

Assignment 6

EE24BTECH11049
Patnam Shariq Faraz Muhammed

1 CARRY ONE MARK EACH

- 1) Which one of the options given represents the feasible region of the linear programming model:

$$\text{Maximize } 45X_1 + 60X_2$$

$$X_1 \leq 45$$

$$X_2 \leq 50$$

$$10X_1 + 10X_2 \geq 600$$

$$25X_1 + 5X_2 \leq 750$$

- a) Region P
 - b) Region Q
 - c) Region R
 - d) Region S
- 2) A cuboidal part has to be accurately positioned first, arresting six degrees of freedom and then clamped in a fixture, to be used for machining. Locating pins in the form of cylinders with hemi-spherical tips are to be placed on the fixture for positioning. Four different configurations of locating pins are proposed as shown. Which one of the options given is correct?
- a) Configuration P_1 arrests 6 degrees of freedom, while Configurations P_2 and P_4 are over-constrained and Configuration P_3 is under-constrained.
 - b) Configuration P_2 arrests 6 degrees of freedom, while Configurations P_1 and P_3 are over-constrained and Configuration P_4 is under-constrained.
 - c) Configuration P_3 arrests 6 degrees of freedom, while Configurations P_2 and P_4 are over-constrained and Configuration P_1 is under-constrained.
 - d) Configuration P_4 arrests 6 degrees of freedom, while Configurations P_1 and P_3 are over-constrained and Configuration P_2 is under-constrained.
- 3) The effective stiffness of a cantilever beam of length L and flexural rigidity EI subjected to a transverse tip load W is
- a) $\frac{3EI}{L^3}$
 - b) $\frac{2EI}{L^3}$
 - c) $\frac{EI}{L^3}$
 - d) $\frac{EI}{3L^3}$
- 4) The options show frames consisting of rigid bars connected by pin joints. Which one of the frames is non-rigid?
- a) figs

- 5) The $S - N$ curve from a fatigue test for steel is shown. Which one of the options gives the endurance limit?
- S_{ut}
 - S_2
 - S_3
 - S_4

- 6) Air (density = $1.2 \frac{kg}{m^3}$, kinematic viscosity = $1.5 \times 10^{-5} \frac{m^2}{s}$) flows over a flat plate with a free-stream velocity of $2 \frac{m}{s}$. The wall shear stress at a location 15 mm from the leading edge is τ_w . What is the wall shear stress at a location 30 mm from the leading edge?

- $\frac{\tau_w}{2}$
- $\sqrt{2}\tau_w$
- $2\tau_w$
- $\frac{\tau_w}{\sqrt{2}}$

- 7) Consider an isentropic flow of air (ratio of specific heats = 1.4) through a duct as shown in the figure.

The variations in the flow across the cross-section are negligible. The flow conditions at Location 1 are given as follows:

$$P_1 = 100 \text{ kPa}, \rho_1 = 1.2 \frac{kg}{m^3}, u_1 = 400 \frac{m}{s}$$

The duct cross-sectional area at Location 2 is given by $A_2 = 2A_1$, where A_1 denotes the duct cross-sectional area at Location 1. Which one of the given statements about the velocity u_2 and pressure P_2 at the Location 2 is TRUE?

- $u_2 < u_1, P_2 < P_1$
- $u_2 < u_1, P_2 > P_1$
- $u_2 > u_1, P_2 < P_1$
- $u_2 > u_1, P_2 > P_1$

- 8) Consider incompressible laminar flow of a constant property Newtonian fluid in an isothermal circular tube. The flow is steady with fully-developed temperature and velocity profiles. The Nusselt number for this flow depends on

- neither the Reynolds number nor the Prandtl number
- both the Reynolds and Prandtl numbers
- the Reynolds number but not the Prandtl number
- the Prandtl number but not the Reynolds number

- 9) A heat engine extracts heat (Q_H) from a thermal reservoir at a temperature of 1000 K and rejects heat (Q_L) to a thermal reservoir at a temperature of 100 K , while producing work (W). Which one of the combinations of [Q_H , Q_L and W] given is allowed?

- $Q_H = 2000 \text{ J}, Q_L = 500 \text{ J}, W = 1000 \text{ J}$
- $Q_H = 2000 \text{ J}, Q_L = 750 \text{ J}, W = 1000 \text{ J}$
- $Q_H = 6000 \text{ J}, Q_L = 500 \text{ J}, W = 5500 \text{ J}$
- $Q_H = 6000 \text{ J}, Q_L = 600 \text{ J}, W = 5500 \text{ J}$

- 10) Two surfaces P and Q are to be joined together. In which of the given joining

operation(s), there is no melting of the two surfaces P and Q for creating the joint?

- a) Arc welding
 - b) Brazing
 - c) Adhesive bonding
 - d) Spot welding
- 11) A beam is undergoing pure bending as shown in the figure. The stress (σ)-strain (ϵ) curve for the material is also given. The yield stress of the material is σ_Y . Which of the option(s) given represent(s) the bending stress distribution at cross-section AA after plastic yielding?
- 12) In a metal casting process to manufacture parts, both patterns and moulds provide shape by dictating where the material should or should not go. Which of the option(s) given correctly describe(s) the mould and the pattern?
- a) Mould walls indicate boundaries within which the molten part material is allowed, while pattern walls indicate boundaries of regions where mould material is not allowed.
 - b) Moulds can be used to make patterns.
 - c) Pattern walls indicate boundaries within which the molten part material is allowed, while mould walls indicate boundaries of regions where mould material is not allowed.
 - d) Patterns can be used to make moulds.
- 13) The principal stresses at a point P in a solid are 70MPa , -70MPa and 0. The yield stress of the material is 100MPa . Which prediction(s) about material failure at P is/are CORRECT?
- a) Maximum normal stress theory predicts that the material fails
 - b) Maximum shear stress theory predicts that the material fails
 - c) Maximum normal stress theory predicts that the material does not fail
 - d) Maximum shear stress theory predicts that the material does not fail