(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2537 Roll No. | | | | | | | | | | |

B.Tech.

(SEM.VI) EVEN THEORY EXAMINATION 2012-13

THEORY OF MACHINE–II

Time : 2 Hours *Total Marks : 50*

Note :– (1) Attempt **all** questions.

(2) Marks are indicated against each question.

1. Attempt any **two** parts of the following : **(2×6=12)**

(a) A vertical single cylinder gas engine has a bore of 8 cm and a stroke of 10 cm. The length of connecting rod is 20 cm. Reciprocating parts weigh 1.5 kg. Gas pressure on the piston is 6 kg/cm^2 when piston has moved downward by 1.5 cm from its I.D.C position on the power stroke. Determine the net vertical load on the gudgeon pin, when the engine runs at 2000 rpm.

At what speed of engine, this load will become zero ?

(b) Torque exerted by a multi cylinder engine running at a mean speed of 240 r.p.m against a constant resistance is

$T(\text{kg-m}) = 350 + 560 \sin\theta + 84 \sin 2\theta + 8.4 \sin 3\theta$.

Find the H.P. of the engine and the minimum weight of the flywheel if the radius of gyration is 90 cm and the maximum fluctuation of speed is to be ± 1% of the mean.

(c) (i) State D'Alemberts principle.

(ii) A link AB of mass m and moment of inertia I (about an axis passing through its C.G.) is to be replaced by a dynamically equivalent system. If one part of mass m of link is placed at its acceleration centre (the link is in motion as part of a mechanism), where should the remaining part of mass be kept to achieve dynamic equivalence ? Explain with the help of a sketch.

2. Attempt any **two** parts : **(2×6=12)**

(a) Draw a sketch of a porter type engine governor. In this governor, the upper and lower arms measure 20 cm and 25 cm respectively and they are pivoted on the axis of rotation. Weight of sleeve is 15 kg, weight of each ball is 2 kg and the friction at sleeve may be taken as 2.5 kg weight. Find the range of speed for this governor if the extreme inclination of upper arms to the vertical are 30° and 40°.

(b) In a Hartnell governor, mass of each ball is 1 kg, vertical arm of bell crank lever is 100 mm long, horizontal arm is 50 mm long. The distance of fulcrum is 80 mm from axis of rotation of governor. Extreme radii of rotation of balls are 75 and 112.5 mm. Maximum equilibrium speed is 5% greater than the minimum equilibrium speed of 360 r.p.m. Find, neglecting obliquity of arms, initial compression of spring and equilibrium speed corresponding to the radius of rotation of 100 mm.

(c) Define governor effort, isochronism, stability and coefficient of insensitiveness of a governor. Draw controlling force v.s. radius of rotation diagram and explain the conditions for achieving stability and isochronism for both gravity as well as spring controlled governors.

3. Answer any **two** of the following : **(2×6=12)**

(a) Why is balancing of rotating parts done ? What is the difference between static and dynamic balancing ?

Three masses of 8 kg, 12 kg and 15 kg attached at radial distances of 80 mm, 100 mm and 60 mm respectively to a disc on a rotating shaft are in complete balance. Determine the angular positions of the masses of 12 kg and 15 kg relative to 8 kg mass.

(b) Four masses, having their radius of rotation in mm as 200, 150, 250 and 300 respectively, are 200 kg, 300 kg, 240 kg and 260 kg in magnitude respectively. Angles between the successive masses are 45°, 75° and 135° respectively. Find the position and magnitude of the balance mass required, if its radius of rotation is 200 mm.

(c) Why is it not possible to balance completely the imbalance caused by a reciprocating mass by providing a single rotating mass ? How had this problem been tackled in balancing of reciprocating masses of steam locomotives ? What problems did partial balancing cause ? Explain the causes behind "hammer blow", "swaying couple" and "variation of tractive effort" occurring in steam locomotives.

4. Answer any **two** of the following : **(2×7=14)**

(a) The turbine rotor of a ship has a mass of 500 kg, radius of gyration of 0.5 metres and it rotates at 2100 r.p.m. in the clockwise direction when viewed from the stern. Find the gyroscopic effect under the following conditions :

The ship pitches 6° above and 6° below the horizontal position. The bow is descending with its maximum velocity. Motion due to pitching is S.H.M. and the periodic time is 20 seconds.

(b) A machine mounted on three springs (each of stiffness 12 N/mm) and fitted with a dashpot has a mass of 60 kg. The amplitude of free vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming viscous damping, determine the damping coefficient, ratio of frequencies of damped and undamped vibrations are the periodic time of damped vibrations.

(c) A typical mass, spring damper system with an equation of motion $m\frac{d^2x}{dt^2}+c\frac{dx}{dt}+sx=0$ is subjected to a sinusoidally varying force. Write down the full equation of motion and its solution in steady state. Explain the terms "dynamic magnifier", "damping ratio" and "resonating frequency" for this system. Present the solution of the equation in the form of a graph and explain the phenomenon of resonance. Also determine the value of damping ratio when resonance just disappears.