EME603

(Following Roll No. to be filled by candidate)

Roll No.

B TECH
SIXTH SEMESTER EXAMINATION 2015-2016
EME603
THEORY OF MACHINES-II

Time: 2 Hours **Max. Marks: 50**

Note:

- Attempt all questions.
- Marks and number of questions to be attempted from the section is mentioned before each section.
- Assume missing data suitably. Illustrate the answers with suitable sketches.

1. Attempt **all parts** of the following: [2x5]
   a. Define the terms *Piston effort* and *Crank effort*.
   b. Explain the term 'partial balancing of primary force'? Why it is necessary?
   c. Explain 'coefficient of insensitiveness' of governors.
   d. Define the terms, steering, pitching and rolling motion of a ship.
   e. What is whirling speed of a shaft? Explain briefly.

2. Attempt any **three** parts of the following: [3x5]
   a. A vertical petrol engine 150 mm diameter and 200 mm stroke has a connecting rod 350 mm long. The mass of the piston is 1.6 Kg and engine speed is 1800 rpm. On the expansion stroke with the crank angle 30° from top dead centre, the gas pressure is 750 KN/m^2. Determine:
      i. net thrust on the engine
      ii. torque on the crankshaft

   b. Four masses A, B, C and D as shown below are to be completely balanced. The planes containing masses B and C are 300 mm apart.

	A	B	C	D
Mass (Kg)	-	30	50	40
Radius(mm)	180	240	120	150

The angle between planes containing B and C is 90°. B and C make angles of 210° and 120° respectively with D in the same sense. Find:
   i. The magnitude and angular position of mass A; and
   ii. The position of planes A and B.

   c. The controlling force in a spring-controlled governor is 1500 N when radius of rotation is 200 mm and 887.5 N when radius of rotation is 130 mm. The mass of each ball is 8 Kg. If the controlling force curve is straight line, then find:
      i. controlling force when radius of rotation is 150 mm.
      ii. the speed of governor when radius of rotation is 150 mm.

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

3. Attempt **any two** parts of the following: [2x5]
   a. A hartnell governor having a central sleeve spring and two right-angled bell crank levers moves between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 Kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine:
      i. Loads on the spring at the lowest and the highest equilibrium, and
      ii. Stiffness of the spring.

   b. 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 the shaft material is 40 Mg/m^3, and Young's modulus is 200 GN/m^2. Assume the shaft to be simply supported.
   c. Discuss the effect of inertia of the shaft in longitudinal and transverse vibrations.

4. Attempt **any two** parts of the following: [2X7.5]
   a. The torque delivered by a two-stroke engine is represented by T = (1000 + 300 sin 2θ – 500 cos2θ) N.m, where θ is the angle turned by the crank from inner dead centre. The engine speed is 250 rpm.The mass of the flywheel is 400 Kg and radius of gyration 400 mm. Determine:
      i. the power developed
      ii. the total percentage fluctuation of speed
      iii. the angular acceleration of flywheel when the crank has rotated through an angle of 60° from the inner dead centre
      iv. the maximum angular acceleration and retardation of the flywheel

   b. The cranks of a two-cylinder uncoupled inside cylinder locomotive are at right angles and are 300 mm long. The distance between the centre lines of the cylinder is 650 mm. The wheel centre lines are 1.6 m apart. The reciprocating mass per cylinder is 300 Kg. The driving wheel diameter is 1.8 m. If the hammer blow is not to exceed 45 KN at 100 Km/hr, then determine:

(i) the fraction of the reciprocating masses to be balanced
(ii) the variation in tractive effort
(iii) the maximum swaying couple.

c. A four wheeled motor car of mass 2000 Kg has a wheel base 2.5 m, track width 1.5 m and height of centre of gravity 500 mm above the ground level and lies at 1 m from the front axle. Each wheel has an effective diameter of 0.8 m and a moment of inertia of 0.8 Kg-m^2. The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of the road wheel, in a clockwise direction when viewed from the front and equivalent to a mass of 75 Kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/hr, find the load on each wheel. Assume axis of wheel is perpendicular to spin axis of engine.