G 1398 (Pages : 3) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2016

Sixth Semester

Branch : Automobile Engineering / Mechanical Engineering

AU 010 601/ME 010 601—MECHANICS OF MACHINES (AU, ME)

(New Scheme—2010 Admission onwards)

[Regular/Improvement/Supplementary]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 3 *marks.*

1. Explain the conditions required for a plane mechanism is to be in static equilibrium.
2. What is the fundamental difference between a *governor* and a *flywheel* ?
3. Explain the term crank effort.
4. What is the magnitude of gyroscopic couple when the ship rolls about its propeller axis ?
5. What is the fundamental difference between a brake and a dynamo meter.

(5 × 3 = 15 marks)

Part B

Answer **all** *questions.*
Each question carries 5 *marks.*

6. Define and explain the superposition theorem as applicable to a system of forces, why it fail in a system having frictional forces.
7. What is meant by effort and power of a governor ? Find the expression for power in any governor.
8. What are turning moment diagrams ? Why are they drawn ?
9. What do you mean by gyroscopic couple ? Derive a relation for its magnitude ?
10. What is meant by self locking and self energised brake.

(5 × 5 = 25 marks)

Part C

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. The dimensions of a four link mechanism are : AB = 40 mm, BC = 600 mm, CD = 500 mm, AD = 900 mm, and ∠ DAB = 60°. AD is the fixed link. E is the point on link BC such that BE = 400 mm and CE = 300 mm (BEC clockwise). A force of 150 ∠ 45° N acts on DC at a distance

Turn over

of 250 mm from D. Another force of magnitude 100 $\angle$ 180° acts at point E. Find the required input torque on link AB for static equilibrium of the mechanism.

Or

12. The piston diameter of an internal combustion engine is 125 mm and the stroke is 220 mm. The connecting rod is 4.5 times the crank length and has a mass of 50 kg. The mass of the reciprocating parts is 30 kg the centre of mass of the connecting rod is 170 mm from the crank pin centre and the radius of gyration about an axis through the centre of mass is 148 mm. The engine runs at 320 r.p.m. Find the magnitude and the direction of the inertia force and the corresponding torque on the crankshaft when the angle turned by the crank is 140° from the inner dead centre.

13. In a porter governor, each of the four arms is 400 mm long. The upper arms are pivoted on the axis of the sleeve, whereas the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 60 kg. What will be the equilibrium speeds for the two extreme radii of 200 mm and 300 mm of rotation of the governor balls ?

Or

14. In a spring controlled gravity governor, the mass of each ball is 1.6 kg. Distance of fulcrum from the axis of rotation is 60 mm. The bell crank lever has a vertical arm of 120 mm long and a horizontal arm 50 mm long. The mass of the sleeve is 6.5 kg. The sleeve begins to rise at 200 r.p.m. and the rise of sleeve for 5% increase is 9 mm. Determine the initial thrust in the spring and its stiffness.

15. A machine is coupled to a two stroke engine which produces a torque of $(800 + 180 \sin 3\theta)$ Nm where θ is the crank angle. The mean engine speed is 400 r.p.m. The flywheel and the other rotating parts attached to the engine has amass of 350 kg at a radius of gyration of 220 mm. Calculate :

    (a) The power of the engine ;

    (b) The total fluctuation of speed of the flywheel when the resisting torque is $(800 + 80 \sin\theta)$ Nm.

Or

16. The turning moment diagram of a four stroke engine is assumed to be represented by four triangles, the areas of which form the line of zero pressure are :

    (a) Suction stroke = 440 mm^2

    (b) Compression stroke = 1600 mm^2

    (c) Expansion stroke = 7200 mm^2

    (d) Exhaust stroke = 660 mm^2

Each mm^2 of area represents 3 Nm of energy. If the resisting torque is uniform, determine the mass of the rim of flywheel to keep the speed between 218 and 222 r.p.m. when the mean radius of the rim is to be 1.25 m.

17. The total mass of a four wheeled racing car is 1800 kg. The car is having a wheel base of 1.6 m and rounds a curve of 24 m radius at 36 km/hr. The road is banked at 10°. The external diameter of the wheel is 600 mm and each pair with axle has a mass of 180 kg with radius of gyration of 240 mm. The height of the centre of mass of the car above the wheel base is 950 mm. Determine the pressure on each rail allowing for centrifugal force and gyroscopic couple actions.

Or

18. A disc with radius of gyration 60 mm and a mass of 4 kg is mounted centrally on a horizontal axle of 80 mm length between the bearings. It spins about the axle at 800 r.p.m. counter clockwise when viewed from the right hand side bearing. The axle processes about a vertical axis at 50 r.p.m. in the clockwise direction when viewed from above. Determine the resultant reaction at each bearing due to the mass and gyroscopic effect.

19. A vehicle moves on a road that has a slope of 15°. The wheel base is 1.6 m and the centre of mass at 0.72 m from the rear wheels and 0.8 m above the inclined plane. The speed of the vehicle is 45 km/hr. The breaks are applied to all the four wheels and the coefficient of friction is 0.4. Determine the distance moved by the vehicle before coming to rest and the time taken to do so if it moves :

    (a) Up the plane ;

    (b) Down the plane.

Or

20. In a belt transmission dynamo meter, the driving pulley rotates at 300 r.p.m. The distance between the centre of the driving pulley and the dead mass is 800 mm. The diameter of each of the driving as well as intermediate pulleys is equal to 360 mm. Find the value of the dead mass required to maintain the and the lever in a horizontal position when the power transmitted is 3 kW. Also, find its value when the belt just begins to slip on the driving pulley, being 0.25 and the maximum tension in the belt 1200 N.

(5 × 12 = 60 marks)