Reg No.:_____ Name:_____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth semester B.Tech examinations (S), September 2020

Course Code: ME304

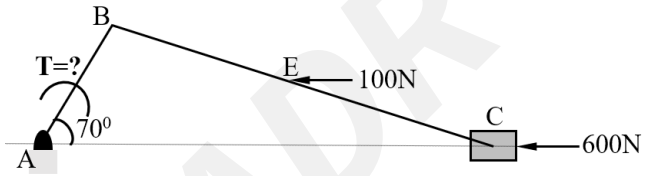
Course Name: DYNAMICS OF MACHINERY

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks. Marks

1 Find the torque developed in crank AB of slider crank mechanism shown figure, when it is in static equilibrium. The crank radius is 50mm, connecting rod length 200mm and BE=100mm. The two external forces are acting parallel to the line of stroke. (10)



2 In a four-bar link mechanism with the following dimensions AB = 30cm, BC=30.5cm, AD=56, CD = 30cm. The link AB makes an angle 45° with the horizontal. A horizontal force 'P'(1500N) is acting on link CD at 10 cm from D. Find the torque applied at link AB to keep the mechanism in static equilibrium. (10)

3 A Single cylinder vertical engine has a bore of 40 cm and a stroke of 50 cm. The connecting rod is 120cm long. The mass of reciprocating parts is 150kg. On the expansion stroke with the crank at 30° from the top dead centre the gas pressure is 1 Mpa. If the engine runs at 300rpm, determine (10)

a. Net force acting on the piston
b. Resultant load on the gudgeon pin
c. Thrust on the cylinder walls

.4 a) What is a dynamically equivalent system? Explain. (5)

b) With the help of a neat sketch explain different forces acting on a helical gear, when it transmits power. (5)

PART B

Answer any three full questions, each carry 10 marks.

5 The equation of the turning moment curve of a three crank engine is (400 + 150 sin 3θ) Nm, where θ is the crank angle in radians. The total fluctuation of speed is 1% of the mean speed and the mean speed is 200rpm. If the resisting torque is constant, find (10)

1. Power developed by the engine
2. Moment of inertia of the flywheel
3. Angular acceleration of the flywheel when the crank has turned through 45^{o} from inner dead centre

6 A rotating shaft carries four unbalanced masses 20 kg,11kg,18kg and 12 kg at radii 8cm,5cm,6cm and 7cm respectively. The 2^{nd}, 3^{rd} and 4^{th} masses revolve in planes 10cm,15cm and 18 cm respectively measured from the plane of the first mass and are angularly located at 70^{o},120^{o} and 270^{o} respectively measured anticlockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 6cm radii and revolving in planes midway between those of 1^{st} and 2^{nd} masses and midway between those of 3^{rd} and 4^{th} masses. Determine graphically the magnitudes of the masses and their respective angular positions. (10)

7 a) Explain the effect of gyroscopic couple on aeroplane while it takes a right turn viewing from rear end (5)

b) A uniform disc of 150 mm diameter has a mass of 5 N. It is mounted on one end of an arm of length 50cm. The other end of the arm is free to rotate in a universal bearing. If the disc rotates about the arm with a speed of 400rpm anticlockwise looking from the front, with what speed will it precess about the vertical axis? (5)

8 A turbine rotor of a ship having a mass of 250 Kg rotates at 2500rpm and its radius of gyration is 0.3m. If the rotation of the rotor is clockwise looking from the aft, determine the gyroscopic couple set by the rotor when (10)

1. Ship takes a left-hand turn at a radius of 300meters at a speed of 40km/hr.
2. Ship pitches with the bow rising at an angular velocity of 1 rad/sec and
3. Ship rolls at an angular velocity of 0.1 rad/sec

PART C

Answer any four full questions, each carries 10 marks.

9 a) Find the natural frequency of a spring mass system using energy method (4)

b) A vibrating system consists of a mass of 60Kg, a spring with stiffness of 40kN/m and a damper. The damping provided is only 20% of the critical value. Determine (6)

1. Damping factor
2. Critical damping coefficient
3. The natural frequency of damped vibration
4. Logarithmic decrement
5. The ratio of two consecutive amplitudes

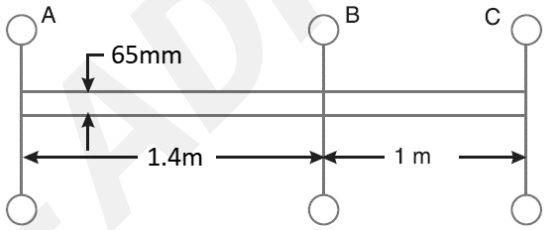
10 A machine part having a mass of 4kg vibrates in a viscous medium. A harmonic exciting force of 35N acts on the part and causes a resonant amplitude of 16mm with a period of 0.25 seconds. Find the damping coefficient. If the frequency of the exciting force is changed to 8 Hz, determine the increase in the amplitude of the forced vibrations upon the removal of the damper. (10)

11 A machine supported symmetrically on four springs has a mass of 70kg. The mass of the reciprocating part is 3kg which moves through a vertical stroke of 150mm with simple harmonic motion. Determine the combined stiffness of the springs so that the force transmitted to the foundation is $1/20^{th}$ of the impressed force. Neglect damping. If under actual working conditions, the damping reduces the amplitudes of successive vibrations by 25%. Find (1) the force transmitted to the foundation at 1000rpm 2) The force transmitted to the foundation at resonance (10)

12 a) What is the whirling speed of a shaft? Explain (4)

b) Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a rotor of mass of 1 kg at its mid-point. The density of the shaft material is 7680 kg/m^3, and the modulus of elasticity is $200GN/m^2$. Assume the shaft is supported on short bearings (6)

13 A single cylinder IC Engine directly drives an electric generator. The rotating mass of the engine, flywheel and rotor of generator with the shaft is equivalent to a three-rotor system as shown in figure. The mass moment of inertia of rotors A, B and C are 0.15, 0.3 and $0.1kgm^2$. The modulus of rigidity of the shaft material is $86kN/mm^2$. Calculate the natural frequency of torsional vibrations. (10)



14 a) Explain torsionally equivalent shaft and derive an expression for it. (6)

b) Write brief notes on vibration isolation (4)

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