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Question Paper Code : 71855

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Fifth Semester

Mechanical Engineering

ME 2302/ME 52/ME 1301/10122 ME 503 — DYNAMICS OF MACHINERY

(Regulation 2008/2010)

(Common to PTME 2302/10122 ME 503 — Dynamics of Machinery for B.E. (Part-Time) Fourth Semester Mechanical Engineering — Regulation 2009/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State the principle of virtual work.

2. Define inertia and inertia force.

3. List the two conditions required for complete external balancing of a rotating system.

4. What is known as hammer blow in reciprocating engines?

5. Write the vibration characteristics.

6. Differentiate coulomb damping and viscous damping.

7. Define vibration isolation.

8. What is fundamental frequency?

9. Enlist the difference between a governor and a flywheel.

10. Depict the effect of gyroscopic couple in ships during pitching.

PART B — (5 × 16 = 80 marks)

11. (a) Refer Fig. 11(a). Determine the couple on crank 2 to be applied for equilibrium of the system, when a force of 500 N acts on the connecting rod at point C as shown. Also determine the resultant of forces exerted on the frame of the engine.

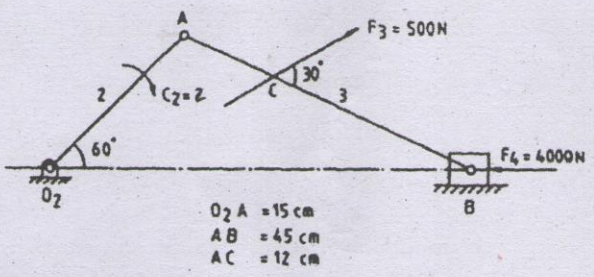


Fig. 11 (a)

Or

(b) The lengths of crank and connecting rod of a horizontal reciprocating engine are 100 mm and 500 mm respectively. The crank is rotating at 400 rpm. When the crank has turned 30° from the inner dead centre, find analytically (i) acceleration of the piston (ii) velocity of the piston (iii) angular velocity of the connecting rod and (iv)angular acceleration of the connecting rod.

12. (a) The following data refer to a two cylinder locomotive with cranks at 90°

(i)	Mass of reciprocating parts/cylinder	=	300 kg
(ii)	Crank radius	=	300 mm
(iii)	Diameter of driving wheel	=	1800 mm
(iv)	Distance between cylinder axis	=	600 mm
(v)	Distance between the driving wheel	=	1600 mm

Determine:

(1) The fraction of the reciprocating masses to be balanced if the hammer blow is not to exceed 45 kN at 95 kmph.

(2) variation in tractive effort.

(3) maximum swaying couple.

Or

(b) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm. find their magnitudes and angular positions.

13. (a) A spring loaded governor of the Hartnell type has equal arms. The balls rotate in a circle of 15 cm dia when the sleeve is in the mid position and the ball arms are Vertical. The equilibrium speed for this position is 500 rpm. The maximum sleeve movement is to be 3 cm 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 5 kg and friction force may be consideration to arise out of an equivalent 3 kg mass at the sleeve. The power of the governor must be sufficient to overcome the friction by 1% change of speed either way from mid position.

Determine :

(i) The rotating mass.

(ii) The spring stiffness.

(iii) The initial compression of spring.

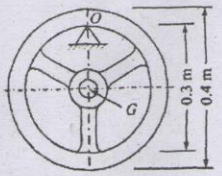
Neglect the obliquity effect of arms.

Or

(b) The driving axle of a locomotive with two wheels has a mass moment of inertia of 350 kg m^2. The wheels are 1.8 min diameter. The distance between the planes of the wheels is 1.5m. When travelling at 100 km/hr the locomotive passes over a defective rail which causes the right hand wheel to fall 10 mm and rise again in a total time of 0.1 sec, the vertical movement of the wheel being with SH.M. Find the maximum gyroscopic torque caused. Determine the direction in which it acts when the wheel is failing. Let the linear motion of the right hand wheel be $\alpha \cos qt$. where

$\alpha = 0.005$m and $q = \frac{2\pi}{0.1} rad/\sec$.

14. (a) A flywheel having a mass of 35 kg was allowed to swing as pendulum about a knife-edge at the inner side of the rim, as shown in Fig. 14 (a). If the measured time period of oscillation was 1.25 second, determine the moment of inertia of the flywheel about its geometric axis.



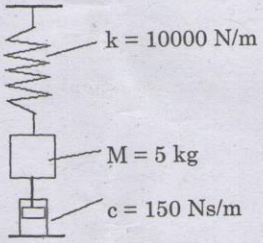
Flywheel as pendulum.

Fig. 14(a)

Or

(b) The disc of a torsional pendulum has a moment of inertia of 0.068 kg-m^2 and it immersed in a viscous fluid. The brass shaft (G = 40 GN/m^2) attached to it is of 10 mm diameter and 380 mm length, When the pendulum is vibrating the amplitudes on the same side of the rest position for successive cycles are 5°, 3° and 1.8°. Determine (i) the logarithmic decrement, (ii) the damping torque at unit velocity (iii) the periodic time of vibration. What would be the frequency of vibrations if the disc were removed from the viscous fluid?

15. (a) The diagram shows a mass-spring-dashpot system. The support is moved with a motion of y = 6 sin(40t) mm. Determine the amplitude of the mass and the phase angle.



Or

(b) The time of free vibration of a mass hung from the end of a helical spring is 0.8 s. When the mass is stationary, the upper end is made to move upwards with displacement Y mm given by Y = 18 sin $2\pi t$, where t is time in seconds measured from the beginning of the motion. Neglecting the mass of spring and damping effect, determine the vertical distance through which the mass is moved in the first 0.3 seconds.