Model (1)
Theory of Machines (b)
Code: M 1152

(a) (i) Write a short note on primary and secondary balancing, and how the different masses rotating in different planes are balanced. Then, explain the method of balancing of different masses revolving in the same plane.

(ii) Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 12 kg, 10 kg, 18 kg and 15 kg respectively and their radii of rotations are 40 mm, 50 mm, 60 mm and 30 mm. The angular position of the masses B, C and D are 60°, 135° and 270° from the mass A. Find the magnitude and position of the balancing mass at a radius of 100 mm.

(b) (i) Derive an expression for the velocity of sliding between a pair of involute teeth. State the advantages of involute profile as a gear tooth profile.

(ii) Two involute gears of 22° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 6 mm and the pitch line speed is 1.3 m/s, assuming addendum as standard and equal to one module, find the angle turned through by pinion when one pair of teeth is in mesh.

(c) Draw the turning moment diagram of a single cylinder double acting steam engine. Then, Write a short note on gyroscope and explain the application of gyroscopic principles to aircrafts

(d) A cam operating a knife-edged follower has the following data :

(i) Follower moves outwards through 40 mm during 60° of cam rotation.

(ii) Follower dwells for the next 45°.

(iii) Follower returns to its original position during next 90°.

(iv) Follower dwells for the rest of the rotation.

The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The least radius of the cam is 50 mm. Draw the profile of the cam when

(1) the axis of the follower passes through the cam axis, and (2) the axis of the follower is offset 20 mm towards right from the cam axis. If the cam rotates at 300 r.p.m., determine maximum velocity and acceleration of the follower during the outward stroke and the return stroke.

Model (2)

(a) (i) Explain clearly the terms 'static balancing' and 'dynamic balancing'. State the necessary conditions to achieve them and discuss how a single revolving mass is balanced by two masses revolving in different plan

(ii) Four masses A, B, C and D revolve at equal radii and are equally spaced along a shaft. The mass B is 7 kg and the radii of C and D make angles of 90° and 240° respectively with the radius of B. Find the magnitude of the masses A, C and D and the angular position of A so that the system may be completely balanced.

(b) (i)Explain briefly the differences between simple, compound, and epicyclic gear trains. What are the special advantages of epicyclic gear trains.

(ii)The pitch circle diameter of the smaller of the two spur wheels which mesh externally and have involute teeth is 100 mm. The number of teeth are 16 and 32. The pressure angle is 20° and the addendum is 0.32 of the circular pitch. Find the length of the path of contact of the pair of teeth.

(c) (i) The turbine rotor of a ship has a mass of 9 tonnes and a radius of gyration 0.6 m. It rotates at 1900 r.p.m. clockwise, when looking from the stern. Determine the gyroscopic couple, if the ship travels at 90 km/hr and steer to the left in a curve of 70 m radius

(ii) Explain the turning moment diagram of a four stroke cycle internal combustion engine. What do you understand by gyroscopic couple. Then, derive a formula for its magnitude.

(d) A cam rotating clockwise with a uniform speed is to give the roller follower of 20 mm diameter with the following motion:

(i) Follower to move outwards through a distance of 30 mm during 120° of cam rotation ;

(ii) Follower to dwell for 60° of cam rotation ;

(iii) Follower to return to its initial position during 90° of cam rotation ; and

(iv) Follower to dwell for the remaining 90° of cam rotation.

The minimum radius of the cam is 45 mm and the line of stroke of the follower is offset 15 mm from the axis of the cam and the displacement of the follower is to take place with simple harmonic motion on both the outward and return strokes. Draw the cam profile.