Printed Pages—4 EME603

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2537 Roll No.

B. Tech.

(SEM. VI) THEORY EXAMINATION 2011-12

THEORY OF MACHINES—II

Time : 2 Hours *Total Marks : 50*

Note : (1) Attempt **all** questions. Marks are indicated against each question.

(2) Assume any missing data suitably.

1. Answer any *two* parts of the following : (2×6=12)

(a) In Fig. (1) a slider crank mechanism is shown. AB = 10 cm, BC = 30 cm. The value of force applied on slider is 3000 N . Determine the forces on various links. Also calculate the driving torque applied on link AB.

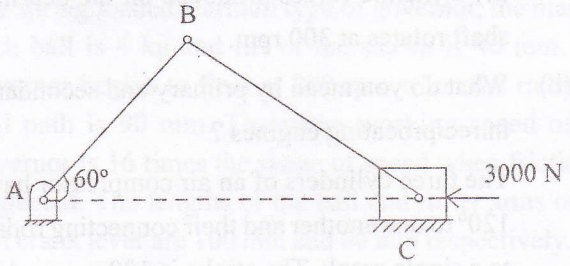

Fig. (1)

(b) Define the following terms :

(i) Equivalent offset inertia force

(ii) Coefficient of fluctuation of energy.

(c) The torque delivered by a two stroke engine is represented by $T = (1200 + 1400 \sin\theta + 210 \sin 2\theta + 21 \sin 3\theta)$ Nm where θ is the angle turned by the crank from the inner dead centre. The engine speed is 210 rpm. Determine the power of the engine and the minimum mass of the flywheel if its radius of gyration is 800 mm and maximum fluctuation of speed is to be ± 1.5% of the mean.

2. Answer any ***two*** parts of the following : **(2×7=14)**

(a) A shaft is supported in bearings 1.8 m apart and projects 0.45 m beyond bearings at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The mass of each pulley is 48 kg and 20 kg and their centre of gravity are 15 mm and 12.5 mm respectively from the shaft axis. The centre pulley has a mass of 56 kg and its centre of gravity is 15 mm from the shaft axis. If pulleys are arranged so as to give static balance determine : (1) Relative angular positions of the pulleys, (2) Dynamic forces produced on the bearings when the shaft rotates at 300 rpm.

(b) What do you mean by primary and secondary unbalance in reciprocating engines ?

The three cylinders of an air compressor have their axes 120° to one another and their connecting rods are coupled to a single crank. The stroke is 100 mm and the length of each connecting rod is 150 mm. The mass of the reciprocating parts per cylinder is 1.5 kg. Find the maximum primary and secondary forces acting on the frame of the compressor when running at 3000 rpm.

(c) The following data refer to two cylinder locomotive with cranks at 90°. Reciprocating mass per cylinder = 300 kg, crank radius = 0.3 m. Driving wheel diameter = 1.8 m, Distance between cylinder centre lines = 0.65 m. Distance between the driving wheel central planes = 1.55 m. Determine :

(i) The fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 km/h.

(ii) The variation in tractive effort.

(iii) The maximum swaying couple.

3. Answer any ***two*** parts of the following : **(2×6=12)**

(a) Explain the following terms related to governors :

(i) Sensitiveness

(ii) Stability

(iii) Controlling force curve

(iv) Hunting

(v) Effort.

(b) In a spring loaded Hartnell type of governor, the mass of each ball is 4 kg and lift of the sleeve is 40 mm. The governor begins to float at 200 rpm when the radius of ball path is 90 mm. The mean working speed of the governor is 16 times the range of speed when friction is neglected. The lengths of the ball and roller arms of the bell crank lever are 100 mm and 80 mm respectively. The pivot centre and axis of the governor are 115 mm apart. Determine the initial compression of the spring taking into account the obliquity of arms.

Assuming the friction at the sleeve to be equivalent to a force of 15 N, determine the total alteration in speed before the sleeve begins to move from the mid position.

(c) In a proell governor the mass of each ball is 8 kg and mass of sleeve is 120 kg. Each arm is 180 mm long. The length of extension of lower arms to which the balls are attached is 80 mm. The distance of pivots of arms from axis of rotation is 30 mm and the radius of rotation of the balls is 160 mm when the arms are inclined at 40° to the axis of rotation. Determine :

(i) The equilibrium speed.

(ii) The coefficient of insensitiveness if the friction of the mechanism is equivalent to 30 N.

(iii) The range of speed when governor is inoperative.

4. Answer any *two* parts of the following : **(2×6=12)**

(a) How do the effects of gyroscopic couple and centrifugal force make the rider of a two-wheeler to tilt on one side ? Derive the relation for the limiting speed of the vehicle.

(b) The turbine rotor of a ship has a mass of 2.2 tonnes and rotates at 1800 rpm clockwise when viewed from the left. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when :

(i) The ship turns right at a radius of 250 m with a speed of 25 km/h.

(ii) The ship pitches with the bow rising at an angular velocity of 0.8 rad/s.

(iii) The ship rolls at an angular velocity of 0.1 rad/s.

(c) Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a mass of 1 kg at its mid point. The density of shaft material is 40 Mg/m^3 and Young's modulus is 200 GN/m^2. Assume the shaft to be simply supported.