B.Tech. Degree V Semester Regular/Supplementary Examination in Marine Engineering December 2020

## MRE 1501 DYNAMICS OF MACHINERY
(2013 Scheme)

Time: 3 Hours   Maximum Marks: 100
                                                                      $(5 \times 20 = 100)$

I. (a) What is meant by piston effort and crank effort?   (5)

    (b) A slider-crank mechanism with following dimensions is acted upon by   (15)
         a force F = 2 KN at B as shown in figure. OA = 100 mm,
         AB = 450 mm. Determine the input torque T on the link OA for static
         equilibrium of the mechanism for the given configuration.
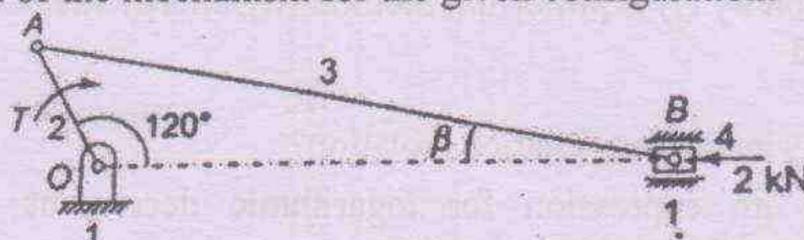
OR

II. (a) What is meant by dynamically equivalent system? Explain.   (5)

     (b) The dimensions of a four-link mechanism are AB = 500 mm,   (15)
          BC = 660 mm, CD = 560 mm. The link AB an angular velocity of
          10.5 rad/sec, counter clockwise and an angular retardation of
          26 rad/sec^2 at the instant when it makes an angle of 60° with AD. The
          mass of the links BC and CD is 4.2 kg/m length. The link AB has a
          mass of 3.54 kg, the centre of which lies at 200 mm from A and a
          moment of inertia of 88500 kg.mm^2. Determine the inertia forces on
          different links.

III. The turning moment diagram for a four stroke gas engine may be   (20)
      assumed for simplicity to be represented by four triangles, the areas of
      which from the line of zero pressure are as follows: Expansion
      stroke = 3550 mm^2; Exhaust stroke = 500 mm^2; Suction
      stroke = 350 mm^2 and compression stroke = 1400 mm^2. Each mm^2
      represents 3 N-m. Assuming the resisting moment to be uniform, find
      the mass of the rim of a fly wheel required to keep the mean speed
      200 rpm within ±2%. The mean radius of the rim may be taken as
      0.75 m. Also determine the crank positions for the maximum and
      minimum speeds.

OR

IV. (a) What is the effect of gyroscopic couple on rolling of ship? Why?   (5)

     (b) The rotor of a turbine yacht rotates at 1200 rpm clockwise when viewed (15)
          from stern. The rotor has a mass of 750 kg and radius of gyration
          of 250 mm. Find the maximum gyroscopic couple transmitted to the
          hull when yacht pitches with a maximum angular velocity of 1 rad/s.
          What is the effect of this couple?

                                                                        (P.T.O.)

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V.	Four masses M1, M2, M3 and M4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angle between successive masses are 45°, 75° and 135°. Find the position and magnitude of balance mass required if its radius of rotation is 0.25 m.	(20)

OR

VI.	A three cylinder radial engine driven by a common crank has the cylinders spaced at 120°. The stoke is 100 mm, length of the connecting rod 200 mm and the reciprocating mass per cylinder 1.5 kg. Calculate the primary and secondary forces at crank shaft speed of 1500 r.p.m.	(20)

VII.	(a)	Define frequency, cycle, period and free vibration.	(5)
	(b)	Derive an expression for the natural frequency of the free longitudinal vibration by (i) Equilibrium method (ii) Energy method (iii) Rayleigh's method	(15)

OR

VIII.	(a)	What is meant by vibration isolation?	(5)
	(b)	Derive an expression for logarithmic decrement in damped free vibration of a mechanical system.	(15)

IX.	Determine the natural frequencies of the vibrating system shown in the following figure. Take $m_1 = 10$ kg, $m_2 = 15$ kg and $K = 320$ N/m.	(20)
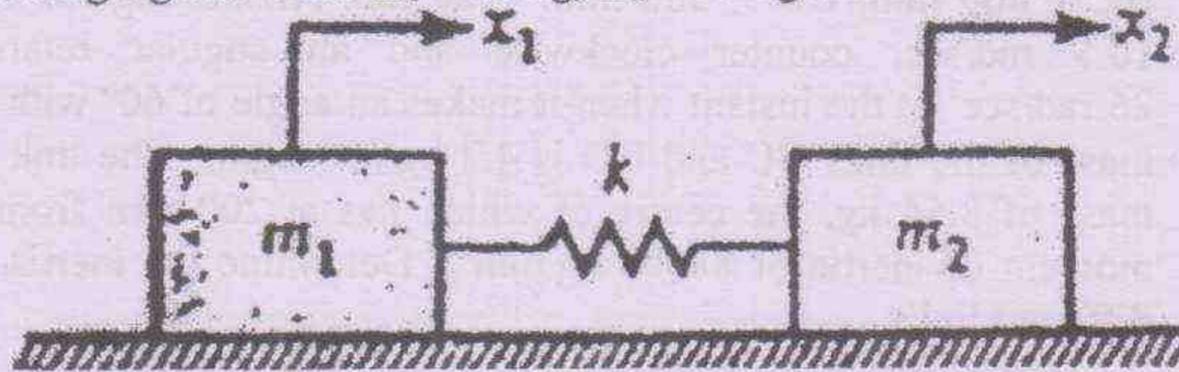
OR

X.	(a)	Describe Rayleigh's method to find the natural frequency of shaft carries various point loads.	(5)
	(b)	A shaft 180 mm diameter is supported in two bearings 2.5 m apart. It carries three discs of mass 250 kg, 500 kg and 200 kg at 0.6 m, 1.5 m and 2 m from the left end. Determine the natural frequency of transverse vibrations. Take modulus of elasticity for the shaft material as 211 GN/m^2.	(15)

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