UNIT 5 - GOVERNORS

UNIVERSITY QUESTIONS

1). Four masses A, B, C and D are completely balanced. Masses C and D makes angles of 90^O and 195^O respectively with B in the same sense. The rotating masses have following properties: m_b : 25 kg;r_b : 150mm, m_c : 40 kg; r_b: 200 mm, m_d : 35 kg; r_c: 100 mm r_d : 180 mm Planes B and C are 250 mm apart. Determine: (i) the mass A and its angular position. (ii) the positions of planes A and D**(April /May 2003)**

2). Four masses m_1 m_2, m_3 and m_4 of 200 kg, 300 kg, 240 kg and 260 kg are attached to a shaft at planes A_1, A_2, A_3, and A_4 respectively and revolve at radii 270 mm, 210 mm, 300 mm and 360 mm respectively. The distance of the planes A_2, A_3, and A_4, are 270 mm, 420 mm and 720 mm respectively from plane A_1. The angles measured counter clock wise are m_1 to m_2 45^O, m_2 to m_3 75^O and m_3 to m_4 135^O. The distance between the balancing planes L and M are 500 mm and L is 120 mm from A_1, and M is 100 mm from A_4. If the balancing masses revolve at a radius of 72 mm, find their magnitude and angular positions. **(November/ December -2003)**

3). A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200, and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses of B, C and D are I0 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. **(April / May – 2004)**

4). Four masses A, R, C and D revolve at equal radii and equally spaced along a shaft. The mass B is 7 kg and the radii of C and D make angles of 90^o and 240^o respectively with the radius of B. Find the magnitude of masses A, C and D and angular position of A so that the system may be completely balanced.**(April / May – 2005)**

5). A shaft carries four rotating masses A, B, C, D are in complete balance. The masses B, C and D are 50 kg, 80 kg and 70 kg respectively. The masses C and D make angles of 90^o and 195^o respectively with mass B, in the same sense. The masses A, B, C and D are concentrated at radius of 75 mm, 100 mm, 50 mm and 90 rnm respectively. The plane of rotation of masses B and C are 250 mm apart. Determine: (i) the mass A and its angular position, and (ii) position of planes A and D. **(November / December -2005)**

6) The cranks of a four cylinder marine oil engine are arranged at angular intervals of 90^o. The engine speed is 70 rpm and the reciprocating parts per cylinder is 800 kg. The inner cranks are 1 meter apart and are symmetrically arranged between the outer cranks which are 2.6 meters apart. Each crank is 400 m long. Determine the firing order of the cylinder for the best balance of reciprocating masses and also the magnitude of the unbalanced primary couple for that arrangement. **(May / June 2006)**

7) How are the different masses rotating in different planes are balanced **(Nov /Dec -2006)**

8). A shaft carries four rotating masses A, B, C and D which are completely balanced. The masses B, c and D are 50 kg, 80 kg and 70 kg respectively. The masses c and D make angles of 90^O and 195^O respectively with mass B in the same sense. The masses A, B, C and D are concentrated at radius 75 mm, 100 mm, 50 mm and 90 mm respectively. The plane of rotation of masses B and c are 250 mm apart. Determine (i) the magnitude of mass A and its angular position and (i) the position of planes A and D. **(Nov / Dec -2006)**

9) How will you balance several masses in different planes? Explain with suitable sketches and tables. **(Nov/Dec -2007)**

10) Four masses m_1,m_2,m_3, and m_4 attached to a rotating shaft on the same plane are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively and the angles between successive masses are 45^O, 75^O and 135^O. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m **(November / December -2007)**

11). A two cylinder uncoupled locomotive has inside cylinders 0.6 m apart. The radius of each crank is 300 mm and are at right angles. The revolving mass per cylinder is 250 kg and the reciprocating mass per

cylinder is 300 kg. The whole of the revolving and two third of reciprocating masses are to be balanced and the balanced masses areplaced, in the planes of rotation of the driving wheels, at a radius of 0.8 m. The driving wheels are 2 m in diameter and 1.5 m apart. If the speed of the engine is 80 kmph, find the hammer blow, maximum variation in tractive effort and maximum swaying couple. **(April / May 2008)**

12) A shaft carries four masses A, B, c and D of magnitude 200 kg, 300 kg, 400 kg an4200 kg respectively and revolving at radii B0 mm, 70 mm, 60 mm and 80 mm in planes Measured from A at 300 mm, 100 mm and 700 mm. The angles between the cranks Measured anticlockwise are A to B 45°, B to C 70 ° and C to D 120 °. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. **(May / June 2009)**

13) A shaft is rotating at a uniform angular speed. Four masses m1, m2, m3 and m4 of magnitudes 300 kg. 150 kg, 360 kg, 390 kg respectively are attached rigidly to the shaft. The masses are rotating in the same plane. The corresponding radii of 'rotation are 200 mm, 150 mm , 250 mm and 300 mm respectively. The angles made b1, these masses with horizontal are 0°, 45 °, 120 ° and 255 ° respectively. In the system is to be is to be balanced by adding two balancing mass. Find: the magnitudes of these balancing masses; and (ii) the position of the balancing mass if its radius of rotation is 200 mm.**(Nov/Dec– 2009)**

14) A shaft carries four masses in parallel planes ,A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100 ° and that between the masses at B and Ais 190 °, both being measured in the same direction. The axial distance between the planes A and B is 100 m and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine:(i) the magnitude of the masses of A and D, (ii) the distance between planes A and D, and (iii) the angular position of the moss at D. **(April / May – 2010)**

15) A shaft carries four rotating mosses A, B, C and D in this order along its axis. The mass of B, C and D are 30 kg, 50 kg and 40 kg respectively. The planes containing B and C are 30 cm apart. The angular spacing of the planes containing C and D are 90 ° and 210 ° respectively relative to B measured in the same sense. If the shaft and masses are to be in complete dynamic balance, find (i) the mass and the angular position of mass A; and (ii) the position of planes A and D. **(November /December -2010)**

16) Four masses A, B, C and D as given below are to be balanced.

	A	B	C	D
Mass (kg)	–	30	50	50
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90 °B and C make angles of 210 ° and l20 ° respectively with D in the same sense. Find the magnitude and the angular positions of mass A and the position of planes A and D. **(November / December 2011)**

17. A shaft carries four mosses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii of 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 33, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45 °, B to C 70 ° and C to D 120 °. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X= 100 mm, between X and Y is 400 mm and between Y and D. is 200 mm. If the balancing messes revolve at a radius of 100 mm, find their magnitude and angular position **(May / June 2012)**

18. A, B, C and D are four masses carried by a rotating shaft at radii l00, 125, 200 and 15A mm respectively. The planes in which the masses revolve. are spaced 60A mm apart and the mass of B, C and D are 10 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular setting of the four masses so that the shaft shall be in complete balance. **(November / December 2012)**

19). A shaft has three eccentrics, each 75 mm diameter and 25 mm thick, machined in one piece with the shaft. The central planes of the eccentric are 60 mm apart. The distance of the centres from the axis of rotation are 12 mm, 18 mm and 12 mrn and their angular positions are 120^{O}apart. The density of metal is 7000 kg/m^2. Find the amount of out-of balance force and couple at 600 rpm. If the shaft is balanced by adding two masses at a radius of 75 mm and at a distance of 100 mm from the central plane of the middle eccentric, find the amount of the masses and their angular positions. **(May / June 2013)**

20) The following data .refer to an outside cylinder uncoupled locomotive. Mass of rotating parts per cylinder : 350 kg; Mass of reciprocating parts per cylinder = 300 kg; Angle between cranks:90^{O}; Crank radius = 0.3; Cylinder centers :1.8 m: Radius of balance masses :0.8 m; Wheel centers : 1.5 m. If whole of the rotating and 2/3'd of the reciprocating parts are to be balanced in planes of the driving wheels, find (i) magnitude and angular positions of balance masses, (ii) speed in km/hr at which the wheel will lift off the rails when the load on each driving wheels is 30 kN and the diameter of tread driving wheels is 1.8 m and (iii) swaying couple at speed found in (ii) plane. (**November / December -2013)**