

**B.Tech. MECHANICAL ENGINEERING
(COMPUTER INTEGRATED
MANUFACTURING) / BTMEVI**

Term-End Examination

December, 2015

BME-020 : KINEMATICS & DYNAMICS OF MECHANISMS

Time : 3 hours

Maximum Marks : 70

Note : Attempt any **five** questions. All questions carry equal marks. Use of calculator is permitted. Assume data if any missing.

1. (a) Describe how you can determine if a part is statically balanced. 4
- (b) A shaft of diameter 70 mm is supported in two bearings at a distance of 1.5 m. A mass of 20 kg is attached to the shaft such that its centre of gravity is 5 mm from the axis. The mass is placed at a distance of 500 mm from right hand bearing. To avoid unequal wearing of bearings, the designer places the mass in the centre of span. Calculate the reactions at bearing, maximum bending moment (BM) and bending stress, if the shaft rotates at 750 rpm. 10

2. (a) Explain Whirling of Shaft. Show the relative position of the centre of gravity, centre of shaft axis and bearing axis centre for various cases for damped and undamped conditions. 6
- (b) The rotor of turbo supercharger weighing 20 kg is keyed to the centre of a 30 mm diameter shaft. The span length of the shaft is 100 cm. Determine the critical speed of the shaft and amplitude of vibration of the rotor at a speed of 300 rpm. The eccentricity of mass is 0.015 mm. Assume Young's Modulus = 2.0×10^{11} Pa. 8
3. (a) A single cylinder vertical engine has a bore 40 cm and a stroke of 50 cm. The connecting rod is 120 cm long. Mass of reciprocating parts is 140 kg. At the expansion stroke with the crank at 30° from TDC, the gas pressure is 0.8 MPa. If the engine runs at 260 rpm, determine : 6
- (i) Net force at piston
- (ii) Resultant load on the gudgeon pin
- (iii) Thrust on the cylinder walls
- (b) Derive an expression for equivalent dynamic system. 8

4. (a) Define energy method and Rayleigh's method. State their differences. 6
- (b) A solid cylinder diesel engine is connected to silencer and it runs at 600 rpm. The pressure is to be measured with a simple U-tube manometer. It is desired that the frequency of oscillation of the liquid column in the manometer is to be 3.5 times slower than frequency of fluctuation in the silencer. Calculate the minimum length of manometer tube. 8
5. (a) State and prove the law of gearing and explain how involute profile satisfies it. 6
- (b) A uniformly rotating cam operates a flat faced follower. Draw cam profile for the following data :
Lift of the follower = 40 mm
Base circle radius of the cam = 40 mm 8
6. (a) Explain the Klein's construction for the slider crank mechanism. Determine the maximum acceleration and the acceleration opposite to this position of crank for the piston. The crank rotates at 600 rpm. The crank radius is 20 cm and the length of the connecting rod is 60 cm. 6

- (b) Four masses weighing 1500 N, 1000 N, 1200 N and 1300 N revolve in planes A, B, C and D respectively. Their respective radii are $r_a = 225$ mm, $r_b = 175$ mm, $r_c = 25$ mm and $r_d = 300$ mm. The angular positions of masses at B, C and D from mass at A are 45° , 75° and 135° . The balancing masses are to be mounted on planes L and M at radii 600 mm for each. Plane L is between planes of A and B whereas plane M is between C and D. The distance of planes A, B, C and D from plane L is 300 mm, 375 mm, 750 mm and 1500 mm, respectively. The distance of plane A, B, C and D from plane M are 1800 mm, 875 mm, 500 mm, and 250 mm, respectively. Find the balancing masses and orientation of their radii with respect to mass at A. 8

7. (a) A gear train of helical gears with the pitch radii of the driver, intermediate and driven gear are 5 cm, 8 cm and 5 cm respectively. The normal pressure angle is 20° and helix angle is 30° . If the input torque is 1500 Nm, find out the output torque. 6

- (b) Explain clearly the terms free vibration and forced vibration. Derive the expression for amplitude in an undamped free vibration. 8