Code No: R1931031 **R19** **SET - 1**

III B. Tech I Semester Regular Examinations, February-2022

DYNAMICS OF MACHINERY

(**Common to** Mechanical Engineering, Automobile Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

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UNIT-I

1. a) In a screw jack, the helix angle of thread is a and the angle of friction is Φ. Show that its efficiency is maximum, when $2a = (90° - Φ)$. [7M]

   b) A centrifugal clutch is to transmit 15 kW at 900 r.p.m. The shoes are four in number. The speed at which the engagement begins is ¾th of the running speed. The inside radius of the pulley rim is 150 mm and the center of gravity of the shoe lies at 120 mm from the center of the spider. The shoes are lined with Ferrodo for which the coefficient of friction may be taken as 0.25. Determine: [8M]
   i) Mass of the shoes, and
   ii) Size of the shoes, if angle subtended by the shoes at the center of the spider is 60° and the pressure exerted on the shoes is 0.1 N/mm^2.

(OR)

2. a) Explain with neat sketches the Bevis-Gibson dynamometer. [7M]

   b) A band brake acts on the ¾th of circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N-m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the [8M]
   i) anti-clockwise direction and ii) clockwise direction.

UNIT-II

3. a) Derive an expression for the inertia force due to reciprocating mass in reciprocating engine, neglecting the mass of the connecting rod. [7M]

   b) 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: [8M]
   i) pressure on slide bars, ii) thrust in the connecting rod,
   iii) tangential force on the crank-pin, and
   iv) turning moment on the crank shaft.

(OR)

4. In a turning moment diagram, the areas above and below the mean torque line taken in order are 4400, 1150, 1300 and 4550 mm^2 respectively. The scales of the turning moment diagram are: Turning moment, 1 mm = 100 N-m ; Crank angle, 1 mm = 1°. Find the mass of the flywheel required to keep the speed between 297 and 303 r.p.m., if the radius of gyration is 0.525 m. [15M]

UNIT-III

5. a) Discuss the effect of the gyroscopic couple on a two wheeled vehicle when taking a turn. [7M]

   b) An aeroplane makes a complete half circle of 50 meters radius, towards left, when flying at 200 km per hour. The rotary engine and the propeller of the plane has a mass of 400 kg with a radius of gyration of 300 mm. The engine runs at 2400 r.p.m. 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 aeroplane turns to its right instead of to the left? [8M]

(OR)

6. a) Prove that the sensitiveness of a Proell governor is greater than that of a Porter governor. [7M]

   b) The upper arms of a Porter governor are pivoted on the axis of rotation and the lower arms are pivoted to the sleeve at a distance of 30 mm from the axis of rotation. The length of each arm is 300 mm and the mass of each ball is 6 kg. If the equilibrium speed is 200 r.p.m. when the radius of rotation is 200 mm, find the required mass on the sleeve. If the friction is equivalent to a force of 40 N at the sleeve, find the coefficient of insensitiveness at 200 mm radius. [8M]

UNIT-IV

7. a) A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. [10M]

   b) Explain clearly the terms 'static balancing' and 'dynamic balancing'. State the necessary conditions to achieve them. [5M]

(OR)

8. The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 r.p.m. are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine: (i) Unbalanced primary and secondary forces, if any, and (ii) Unbalanced primary and secondary couples with reference to central plane of the engine. [15M]

UNIT-V

9. a) Explain the terms 'under damping', 'critical damping' and 'over damping'. [7M]

   b) The machine mounted on springs and fitted with a dashpot has a mass of 60 kg. There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine. [8M]
   i) The damping coefficient,
   ii) The ratio of frequencies of damped and un-damped vibrations,
   iii) The periodic time of damped vibrations.

(OR)

10. a) Explain the term 'whirling speed' or 'critical speed' of a shaft. Prove that the whirling speed for a rotating shaft is the same as the frequency of natural transverse vibration. [8M]

    b) A shaft of 100 mm diameter and 1 m long is fixed at one end, and the other end carries a flywheel of mass 1 tonne. The radius of gyration of the flywheel is 0.5 m. Find the frequency of torsional vibrations, if the modulus of rigidity of the shaft material is 80 GN/m^2. [7M]

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