

C.U.SHAH UNIVERSITY

Summer Examination-2018

Subject Name : Dynamic of Machines

Subject Code : 4TE05DOM1

Branch: B.Tech (Mechanical)

Semester : 5

Date : 31/03/2018

Time : 10:30 To 01:30

Marks : 70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
- (2) Instructions written on main answer book are strictly to be obeyed.
- (3) Draw neat diagrams and figures (if necessary) at right places.
- (4) Assume suitable data if needed.

Q-1 Attempt the following questions: (14)

- a) Elastomeric foam used as a sound absorber is made of _____
(A) Non-porous material (B) Porous material (C) Perforated material (D) Resonator
- b) A vibrating machine of 100 kg is mounted on a rubber pad which has stiffness of 500 N/m. Determine force transmitted to the foundation if the unbalanced force 500 N acts on it. The frequency ratio (ω/ω_n) is 1.5 and $\xi = 0.5$
(A) 461.62 N (B) 400.23 N (C) 450 N (D) Insufficient data
- c) Which type of instruments do not require separate power source for measuring vibratory response of a vibratory system?
(A) Active instruments (B) Passive instruments
(C) Both a. and b. (D) None of the above
- d) Calculate critical speed of a vehicle which moves on a road having sinusoidal profile of wavelength 2.5 m. The mass of the vehicle is 300 kg and natural frequency of its spring suspension system is 8 rad/sec
(A) 4.15 m/sec (B) 3.18 m/sec (C) 2.36 m/sec (D) None of the above
- e) Which type of vibrations are also known as transient vibrations?
(A) Undamped vibrations (B) Damped vibrations
(C) Torsional vibrations (D) Transverse vibrations
- f) Which of the following relations is true when springs are connected parallelly?
where K = spring stiffness
(A) $K_e = K_1 + K_2$ (B) $(1 / K_e) = (1/K_1) + (1/ K_2)$
(C) $K_e = (1/K_1) + (1/ K_2)$ (D) None of the above
- g) The unbalanced primary couple caused due to reciprocating mass of each cylinder is given as
(A) $mrl\omega^2 \cos \theta$ (B) $mrl\omega (\cos \theta / n)$ (C) $mrl\omega^2 \cos 2\theta$ (D) $mr\omega^2 \cos 2\theta$
- h) What will be the sound power level, if a machine generates 20 W power?
(A) 124 dB (B) 133 dB (C) 150 dB (D) 200 dB
- i) The noise level generated by domestic air conditioner ranges between _____
(A) 38 dB to 70 dB (B) 35 dB to 52 dB (C) 62 dB to 88 dB (D) 50 dB to 60 dB
- j) Which among the following is the value of static deflection (δ) for a fixed beam with central point load?
(A) $(Wl^3)/(192 EI)$ (B) $(Wl^2)/(192 EI)$



- (C) $(Wl^3)/(384 EI)$ (D) None of the above
- k) Which of the following factors are not responsible for unbalancing in rotating systems?
 (A) Errors (B) Tolerances (C) Shape of the rotor (D) None of the above
- l) At which angle primary unbalanced force in reciprocating engine mechanism is maximum?
 (A) 0° (B) 90° (C) 360° (D) All of the above
- m) Which of the following is a type of untuned vibration absorber?
 (A) Houdaille damper (B) Torsional vibration absorber
 (C) Centrifugal pendulum absorber (D) All of the above
- n) Which of the following vibrometers have frequency ratio $(\omega/\omega_n) \ll 1$?
 (A) Accelerometers (B) Velometers (C) Both a. and b. (D) None of the above

Attempt any four questions from Q-2 to Q-8

Q-2 Attempt all questions

- (a) What are different approaches to get equations of motion of a vibratory system? (7)
 Explain any one in brief.
- (b) Discuss different cases showing the characteristics of the system performance for a damped free vibration. (7)

Q-3 Attempt all questions

- (a) Derive an expression for the response of a rotating unbalance system. Plot the amplitude frequency response curves for different damping factors. (7)
- (b) Explain Accelerometer and frequency measuring instruments. (7)

Q-4 Attempt all questions

- (a) Derive the expression for naturally frequency for free vibration using equilibrium and energy method. (7)
- (b) Write a short note on vibration isolation. (7)

Q-5 Attempt all questions

- (a) Explain the term half frequency whirl, Derive the expression for it. (3)
- (b) Explain Rayleigh's method for finding the natural frequency of vibratory system. (4)
- (c) Explain the term Whirling speed of a shaft. Prove that the Whirling speed for a rotating shaft is same as frequency of natural transverse vibrations. (7)

Q-6 Attempt all questions

- (a) What do you mean by vibration monitoring of machine? Explain various types of vibration monitoring techniques. (7)
- (b) Four masses m_1, m_2, m_3 and m_4 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 angles between successive masses are $45^\circ, 75^\circ$ and 135° . Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. (7)



Q-7 Attempt all questions

- (a) Explain Holzer's method to determine natural frequencies of multi-rotor system. (7)
- (b) The following data refer to two cylinder locomotive with cranks at 90° : (7)
- Reciprocating mass per cylinder = 300 kg ; Crank radius = 0.3 m ; Driving wheel diameter = 1.8 m ; Distance between cylinder centre lines = 0.65 m ; Distance between the driving wheel central planes = 1.55 m.
- Determine:
1. The fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 km. p.h. ;
 2. The variation in tractive effort ; and
 3. The maximum swaying couple.

Q-8 Attempt all questions

- (a) Explain the method to determine the critical speed of shaft carrying single rotor, considering damping. (7)
- (b) A single cylinder oil engine drives directly a centrifugal pump. The rotating mass of the engine, flywheel and the pump with the shaft is equivalent to a three rotor system as shown in figure. (7)
- The mass moment of inertia of the rotors A, B and C are 0.15, 0.3 and 0.09 $\text{kg}\cdot\text{m}^2$. Find the natural frequency of the torsional vibration. The modulus of rigidity for the shaft material is 84 kN/mm^2 .

