CBCS SCHEME

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15AU52

# Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
## Dynamics of Machines

Time: 3 hrs. Max. Marks:80

**Note:** ***Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. What is point of concurrency? Explain equilibrium with respect to four force member. **(06 Marks)**

b. For the mechanism shown in Fig.Q1(b), find the required input torque for the static equilibrium. The lengths OA and AB are 250 mm and 650 mm respectively and force is 500 N.

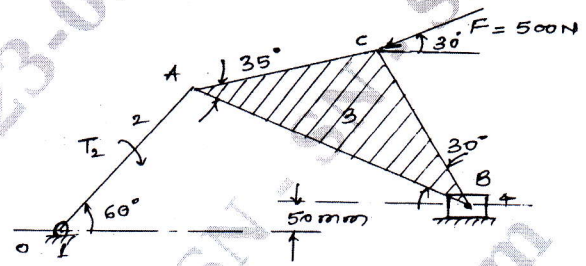


Fig.Q1(b) **(10 Marks)**

**OR**

2 a. Explain the following terms with respect to I.C. engine:
i) Piston effort ii) Crank effort **(04 Marks)**

b. The crank and connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240 mm respectively. The diameter of the piston is 80 mm and the mass of the reciprocating parts is 1.2 kg. At a point during the power stroke, when the piston has moved 20 mm from the top dead centre position, the pressure on the piston is 800 kN/m$^2$. Determine: i) Net force on the piston, ii) Thrust in the connecting rod, iii) Thrust on the sides of cylinder walls, iv) Engine speed at which the above values are zero. **(12 Marks)**

### Module-2

3 a. Why is balancing of rotating parts necessary for high speed engine? **(02 Marks)**

b. A shaft carries four masses A, B, C and D are 200 kg, 300 kg, 240 kg and 360 kg respectively, revolving at radii 90 mm, 70 mm, 100 mm and 120 mm respectively. The distance from the plane A are 270 mm, 420 mm and 720 mm. Angle between the crank A and B is 45°, B and C is 75 °, C and D is 130°. Balancing masses are placed 120 mm and 100 mm from D and A respectively. The distance between them being 500 mm. Find the balancing masses and their angular position, if they are placed at a radius of 100 mm. **(14 Marks)**

**OR**

4 a. What is "primary balancing" and "secondary balancing" as applied to balancing of reciprocating masses? **(04 Marks)**

b. The pistons of a 4-cylinder vertical inline engine reach their uppermost position at 90° interval in order of their axial position. Pitch of cylinder = 0.35 m, crank radius = 0.12 m, length of connecting rod = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg. Find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. **(12 Marks)**

## Module-3

5 Turning moment curve for one revolution of a multi-cylinder engine above and below line of mean resisting torque are given by –0.32, +4.06, –2.71, +3.29, –3.16, +2.32, –3.74, +2.71 and –2.45 sq.cm. The vertical and horizontal scales are 1 cm = 60000 kgcm and 1 cm = 24° respectively. The fluctuation of speed is limited to ±1.5% of mean speed which is 250 rpm. The hoop stress in rim material is limited to 56 kg/cm$^2$. Neglecting effect of boss and arms determine suitable diameter and cross section of flywheel rim. Density of rim material is 0.0072 kg/cm$^3$. Assume width of rim equal to 4 times its thickness. **(16 Marks)**

**OR**

6 a. Explain following: (i) Sensitiveness (ii) Stability of governor. **(04 Marks)**

b. In an engine governor of the porter type, the upper and lower arms are 200 mm and 250 mm respectively and are pivoted on the axis of rotation. The mass of sleeve is 15 kg, the mass of each ball is 2 kg and friction of the sleeve together with the resistance of operating gear is equal to a load of 25 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, find taking friction into account, range of speed on the governor. **(12 Marks)**

## Module-4

7 a. Enumerate laws of friction. **(04 Marks)**

b. Derive an equation for frictional torque developed in a flat pivot bearing. **(06 Marks)**

c. A shaft has a number of collars integral with it. The external diameter of the collar is 400 mm and the shaft diameter is 250 mm. If the intensity of pressure is 0.35 N/mm$^2$ (uniform), and the coefficient of friction is 0.05, estimate the power absorbed when the shaft runs at 105 rpm carrying a load of 150 kN and number of collars required. **(06 Marks)**

**OR**

8 a. Derive an expression for centrifugal tension in the belt. **(04 Marks)**

b. A pulley is driven by a flat belt, the angle of lap being 120°. The belt is 100 mm wide by 6 mm thick and density 1000 kg/m$^3$. If coefficient of friction is 0.3 and maximum stress in the belt is not to exceed 2 MPa, find the greatest power which the belt can transmit and the corresponding speed of the belt. **(12 Marks)**

## Module-5

9 With usual notations derive the equation C = IWWp. **(06 Marks)**

Each road wheel of motor cycle has a moment of inertia of 2 kg m$^2$. The rotating parts of the engine of the motor cycle has the moment of inertia of 0.2 kg m$^2$. The speed of the engine is 5 times the speed of the wheel and is in the same sense. The mass of the motor cycle with rider is 200kg and its c-g is 500mm above ground level. The diameter of the wheel is 500mm. The motor cycle is travelling at 15m/sec on a curve of 30m radius. Determine:
i) Gyro couple ii) Centrifugal couple iii) Overturning couple and balancing couple interms of angle of heel. Also find the angle of heel. **(10 Marks)**

**OR**

10 The following data relate to a symmetrical circular cam operating on flat faced follower. Least radius equals 25mm, nose radius equals 8mm, lift of the valve equals 10mm, angle of action of cam = 120°. Cam shaft speed = 1000 rpm. Determine: i) flank radius
ii) maximum velocity iii) maximum acceleration and iv) maximum retardation. **(16 Marks)**

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