Registration no: | | | | | | | | | | |

Total Number of Pages: 02 **B.Tech**
PEME5401

7th Semester Regular / Back Examination 2017-18
Mechanical Vibration
BRANCH: Mech
Time: 3 Hours
Max Marks: 70
Q.CODE: B411
Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2 x 10)**

a) Discuss the effect of inertia of a shaft on the free torsional vibration.

b) Explain why the mass are, damping and stiffness matrices are symmetrical?

c) What is he equivalent stiffness of spring connected in parallel having stiffness k_1 and k_2?

d) What is the cause and effect of vibration?

e) List four differences between the free vibrations of an under damped system and a system with Coulomb damping.

f) Explain the concept of hysteresis? What is the area under a hysteresis cycle?

g) What is node? Describe with neat sketch.

h) Define free vibration, forced vibration and damped vibrations.

i) Explain how the natural frequency of torsional vibration for a two rotor system is obtained?

j) A mass of 12 kg is attached to two springs each of stiffness 4000 N/m and mounted in parallel. What is the natural frequency of the system?

Q2 **a)** Explain an expression for amplitude of forced vibration. **(5)**

b) What is the static and dynamic coupling? How can you eliminate coupling of the equation of motion? **(5)**

Q3 **a)** A 65 kg industrial sewing machine operates at 125 Hz and has a rotating unbalance of 0.15 kg·m. The machine is mounted on a foundation with a stiffness of $2x10^6$ N/m and a damping ratio of 0.12. Determine the machine's steady amplitude. **(5)**

b) Explain the whirling of shaft **(5)**

Q4 **a)** A 50-kg machine tool is mounted on an elastic foundation that is modeled as a spring and viscous damper in parallel. In order to determine the properties of the foundation, a force with a magnitude of 8000 N is applied to the machine tool at a variety of speeds. It isobserved that the maximum steady-state amplitude is 2.5 mm, which occurs at 35 Hz. Determine the equivalent stiffness and equivalent damping coefficient of the foundation. **(5)**

b) Why can't the concept of logarithmic decrement be used to measure viscous damping ratios greater than or equal to one? Explain. **(5)**

Q5 **a)** Derive the expression for free torsional vibration fixed at one end and carrying a load on the free end. **(5)**

b) A 40 kg pump is to be placed at the midspan of a 2.5-m long steel (E = 200 x10^9 N/m2) beam. The pump is to operate at 3000 rpm. For what values of the cross-sectional moment of inertia will the oscillations of the pump be within 3 Hz of resonance? **(5)**

Q6 **a)** Discuss the effect of inertia of the shaft in longitudinal and transverse vibration. **(5)**

b) Describe the method of finding the natural frequency of torsional vibration for a three rotor system. **(5)**

Q7 A flow-monitoring device of mass 10 kg is to be installed to monitor the flow of a gas in a manufacturing process. Because of the operation of pumps and compressors, the floor of the plant vibrates with amplitude of 4 mm at a frequency of 2500 rpm. Effective operation of the flow-monitoring device requires that its acceleration amplitude be limited to 5g.What is the equivalent stiffness of an isolator with a damping ratio of 0.05 to limit the transmitted acceleration to an acceptable level? What is the maximum displacement of the flow-monitoring device and what is the maximum deformation of the isolator? **(10)**

Q8 **Write short answer on any TWO:** **(5 x 2)**

a) Vibration isolation

b) Accelerometer

c) Orthogonality of mode shapes

d) Transverse vibration of Euler-beams