ADAMAS UNIVERSITY

END-SEMESTER EXAMINATION (JULY 2020)

(Academic Session: 2019 – 20, Semester Term: Jan. 2020 – May 2020)

Name of the Program: M.Tech
Stream: ME
Semester: II

PAPER TITLE: ADVANCED MECANICS OF SOLIDS
PAPER CODE: EME61102

Maximum Marks: 40
Time duration: 3 hours

Total No of questions: 08
Total No of Pages: 02

Instruction to the candidate:

1) At top sheet, clearly mention Name, University Roll No, Enrolment No, Paper Name & Code, Date of Exam.
2) All parts of a Question should be answered consecutively. Each answer should start from a fresh page.
3) Assumptions made if any, should be started clearly at the beginning of your answer.

Answer all the Groups

Group A

(Answer all the questions)

$5 \times 1 = 5$

1. **a)** What is the meant by stress deviator?
b) Write down the bending equation?
c) What is the expression of green Lagrange strain tensor for Cartesian coordinate system.
d) How many elements is present in three-dimensional state of stress matrix.
e) Describe the curvilinear coordinate system for strain displacement analysis.

Group B

(Answer any three questions)

2. The state of stress at a point is characterized by the components σ_x=100MPa, σ_y= -40MPa, σ_z=80MPa, $\zeta_{xy}=\zeta_{yz}=\zeta_{zx}=0$. Determine the extreme value of the shear stresses and their associated normal stresses, the Octahedral shear stress and its associated normal Stress. (5)

3. Write a short note on the followings- Plane state of stress, Octahedral Stress. (5)

4. What are Stress Invariants? Derive the equation of $\zeta = {}^{+}- (1/\sqrt{9}) \sqrt{(2I_1{}^2 — 6I_2)}$ for Octahedral plane. (2+3)

5. If the rectangular components of stress at a point are the same as the matrix shown below. Determine the unit normal of the plane parallel to the Z axis i.e $n_z=0$ on which the resultant stress vector is tangential to the plane $[\zeta_{ij}] .= \begin{vmatrix} a & 0 & d \\ c & b & e \\ d & e & c \end{vmatrix}$ (5)

Group C

(Answer any two questions)

$2 \times 10 = 20$

6. Derive the equation of equilibrium for Cartesian Coordinate System in plane state of stress condition. (10)

7. a) Draw the stress strain diagram of mild steel and indicate the engineering stress and true stress point. (3)
   b) The state of stress at a point in a body is given by the matrix,
   $[\zeta_{ij}]= \begin{vmatrix} 1 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{vmatrix}$
   Find the normal and shear stress on a plane. Where, $n_x=2/\sqrt{6}$, $n_y=1/\sqrt{6}$, $n_z= -1/\sqrt{6}$ (7)

8. a) Considering a tetrahedron derive Cauchy's stress formula with application of any body-force. (5)
   b) Derive the Compatibility equation for any displacement field. (5)

ADAMAS UNIVERSITY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: M. Tech
Stream: ME
PAPER TITLE: Advanced Finite Element Method
Maximum Marks: 40
Total No of questions: 8

Semester: II
PAPER CODE: EME61104
Time duration: 3 Hours
Total No of Pages: 02

Instruction to the Candidate:
1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

Answer all the Groups

Group A

Answer all the questions of the following $5 \times 1 = 5$

1. **a)** What is DOF?
b) What is CST element?
c) When an element will be considered as super parametric?
d) What is meant by discretization and assemblage?
e) During discretization, mention the places where it is necessary to place a node**?**

GROUP –B
(Short Answer Type Questions)

Answer *any three* of the following $3 \times 5 = 15$

2. The circular rod has an outside diameter of 60 mm, length of 1 m, and is perfectly insulated on its circumference. The left half of the cylinder is aluminum, for which k_x = 200 W/m-°C and the right half is copper having k_x = 389 W/m-°C. The extreme right end of the cylinder is maintained at a temperature of 80°C, while the left end is subjected to a heat input rate 4000 W/m^2. Using four equal-length elements, determine the steady-state temperature distribution in the cylinder.

3. Derive the stiffness matrix for an element in the form $K = [B]^T T [B] dv$. Show that the above matrix is symmetric.

4. Apply Castigliano's first theorem to the system of four spring elements depicted in Figure- 1 to obtain the system stiffness matrix. The vertical members at nodes 2 and 3 are to be considered rigid. Solve for the displacements and the reaction force at node 1 if k_1 = 4 N/mm k_2 = 6 N/mm K_3 = 3 N/mm, $F_2 = -30$ N, $F_3 = 0$N, $F_4 = 50$ N.

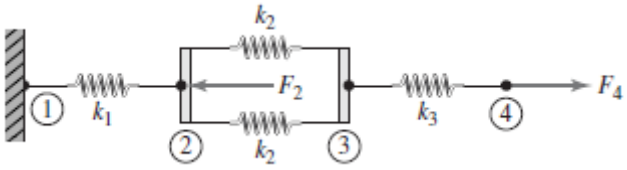


Figure 1

5. Derive the finite element formulation for bar element using Galerkin's method.

GROUP –C
(**Long Answer Type Questions**)

Answer *any two* of the following $2 \times 10 = 20$

6. Derive Stress-Strain relationship for an isotropic material for 3D element.

7. Derive the element matrices, using Galerkin method for heat conduction in one dimensional element with heat generation Q.

8. Determine the finite element formulation for truss element.

ADAMAS UNIVERSITY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: M. Tech
Stream: ME
PAPER TITLE: **Advanced Thermodynamics**
Maximum Marks: 40
Total No of questions: 08

Semester: II
PAPER CODE: EME61106
Time duration: 3 Hours
Total No of Pages: 02

Instruction to the Candidate:
1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

Answer all the Groups

Group A

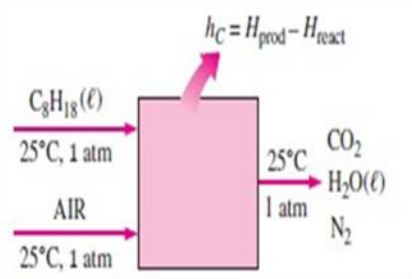
Answer all the questions of the following $5 \times 1 = 5$

1. **a)** A 250L rigid tank contains methane at 1500 kPa, 500 K. It is now cooled down to 300K. Find the heat transfer.
   b) A piston cylinder contains 3kg of air at 20°C and 300 kPa. It is now heated up in a constant pressure process to 600 K. Find the heat transfer
   c) Define Mach Number.
   d) Where the Leidenforst point can be found in a boiling curve?
   e) What is the maximum heat transfer rate in a modern boiler?

GROUP –B
(Short Answer Type Questions)
Answer *any three* of the following $3 \times 5 = 15$

2. Do the qualitative classification of flow regime of two-phase flow. [5]
3. Determine the enthalpy of combustion of liquid octane at 25^0C and 1 atm. [5]

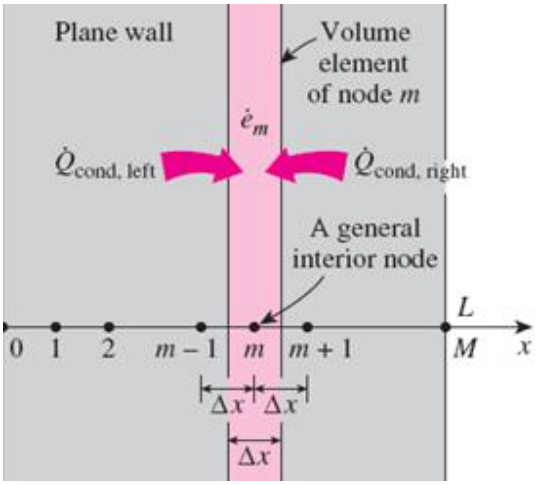
Given Properties: ***Properties*** The enthalpy of formation at 25°C and 1 atm is −393,520 kJ/kmol for CO_2, −285,830 kJ/kmol for $H_2O(\ell)$, and −249,950 kJ/kmol for $C_8H_{18}(\ell)$ (Table A–26).



4. Define Enthalpy of reaction h_R , Enthalpy of combustion h_C and The enthalpy of formation h_f [5]
5. Draw the Pool Boiling Curve of water at atmospheric pressure on a flat plate and explain. [5]

GROUP –C
(**Long Answer Type Questions**)
Answer *any two* of the following $2 \times 10 = 20$

6. Formulate the equation for the node 'm' using FDM of this given problem.



7. a) A coal sample gave the following analysis by weight, Carbon 85 per cent, Hydrogen 6 per cent, Oxygen 6 per cent, the remainder being incombustible. Determine minimum weight of air required per kg of coal for chemically correct composition. [4]

b) The percentage composition of sample of liquid fuel by weight is, C = 84.8 per cent, and H2 = 15.2 per cent. Calculate (i) the weight of air needed for the combustion of 1 kg of fuel ; (ii) the volumetric composition of the products of combustion if 15 per cent excess air is supplied. [6]

8. By explaining the Dulong's formula show how bomb calorimeter is used to find out the calorific value of fuel. [10]

ADAMAS UNIVERSITY

END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: M.Tech. Semester : II
Paper Title : Vibration of Structures **Paper Code : EME61112**
Maximum Marks : 40 Time duration : 3 hrs
Total No of questions : 08 Total No of Pages: 02

Answer all the Groups

Group A

Answer all the questions of the following **$5 \times 1 = 5$**

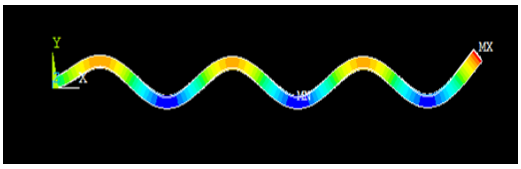
1. **a)** For a system with Potential Energy given by $V = \frac{1}{2}K_1X_1^2 + \frac{1}{2}K_1K_2X_1X_2 + \frac{1}{2}K_2X_2^2$. Determine the stiffness matrix $[K]$.

b) Identify the object shown in the figure and mention its function.

c) It is required to control vibrations of rotating machinery operating at a speed of 60000 rpm. Identify the system parameter for vibration control if the natural frequency of the system consisting of the machine and the support is 100 Hz.

d) Piezoelectric accelerometers are preferred over seismic accelerometers. Justify.

e) Mode shape of transverse vibration of a cantilever beam is shown in the figure. Mention the order of the mode and the number of nodes.



GROUP –B

(Short Answer Type Questions)

Answer *any three* of the following **$3 \times 5 = 15$**

2. A 50-kg mass is subjected to the harmonic force given by F(t) =1000 cos (120t) N. Design an undamped isolator so that the force transmitted to the base does not exceed 5% of the applied force. Also, find the displacement amplitude of the mass of the system with isolation.

3. A vibrometer having a natural frequency of 4 rad/s and damping ratio of 0.2 is attached to a structure that performs a harmonic motion. If the difference between the maximum and the minimum recorded values is 8 mm, find the amplitude of motion of the vibrating structure when its frequency is 40 rad/s.

4. Draw the frequency spectrum corresponding to a time domain signal consisting of three harmonics at frequencies 1 Hz, 10 Hz and 100 Hz. The corresponding amplitudes are 1g, 3g and 2g, respectively, where 'g' is equal to 9.8 m/s^2. Also mention the RMS amplitude at each frequency.

5. The Dynamic matrix [D] of a 2DOF system is given by

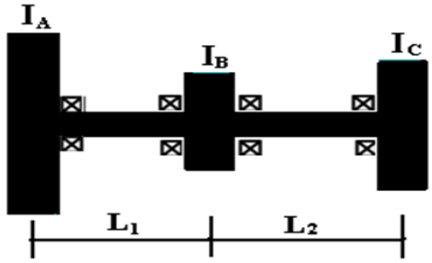
$$\begin{bmatrix} 3K/4M & -KL/4M \\ -12K/4ML & 5K/4M \end{bmatrix}$$

Find out the natural frequencies of the system.

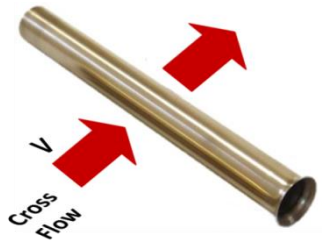
GROUP –C
(Long Answer Type Questions)

Answer *any two* of the following $\mathbf{2 \times 10 = 20}$

6. Determine the natural frequencies of torsional vibration for the three rotor system. The shaft has a moment of inertia J=2.5x10^{-6} m^4, and modulus of rigidity G=85 GPa. I_A=0.2 kg-m^2, I_B=0.1 kg-m^2, I_C=0.15 kg-m^2, L_1=1 m, L_2=1 m.



7. Hot oil flows across the metal tube of diameter 20 mm as shown in the figure. The oil has a density of 800 kg/m^3 and a kinematic viscosity of 10^{-5} m^2/s. The flow Reynolds number is 1300. If the natural frequency of the tube is 50 Hz, predict the chances of resonant vibration of the tube due to vortex shedding.



8. Compute the first three natural frequencies of the transverse vibrations of a uniform cantilever beam of rectangular cross section (width = 500 mm, thickness = 100 mm) with L = 2 m, E = 20.5x10^{10} N/m^2, and ρ = 7.8x10^3 kg/m^3. Also illustrate the corresponding mode shapes.

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: M. Tech
Stream: ME
PAPER TITLE: Gas turbine and Jet propulsion
Maximum Marks: 40
Total No of questions: 08

Semester: II
PAPER CODE: EME61118
Time duration: 3 hours
Total No of Pages: 02

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
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Answer all the Groups

Group A

Answer all the questions of the following $5 \times 1 = 5$

1. **a)** What do you mean by compression ratio? What is the range of compression ratio in a gas turbine engine?

b) Explain the air-fuel ratio with context to aircraft engine.

c) How will you calculate propulsive efficiency in gas turbine engine?

d) What do you mean to bypass ratio?

e) Airplane fly at high altitudes for long flight, why?

GROUP –B
(Short Answer Type Questions)

Answer *any three* of the following $3 \times 5 = 15$

2. A gas turbine expands 4 Kg/s of air from 12 bar and $900^0 C$ to 1 bar adiabatically with an isentropic efficiency of 87 %. Calculate the exhaust temperature and the power and isentropic efficiency of 87%. Calculate the exhaust temperature and the power output.
Take $\gamma = 1.4, C_p = 1005 J / KgK.$

3. Show classification of Rocket engine. Also mention application areas of Rocket engine.

4. What are the various ways to improve the performance of a gas turbine engine? Explain with necessary sketch.

5. Discuss fatigue induced problems in a gas turbine for aeroengine application.

GROUP –C

(**Long Answer Type Questions**)

Answer *any two* of the following $\mathbf{2 \times 10 = 20}$

6. Present a report on Chandrayann-2 indicating all its main features with context jet propulsion.

7. Explain the working of Turboprop and Turbofan engine with neat sketch. Also differentiate between Turboprop and Turbofan.

8. Explain the combustion process of gas turbine engine with neat sketch. Clearly explain primary, secondary and tertiary zone of combustion process.