PART – C (1×15=15 Marks)

16. a) The crank-pin circle radius of a horizontal engine is 300 mm. The 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/mm^2. 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 horizontal steam engine running at 120 r.p.m. has a bore of 250 mm and a stroke of 400 mm. The connecting rod is 0.6 m and mass of the reciprocating parts is 60 kg. When the crank has turned through an angle of 45° from the inner dead centre, the steam pressure on the cover end side is 550 kN/m^2 and that on the crank end side is 70 kN/m^2. Considering the diameter of the piston rod equal to 50 mm, determine :
    1) Turning moment on the crank shaft,
    2) Thrust on the bearings, and
    3) Acceleration of the flywheel, if the power of the engine is 20 kW, mass of the flywheel 60 kg and radius of gyration 0.6m.

18/05/18 (AN)

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Question Paper Code : 41407

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Fourth/Fifth Semester
Mechanical Engineering
ME 6505 – DYNAMICS OF MACHINES
(Common to : Mechanical Engineering (Sandwich)/ Mechatronics Engineering)
(Regulations 2013)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. What is meant by crank pin effort ?
2. What is the significance of inertia force analysis ?
3. What is meant by balancing of a single rotating mass ?
4. Differentiate static and dynamic balancing.
5. Define logarithmic decrement.
6. State different methods of finding natural frequency of a system.
7. What is vibration isolation ?
8. Define transmissibility.
9. Which part of the automobile is subjected to the gyroscopic couple ?
10. Define stability of a governor.

PART – B (5×13=65 Marks)

11. a) A multi-cylinder engine is to run at a speed of 600 r.p.m. On 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 mm^2 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 is 6 MPa. Assume that the rim contributes 92% of the flywheel effect.

(OR)

b) A connecting rod is suspended from a point 25 mm above the centre of small end and 650 mm above its centre of gravity, its mass being 37.5 kg. When permitted to oscillate, the time period is found to be 1.87 seconds. Find the dynamical equivalent system constituted of two masses, one of which is located at the small end centre.

12. a) 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.

(OR)

b) The three crancks of a three cylinder locomotive are all on the same axle and are set at 120°. The pitch of the cylinders is 1 metre and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, find :

1) The magnitude and the position of the balancing masses required at a radius of 0.6 m; and
2) The hammer blow per wheel when the axle makes 6 r.p.s.

13. a) A shaft 1.5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft.

(OR)

b) A coil of spring stiffness 4 N/mm supports vertically a mass of 20 kg at the free end. The motion is resisted by the oil dashpot. It is found that the amplitude at the beginning of the fourth cycle is 0.8 times the amplitude of the previous vibration. Determine the damping force per unit velocity. Also find the ratio of the frequency of damped and undamped vibrations.

14. a) A machine part of mass 2 kg vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of 25 N results in resonant amplitude of 12.5 mm with a period of 0.2 second. If the system is excited by a harmonic force of frequency 4 Hz, what will be the percentage increase in the amplitude of vibration when damper is removed as compared with that with damping.

(OR)

b) A single-cylinder engine of total mass 200 kg is to be mounted on an elastic support which permits vibratory movement in vertical direction only. The mass of the piston is 3.5 kg and has a vertical reciprocating motion which may be assumed simple harmonic with a stroke of 150 mm. It is desired that the maximum vibratory force transmitted through the elastic support to the foundation shall be 600 N when the engine speed is 800 r.p.m. and less than this at all higher speeds.

1) Find the necessary stiffness of the elastic support and the amplitude of vibration at 800 r.p.m., and
2) If the engine speed is reduced below 800 r.p.m. at what speed will the transmitted force again becomes 600 N ?

15. a) The mass of the turbine rotor of a ship is 20 tonnes and has a radius of gyration of 0.60 m. Its speed is 2000 r.p.m. The ship pitches 6° above and 6° below the horizontal position. A complete oscillation takes 30 seconds and the motion is simple harmonic. Determine the following :

1) Maximum gyroscopic couple,
2) Maximum angular acceleration of the ship during pitching, and
3) The direction in which the bow will tend to turn when rising, if the rotation of the rotor is clockwise when looking from the left.

(OR)

b) The arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified.