

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2022****Subject Code:2151902****Date:17-01-2023****Subject Name:Theory of Machines****Time:10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

	MARKS
Q.1 (a) Justify porter governor cannot be isochronous.	03
(b) Describe the effort and power of the governor.	04
(c) Refer to Fig.1. Determine couple T_2 for the equilibrium of the system.	07

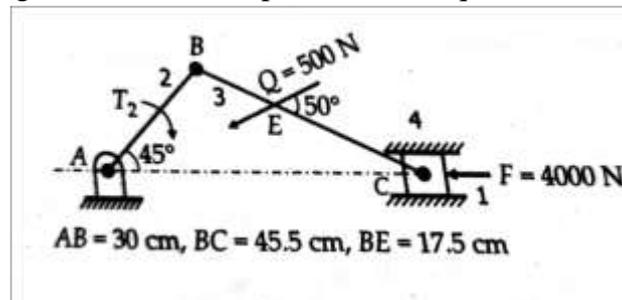


Figure.1.

Q.2 (a) Explain the basic term of Gyroscope with suitable sketch.	03
(b) Derive the expression for the angle of heel for balancing of two wheel vehicle while negotiating the curve.	04
(c) The rotor of a turbojet engine has a mass of 200 kg and a radius of gyration 25 cm. The engine rotates at a speed of 10000 rpm in clockwise direction if viewed from the front of the aeroplane. The aeroplane while flying at 1000 km/hr turns with a radius of 2 km to the right. Compute the gyroscopic moment exerted by the rotor on the plane structure. Also determine whether the nose of the plane tends to rise or fall when plane turns.	07

OR

(c) An automobile is traversing along a curved track of 200 m mean radius. Each of the four road wheels has a mass of 80 kg with radius of gyration of 0.4 m. The rotating parts of the engine have a mass moment of inertia of 10 kg.m^2 . The crank shaft rotates in the same direction as the road wheels. The gear ratio of the engine to the back wheels is 5:1. The vehicle has a mass of 3000 kg and its CG is 0.5 m above the road level. The width of track of vehicle is 1.5 m. calculate the limiting speed of the vehicles around the curve for all wheels to maintain contact with the road surface. The effective radius of wheel is 0.40 m.	07
Q.3 (a) Establish the relationship of the coefficient of speed in terms of maximum fluctuation of energy.	03

- (b) Explain the turning moment diagram for 4 cylinder four stroke cycle internal combustion engine. **04**
- (c) A punching press is required to punch 30 mm diameter holes in a plate of 20 mm thickness at the rate of 20 holes per minute. It requires 6 N-m of energy/mm² of sheared area. If punching takes place in 1/10 of a second and the rpm of the flywheel varies from 160 to 140, determine the weight of flywheel having radius of gyration $k = 1$ m. **07**

OR

- Q.3** (a) What is meaning of Stability of governor? Explain the condition for stability. **03**
- (b) Explain in brief the working of flywheel in punching Press. **04**
- (c) Turning moment area for the revolution of a multicylinder engine with reference to the mean turning moment in sq.cm are: -0.32, +4.08, -2.67, 3.33, -3.1, 2.26, -3.74, 2.74, -2.58. The scale for the ordinate and abscissa are 1 cm = 14°, 1 cm = 6000 N-m. The mean speed is 200 rpm, with 1.5% fluctuation. If the hoop stress in the rim material is not to exceed 56 bar, calculate the diameter and X-section of rim of the flywheel. Neglect the effect of bars and arms. Density of material = 0.0672 kg/cm³. **07**

- Q.4** (a) Derive condition of self locking for simple shoe brake. **03**
- (b) Determine the retardation of a four wheel car when the brakes are applied to all the four wheels. **04**
- (c) A band brake acts on the $\frac{3}{4}$ 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 (i) anticlockwise directions, and (ii) clockwise direction. **07**

OR

- Q.4** (a) Explain working of Bevis Gibson flash light torsion dynamometer. **03**
- (b) Demonstrate working principle of a centrifugal clutch with neat sketch. **04**
- (c) A single plate clutch effective on both sides is required to transmit 25 KW at 3000 rpm. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed 0.1×10^6 N/m². Also determine the axial thrust to be provided by springs. Assume uniform wear. **07**

- Q.5** (a) State and explain the parallel axis theorem. **03**
- (b) What is meant by dynamically equivalent system? State and prove conditions for it. **04**
- (c) How is the effect of friction forces considered in the static force analysis of a mechanism having turning pairs? **07**

OR

- Q.5** (a) State and Explain the D'Alembert Principle. **03**
- (b) Explain any one method used to finding out the radius of gyration of components having complicated geometry? **04**

- (c) 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 IDC., the difference between the driving and the back pressure 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 rpm and if the effect of piston rod diameter is neglected, calculate: 1. Pressure on slide bar, 2. Thrust in the connecting rod, 3. Tangential force on the crank pin and 4. Turning moment on the crank shaft.
