

**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**  
**(UG11T2403)**

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**Date: 28/06/2019**

**Maximum Marks: 100**

**Time: 3 Hrs**

**Pass Marks: 50**

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**PART-A**

*All questions are compulsory*

**[3x10=30 Marks]**

**Q1)**

- a) What is Undamped Free Vibration ?
- b) Derive the formula for springs in series combination
- c) Why balancing of rotating parts are necessary for high speed engine?
- d) Explain whirling speed of shaft.
- e) Explain Jump phenomenon
- f) Draw frequency response graph for Harmonic excitation.
- g) Explain logarithmic decrement.
- h) Explain Coulomb's damping.
- i) What are the consequences of vibration ?
- j) What is Degree Of Freedom of the system ?

**PART-B**

*Answer any five of the following*

**[14x5=70 Marks]**

**Q2)** A , B ,C and D are four masses carried by a rotating shaft at radii 100,125,200 and 150 mm respectively.The planes in which the masses revolve are spaced 600 mm apart and the mass of B , C and D are 10 Kg, 5 Kg and 4 Kg respectively.Find the required mass A and the relative angular settings of the four masses so that the shaft be in complete balnce.

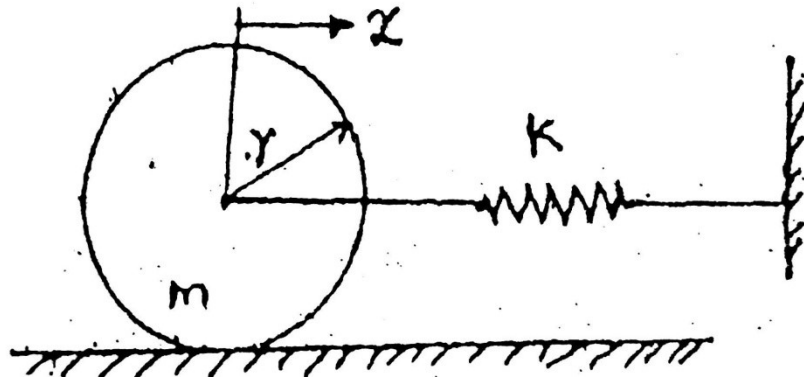
**[ 14 marks ]**

**Q3)**

- a) Determine the natural frequency of the spring mass system by Newton's Method.

[ 7 marks ]

- b) 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 ]

- Q4)** 40 N at 20 cm, 30 N at 60 cm and 10 N at 110 cm from the fixed end are the loading on a cantilever. The deflection under 30 N load is 3 mm. What would be the natural frequency of transverse vibration by Rayleigh's Method if 20 N. is added at 90 cm from fixed end?

(the deflection at a section 'J' is given by  $U_{ij}=U_{ji}$  )

$$U_{ij} = \frac{S_i^2(3S_j - S_i)}{\text{constant}}$$

Where S is the distance of the section from fixed end)

[ 14 marks ]

**Q5)** A steel shaft 1.5 m long is 95 mm in diameter for the first 0.6 m of its length 60 mm in diameter for the next 0.5 m of the length and 50 mm in diameter for the remaining 0.4 m of its length. The shaft carries two flywheels at two ends, the first having mass of 900 Kg and 0.85 m in radius of gyration located at the 95 mm diameter end and the second having a mass of 700 Kg and 0.55 m radius of gyration located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. Assume  $G = 80$  GPa for shaft material.

**[ 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 ]**

**Q7)** A 80 Kg reciprocating machine is placed on thin, mass less beam, A frequency sweep is run to determine the magnitude of the machines rotating unbalance and the beams equivalent stiffness. As the speed of the machine increased the following is noted 1] The steady state amplitude of the machine at a speed of 65 rad/s is 7.5 mm, 2] The maximum steady state amplitude occurs for a speed less than 65 rad/s and 3] As speed is greatly increased the steady state amplitude approaches 5 mm. Assume the system is undamped.

**[ 14 marks ]**

**Q8)** The cranks and connecting rods of 4-cylinder in-line engine running at 1800 rpm are 600 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If cylinders are numbered 1 to 4 in sequence from one end the cranks appear at intervals of  $90^\circ$  in an end view in the order 1-4-2-3, the reciprocating mass corresponding to each cylinder is 1.5 Kg. determine

- 1) Unbalanced primary and secondary forces if any and
- 2) Unbalanced primary and secondary couples with reference to central plane of the engine

**[14 marks]**