Seat No: _____ Enrollment No: _____

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B. Tech. Summer 2022-23 Examination

Semester: 4 **Date: 22/03/2023**
Subject Code: 203113253 **Times: 2:00pm to 4:30pm**
Subject Name: Theory of Machines for Mechatronics **Total: Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Answer the following questions. **(15)**

1) What is function of Flywheel?
2) Define the term "Gyroscopic Couple"
3) What is functional difference between brakes and Dynamometer?
4) Draw the controlling force diagram for unstable governor.
5) Define the term "self-energizing of brake"
6) Cyclic up and down motion of port and starboard about the longitudinal axis of ship is called as_____ of ship
7) A rim type flywheel having mass '100 kg' and radius of rim '1m' , then its Mass moment inertia is equal to _____kg.m^2
8) Hartnell governor is _____ type of centrifugal governor.
9) In watt governor, the mass of fly ball is 5 kg. When speed increase from 50 rpm to 60 rpm then effort of governor is _____N
10) In moped scooter _____Clutch is used.
11) Which one of the following is not a friction device?
a) Brakes b) Flywheel
c) Dynamometer d) Clutch
12) When brakes are applied on a moving vehicle; the kinetic energy is converted to-
a) Potential energy b) Heat energy
c) Sound energy d) None of the above
13) Effect of friction, at the sleeve of a centrifugal governor is to make it
a) More sensitive b) More stable
c) Insensitive over a small range of speed d) Unstable
14) What is the ratio of the radius of gyration of disc type flywheel to radius of gyration rim type flywheel for the same diameter?
a) 1.707 b) 1.414
c) 0.707 d) 2.141
15) Gyroscopic effect is not observed in which of the following actions performed by the ships?
a) Rolling b) Steering
c) Pitching d) All above these.

Q.2 Answer the following questions. (Attempt any three) **(15)**

A)Explain the terms related to centrifugal governor
(i) Effort of governor (ii) Power of governor (iii) Equilibrium speed
B) Derive an expression for height in case of porter governor
C) Draw and explain turning moment diagram for Punching press.

D) An aeroplane makes a half circle of 50 m radius, towards left when flying at 200Km/hr. The engine and propeller of plane weights 400Kg and has a radius of gyration of 40 cm. The engine rotates at 2400 rpm clockwise, when viewed from rear end. Find the gyroscopic couple and its effect on aeroplane.

Q.3 A) An engine developing 45 kW at 1000 r.p.m. is fitted with a cone clutch built inside the flywheel. The cone has a face angle of 12.5º and a maximum mean diameter of 500 mm. The coefficient of friction is 0.2. The normal pressure on the clutch face is not to exceed 0.1 N/mm^2.Determine : **(07)**

(i) the axial spring force necessary to engage to clutch, and
(ii) the face width required

B) In a spring loaded Hartnell type governor, the extreme radii of rotation of the balls are 80 mm and 120 mm. The ball arm and the sleeve arm of the bell crank lever are equal in length. The mass of each ball is 2 kg. If the speeds at the two extreme positions are 400 and 420 r.p.m. Find **(08)**

(i) the initial compression of the central spring, and
(ii) the spring constant

OR

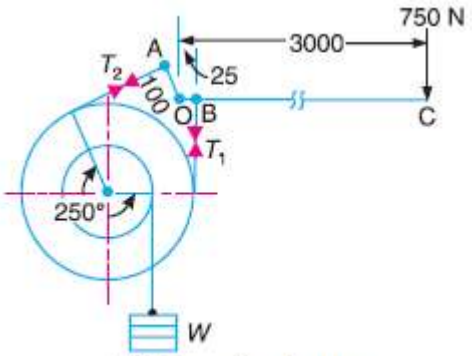
B) The torque exerted on the crank shaft of a two stroke engine is given by T = 20000+ 9500 Sin2θ - 5700Cos2θ N-m. Assuming the resistance torque to be constant, determine **(08)**

(i) The power of the engine when running at 180rpm
(ii) The moment of inertia of flywheel if the speed variation from the mean speed of 150 rpm is not to exceed ± 0.5%

Q.4 A) What is a dynamometer? How the dynamometer differs from the brake? Explain with neat sketch, the working of any one of the Absorption type dynamometers. **(07)**

OR

A) In a winch, the rope supports a load W and is wound round a barrel of diameter 450 mm **(07)**
A differential band brake acts on a drum 800 mm diameter which is keyed to the same shaft as the barrel. The two ends of the bands are attached to pins on opposite sides of the fulcrum of the brake lever and at distances of 25 mm and 100 mm from the fulcrum. The angle of lap of the brake band is 250° and the coefficient of friction is 0.25. What is load W which can be supported by the brake when a force of 750 N is applied to the lever at a distance of 3000 mm from the fulcrum? (consider clockwise rotation of drum)



All dimensions in mm.

B) The rotor of a marine turbine has a moment of inertia of 750 kg.m^2 and rotates at 3000 rpm clockwise when observed from aft. If the ship pitches with angular SHM having a periodic time of 16 s and amplitude of 0.1 rad, Find **(08)**

(i) Maximum angular velocity of the rotor axis,
(ii) Maximum value of the gyroscopic couple and
(iii) The gyroscopic effect as the bow dips.