of to the left?

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