INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

END SEMESTER EXAMINATION June-July 2019

B.Tech (Marine Engineering)

Semester: IV

MECHANICS OF MACHINES-II

(UG11T3403)

Date: 28/06/2019 **Maximum Marks: 100**

Time: 3 Hrs **Pass Marks: 50**

PART – A Marks: 10 X 3=30

(All questions are compulsory)

Q.1 (a) What is "Engine Rocking" resulting from partial balancing .

(b) What do you understand by 'Barred speed range' or 'Critical speed range'. Name one technique to tackle the same.

(c) Explain how complete secondary balance of high speed multi-cylinder-engine is carried out. Explain with figure.

(d) In case of Three-rotor-system which is Semi-definite-torsional-vibrating system, Explain zero-node or Imaginary node, one-node, two-node frequencies.

(e) Draw frequency response graph for Harmonic excitation.

(f) Explain the characteristic feature of Over-damped, Critical-damped, Under-damped system used to reduce vibrations.

(g) Explain logarithmic decrement.

(h) Define 'Motion Transmissibility', 'Force Transmissibility' with respect to vibration isolation.

(i) What is Degree Of Freedom of the system ?

(j) Explain whirling speed of shaft.

PART – B Marks: 5 X 14=70

(Answer any 5 of the following)

Q.2 A shaft carries four masses A, B,C and D placed in parallel planes perpendicular to the shaft axis and in the same order along the shaft. The masses B and C are 36 kg and 25 kg and both are assumed to be concentrated at a radius of 150 mm, while the masses A and D both are assumed to be concentrated at a radius of 200 mm. The angle between B and C is 100^0 and that between B and A is 190^0,both angles being measured in the same sense i.e. Counter-clockwise

direction. The planes containing A and B are 250 mm apart and those containing B and C are 500 mm apart. If the shaft is to be in complete static and dynamic balance, find

i)The masses A and D

ii)The distance between planes C and D

iii)The angular position of D. **[14 Marks]**

Q.3 a) A circular cylinder of mass 'm' and radius 'r' is connected by a spring of stiffness 'k' as shown in fig (1). If it is free to roll on the horizontal surface without slipping. Find the natural frequency of vibration.

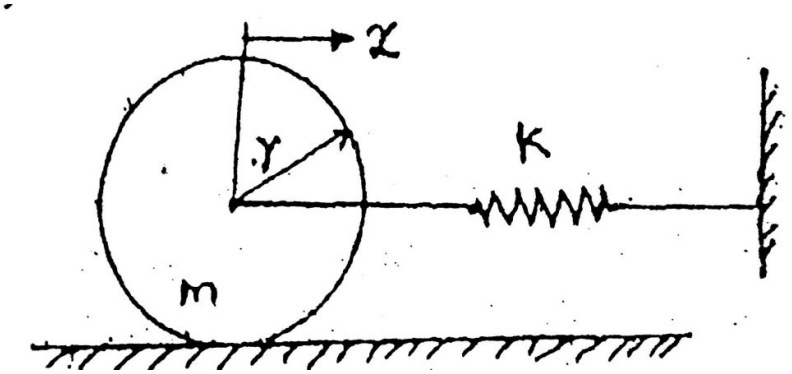

FIG.1 **[7 marks]**

b) A vertical shaft of torsional stiffness of 940 N-m/rad with it's upper end fixed carries a rotor of mass moment of inertia of 60 kg-m^2. The mass moment if inertia of shaft is 8.6 kg-m^2.

Derive differential equation of motion and natural frequency by Energy method.

[7 marks]

Q.4 a) A shaft of 40 mm diameter and 2.5 m length is subjected to UDL (Uniformly distributed load) of 147.15 N/m for entire length of 2.5 m. It is simply supported at the ends and carries three masses of 90 kg, 140 kg, 60 kg at the distances of .8 m, 1.5 m, 2 m from Left end support. Find the lowest natural frequency of transverse vibrations by Dunkerley's method. Assume E=200 GPa

[7 marks]

b) A rotor having a mass of 6 kgs is mounted midway on a simply supported shaft of diameter 10 mm and length 400 mm.The center of gravity of rotor is 0.02 mm away from the geometric center of rotor. If the rotor rotates at 2500 rpm find the critical speed or whirling speed, the amplitude of steady state vibrations and the dynamic force transmitted to the bearing. Assume for the shaft material E = 200 GPa . **[7 marks]**

Q.5 An I.C.Engine drives a centrifugal pump through a gear drive. The gear or wheel is coupled to engine and Pinion is coupled to pump. The length and the diameter of the shaft from engine to the gear are 1 m and 80 mm respectively. The centrifugal pump runs 3 times faster than that of engine. The length and the diameter of the shaft from pinion to the pump impeller are 400 mm and 60 mm respectively. The moment of inertias of pinion and gear are 1 kg-m^2 and 11 kg-m^2 respectively. The moment of inertias of engine and pump impeller are 100

kg-m^2 and 25 kg-m^2 respectively. (Given modulus of rigidity for shaft material is 80 GN / m^2.) Determine natural frequencies and node points considering the inertias of the gears**.** **[14 marks]**

Q6**)** A viscously damped system has stiffness of 5000 N/m and critical damping coefficient of 0.2 N-S/mm and logarithmic decrement of 2.If the system is given an initial velocity of 1 m/s,Determine a] Maximum displacement of the system and b] Amplitude after 2 cycles

[14 marks]

Q.7 An engine weighing 1 kN is supported on four springs. It has a stroke length of 80 mm and runs at 1000 rpm. If the springs are symmetrically placed with respect to CG of the engine, find neglecting the damping the combined stiffness of the springs in order that the force transmitted to the foundation is 1/25 times of the impressed force. It is found that the damping however small, reduces the amplitude of successive vibrations by 25%.

i) Force transmitted to the foundation at 1000 rpm ii) Force transmitted to the foundation at resonance and iii) the amplitude of vibration if the weight of the reciprocating parts is 20 N

[14 marks]

Q.8 A vertical Marine In-line Engine four-stroke, six-cylinder has a firing order or sequence **1-4-5-2-3-6-1**. Firing takes place with equal angular interval. The mass of reciprocating parts per cylinder is 3 kg, connecting rod length is 200 mm and stroke length is 100 mm. The cylinder center-lines are spaced 300 mm apart. The crank shaft speed is 1000 rpm. Examine the engine for the balance of primary and secondary forces and couples. Also find the values of primary and secondary couples and position of crank No 1 at which these values occur. **[14 marks]**