B. E. ME Examination

DYNAMICS OF MACHINES

Paper–ME–302–E

Time allowed : 3 hours　　　　　*Maximum marks : 100*

Note : (i)　Attempt any five questions.

　　　(ii)　All questions carry equal marks.

1. The connecting rod in a horizontal engine has mass of 11-25 kg and is 600mm long. The centre of gravity is 150mm from the crank pin centre. The radius of gyration of the connecting rod about its centre of gravity is 500mm. The crank radius is 125mm and speed is 240 r.p.m., when the crank is vertical. Find the inertia torque at the crank shaft due to the connecting rod.　　　　20

2. A vertical petrol engine 150mm diameter and 200mm stroke has a connecting rod 350mm long. The mass of the piston is 1.6 kg and the engine's speed is 1800 r.p.m. On the expansion stroke with crank angle 30° from TDC, the gas pressure is 750 kN/m^2. Determine the net thurst on the piston.　　　　20

3. Four masses P, Q, R and S rotating in different planes are to be arranged to give complete balance. Planes containing Q and R are 45 cm apart. The masses Q and R are at right angles to each other and mass S makes angles 140° and

230° respectively with masses Q and R in the same sense. Find where the planes containing P and S should be placed and also the magnitude and angular position of mass P.

Mass	Weight (kg)	Radium (cm)	
P	W	30	
Q	200	50	
R	300	20	
S	225	40	20

4. The pistons of a 60° twin V-engine has strokes of 120mm. The connecting rods-driving a common crank, has a length of 200mm. The mass of the reciprocating parts per cylinder is 1 kg and the speed of the crank shaft is 2500 r.p.m. Determine the magnitude of primary and secondary forces.

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5. A governor of the Hartnell type has equal balls of mass 3 kg, set initially at a radius of 200mm. The arms of the ball crank lever are 110mm vertically and 150mm horizontally. Find :

(a) the initial compressive force on the spring, if the speed for an initial ball radius of 20mm is 240 r.p.m., and

(b) the stiffness of the spring required to permit a sleeve movement of 4mm on a fluctuation of 7.5 per cent in the engine speed.

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6. A torsion dynamometer is fitted on a turbine shaft to measure the angle of twist. It is observed that the shaft twists 1.50 in a length of 5 metres at 500 r.p.m. The shaft is solid and has a diameter of 200 mm. If the modulus of rigidity for the shaft material is 85 GPa, find the power transmitted by the turbine. 20

7. (a) Describe the gyroscopic effect on sea going vessels.

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   (b) The moment of inertia of an aeroplane air screw is 6.75 kg-m^2 and rotates at 1200 r.p.m. The aircraft makes a complete half circle turn in 10 seconds. Calculate the gyroscopic couple on the aircraft and state its effect on the aircraft. The air screw rotates clockwise when viewed from the sear. 12

8. Explain any *two* of the following :
   (a) Hunting of centrifugal governors
   (b) Prony brake dynamometer
   (c) Balancing machines. 10, 10