



1 (a) Define the term sensitiveness, Isochronism and hunting of governor. Utilizing controlling force diagram comment on the stability of a governor.

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(b) Draw a neat sketch of Hartnell governor and deduce the relationship between stiffness of spring and other parameters.

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## UNIT - II

2 (a) Discuss the effect of the gyroscopic couple on a two wheeled vehicle taking a turn.

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(b) An aeroplane flying with the speed of 200 km/hr turns towards right and completes a quarter circle of 50 m radius. The man of the rotary engine and the propeller of the plane amounts to 400 kg with a radius of gyration of 300 mm. The engine speed is 1500 rpm, clockwise when viewed from the front. Determine the gyroscopic couple on the air craft and state its effect. In what way the effect changed when the aeroplane turns towards left.

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## OR

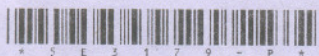
2 A certain machine requires a torque of  $(5000 + 500 \sin \theta)$  N-m to drive it, where  $\theta$  is the angle of rotation of shaft measured from certain datum. The machine is directly coupled to an engine which produces a torque of  $(5000 + 600 \sin 2\theta)$  N-m. The flywheel and the other rotating parts attached to the engine has a man of 500 kg at a radius of gyration of 0.4 m. If the mean speed is 150 rpm find

(a) the fluctuation of energy

(b) the total percentage fluctuation of speed and

(c) the maximum and minimum angular acceleration of the flywheel and the corresponding shaft position.

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## UNIT - III

- 3 (a) With the help of a neat sketch derive the condition for minimum number of teeth on wheel to avoid interference. 8
- (b) A pinion of 32 involute teeth and 4mm module driver a rack. The pressure angle is  $20^\circ$ . The addendum of both pinion and rack is the same. Determine the maximum permissible value of the addendum to avoid interference. Also find the number of pairs of teeth in contact. 8

OR

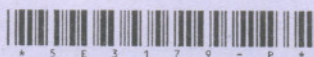
- 3 (a) State the law of gearing and derive the same with the help of a neat sketch. 8
- (b) Two equal involute gear wheels of  $20^\circ$  pressure angle have 20 teeth each. Calculate length of arc of contact if the addendum was standard and equal to one module. Pitch of teeth is 6mm of diameter per tooth. What should be the addendum if the arc of contact is to be minimum possible? What is then the length of arc of contact? 8

## UNIT - IV

- 4 (a) Explain with neat sketch working of automotive differential. Using tabular method calculate the difference in output at two rear wheels. 8
- (b) Explain the working of a sliding mesh gear box. 8

OR

- 4 (a) Draw a neat sketch of sun and planet gear arrangement. Using tabular method derive the expression for speed of arm when sun wheel is fixed and when annular wheel is fixed respectively. 8
- (b) Determine a suitable train of wheels to satisfy the requirements of a clock. The minute hand of which is fixed to a spindle and the hour hand to a sleeve rotating freely on the same spindle. The pitch is same for all the wheels and each wheel has at least 11 teeth. The total number of teeth should be as small as possible. 8



## UNIT - V

- 5 A shaft is supported in bearings 180 cm apart and project 45 cm beyond bearing at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The end pulleys weigh 471 N and 196.2 N and their centres of gravity are 1.5 cm and 1.25 cm respectively from the shaft axis. the central pulley weighs 549.4 N and its centre of gravity is 1.5 cm from the shaft axis. If the pulleys are arranged so as to give static balance determine
- (a) relative position of the pulleys
  - (b) dynamic forces produced on the bearings when the shaft rotates at 400 rpm.

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OR

- 5 (a) Explain the effect of partial balancing in locomotives.
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- (b) The axis of a three-cylinder air compressor are at  $120^\circ$  to one another and their connecting rods are coupled to a single crank. The length of each connecting rod is 240 mm and the stroke is 160 mm. The reciprocating parts have a mass of 2.4 kg per cylinder. Determine the primary and secondary forces if the engine runs at 2000 rpm.

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