Hall Ticket No | | | | | | | | | | |  Question Paper Code: BCC213

# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**

M.Tech II Semester End Examinations (Regular) - July, 2018

**Regulation: IARE–R16**

## STRESS ANALYSIS AND VIBRATION

**Time: 3 Hours** **(CAD/CAM)** **Max Marks: 70**

**Answer ONE Question from each Unit**
**All Questions Carry Equal Marks**
**All parts of the question must be answered in one place only**

### UNIT – I

1. (a) Derive compatibility equations of a two dimensional state of strain in rectangular coordinate system. **[7M]**

   (b) A pipe considering as simply supported beam of circular cross-section 50 mm diameter and 10 mm thick is 1000 mm in length. It carries a continuous load of 1000 N throughout the beam. Determine the stresses in the simply supported beam at mid-length. **[7M]**

2. (a) Derive the Lame's equations for a thick cylindrical shell. **[7M]**

   (b) Determine the maximum and minimum hoop stress across the section of a pipe of 400mm internal diameter and 100mm thick, when the pipe contains a fluid at a pressure of 8 N/$mm^2$ . Also sketch the radial pressure distribution and hoop stress distribution across the section . **[7M]**

### UNIT – II

3. (a) Derive the expression which relates maximum shear stress and torsion for thin rectangular plate. **[7M]**

   (b) A shaft is of elliptical cross section having semi-major axis 50mm and semi minor axis 25mm. It is subjected to a torque of 1000 N-m . Determine the maximum shear stress developed in the shaft. **[7M]**

4. (a) Derive the relationship between torque, T, and angle of twist per unit length for a thin wall hollow section. **[7M]**

   (b) Compare the weights per unit length of shafts of circular and elliptic cross-sections when shafts are subjected to the same torsional moment and angle of twist per unit length is same. **[7M]**

### UNIT – III

5. (a) A mass, when suspended by a helical spring , has a natural frequency 125 cycles /minute. Now the spring is cut into two equal halves and the same mass is suspended both halves in parallel. Determine the natural frequency of the new system. **[7M]**

   (b) For the system ,let K=10,000 N/m, M=0.633 kg,$x_o$=0.1m, $v_o$=10 m/s and the damping ratio $\zeta$ =0.05.Compute the ratio of the damped to the un damped natural frequency for damping ratios of (i) 5%, (ii) 10% and (iii) 20% of the critical damping. **[7M]**

6. (a) Derive an expression for the magnification factor for a spring - mass- damper system subjected to external excitation. Draw the curve between magnification factor and ratio of frequencies of system and natural frequency. **[7M]**

   (b) A machine part of mass 5Kg vibrates in a viscous medium. A harmonic exiting force of 36N acts on the part and causes resonant amplitude of 15mm with a period of 0.32 sec. Find the damping coefficient if the frequency of the exciting force is changed to 4Hz. Determine the increase in the amplitude of forced vibration upon removal of the damper. **[7M]**

## UNIT – IV

7. (a) Determine the response of the overdamped, single-degree-of freedom spring mass system ($\zeta$>1)using any method. **[7M]**

   (b) A single degree of freedom system is subjected to impulsive excitation of 0.5 Ns. Obtain the expression for the response of the system. Use mass of body = 1.5 Kg; c = 0.5 kg/s and stiffness is 5 N/m **[7M]**

8. (a) Explain time domain analysis for random response of single degree of freedom system. **[7M]**

   (b) Differentiate among deterministic and nondeterministic forcing functions. **[7M]**

## UNIT – V

9. (a) Determine the natural frequencies of three-rotor (semi-Definite) system by using Newton's method . **[7M]**

   (b) A stepped shaft at fixed end has 80mm diameter and length 200mm another shaft of diameter 50mm and length 500mm is placed between a rotor and shaft of 80mm. The moment of inertia of disc is 100 N/$s^2$. Determine the natural frequency for torsional vibration of the system **[7M]**

10. (a) Derive the mode shape equation of the transverse vibrations of beams. **[7M]**

    (b) Derive the frequency equation of a uniform beam fixed at one end and free at the other end for transverse vibrations. **[7M]**

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