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**BIMEE-007**

# B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

00252

## Term-End Examination

## December, 2017

## BIMEE-007 : ADVANCED DYNAMICS OF MACHINES

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** *Answer any **five** questions. All questions carry equal marks. Assume missing data, if any, suitably.*

**1.** (a) Describe the principle of virtual work. State its applications. *6*

(b) The diameters of two pulleys of a differential pulley block are 30 cm and 25 cm respectively. Using the principle of virtual work, calculate the value of the effort 'P' required to lift a load 'W' of 1000 N. *8*

**2.** (a) What is Dynamically Equivalent Link and System ? Describe. *4*

(b) A horizontal double acting steam engine, 0·3 m diameter and 0·5 m stroke, has an equivalent mass of 100 kg for the reciprocating parts. The engine runs at 200 rpm. The gas pressure when the crank has turned 45° from the inner dead centre, is 1 $MN/m^2$ and the back pressure is 35 $kN/m^2$. The ratio of the connecting rod length to the radius of the crank is 4.

Find : *10*

(i) Piston effort

(ii) Turning moment on the crank shaft

**3.** (a) What is fluctuation of energy and coefficient of fluctuation of energy ? Explain. *4*

(b) A rivetting machine is driven by a constant torque 3 kNm by motor. The moving parts including the flywheel are equivalent to 150 kg at 0·6 m radius. One rivetting operation takes 1 second and absorbs 10000 Joules of energy. The speed of the flywheel is 3000 rpm before rivetting. Find (i) the number of rivets that can be closed per hour, and (ii) reduction in speed after the rivetting operation is over. *10*

4. (a) How are the different masses rotating in different planes balanced ? Describe. *4*

(b) A turning moment diagram for a petrol engine is drawn to the following scales :

Turning moment 1 mm = 5 Nm

Crank angle 1 mm = 1°

The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line, taken in order, are 295, 685, 40, 340, 960 and 270 $mm^2$. The rotating parts are equivalent to a mass of 36 kg at radius of gyration of 100 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 rpm. *10*

5. (a) Describe the motion of a rigid body in three dimensions. *4*

(b) A circular disc rotating around a vertical spindle has the following masses placed on it :

| Mass | Position of Mass | | Magnitude of mass (kg) |
|---|---|---|---|
| | θ with respect to Y-Y (degrees) | Distance from centre (mm) | |
| A | 0 | 260 | 2·5 |
| B | 60 | 300 | 3·5 |
| C | 150 | 225 | 5·0 |

Determine the magnitude and angular position of a mass that should be placed at 262·5 mm to give balance when rotating. Also determine the unbalanced force on the spindle when the disc is rotating at 250 rpm. *10*

6. (a) Discuss the effect of the gyroscopic couple on a naval ship. *4*

(b) A ship is pitching through a total angle of 15°; the oscillation may be taken as simple harmonic and the complete period is 32 seconds. The turbine rotor has a mass of 6 tonnes, its radius of gyration is 450 mm and it is rotating at 2400 rpm. Calculate the maximum value of the gyroscopic couple set up by the rotor. If the rotation of the rotor is clockwise, in which direction will the bow tend to turn while falling ? What is the maximum angular acceleration to which the ship is subjected while pitching ? *10*

7. (a) Describe the gyroscopic effect on critical speed. *4*

(b) A vertical shaft, 25 mm diameter and 0·75 m long, is mounted on long bearings and carries a pulley 0·5 mm from the axis of the shaft. Find the (i) critical speed, and (ii) bending stress in the shaft when it is rotating at 1700 rpm. Neglect the weight of the shaft and take E = 200 GN/m$^2$. *10*

8. Write short notes on the following : $4 \times 3\frac{1}{2} = 14$

(a) Generalized Forces

(b) Dynamic Equilibrium

(c) Motion Analysis

(d) Lagrange's Equation of Motion