جامعة المنوفيه - كلية الهندسة بشبين الكوم
قسم العلوم الأساسية الهندسية
إختبار تأهيلى ماجستير فى الميكانيكا الهندسية
الفصل الدراسي الأول

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الزمن المسموح: ثلاث ساعات

**Answer all the following questions:**

1-1 Define "the tensor quantity" and mention its importance and the fields of its applications. What is the main differerence between tensors and matrices?

1-2 Using the Cartesian and the polar coordinates in plane verify that the conservative force field **F**=ay**i**+ax**j** represents a covariant vector where a is a real constant.

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2-1 Define and classify deformable bodies, body forces, and surface forces with examples.

2-2 At a point in a body the stresses $\tau_{xy}$=14 MPa, $\tau_{xz}$=-28MPa and $\tau_{yz}$=6 Mpa. If the stress resultant at the same point is $\sigma_p$=140 MPa and acts in a dierction making cosine direction angles $\cos\alpha_1=\sqrt{5}/5$ and $\cos\beta_1$=2/5 with x and y axis. Calculate: (i) the normal stress $\sigma_{x'}$ (ii) the resultant shear stress $\tau$ on an oblique plane whose normal makes cosine direction angles $\cos\alpha_2$=1/5, $\cos\beta_2$=2/5 with x and y axis. (iii) the stress components $\sigma_x$ , $\sigma_y$ and $\sigma_z$.

2-3 A circular solid disk rotates with angular velocity $\omega$. If the stresses of the disk are given by the relations: $\sigma_r=A-Br^{-2}$ and $\sigma_\theta=A-Cr^{-2}$ , where A, B, and C are real constants. Assuming the mass density of the disk is $\rho$=unity, and the constants B=4, C=3. Determine the magnitude of the angular velocity $\omega$.

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3-1 Define briefly the three main kinds of infinitismal strains.

3-2 Given the strain field: $u=ax^2y$ and $v=bxy^2$, where a and b are constants, determine: (i) the strain components, (ii) the volumetric strain at point(2,4), (iii) the original displacement field $u^*$ and $v^*$, (iv) show that the two terms $u^*$ and $v^*$ represent rigid-body motion, and find the rotation about z axis.

3-3 A circular disk undergoes a deformation: u=Brcos2$\theta$, v=Ar+Brsin2$\theta$, and w=0, where A and B are positive real constants. Calculate: (i) the locations and the magnitude of the largest positive strains, (ii) the maximum shear strain, (iv) the volumetric strain.

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4-1 Define the strain energy denisty, the dilatation energy and distorsion energy.

4-2 The deformation of a solid is defined by the displacement component $u=3x^2+\sqrt{2}y$, $v=2y^2+3\sqrt{2}x$, w=0. Determine: (i) the principal strains at point (1,1), and (ii) the principal stresses at the same point for $\nu$=1/3.

4-3 A closed thin walled pressure cylinder of mean radius $r_m$=3m, length L=10m, and initial temperature $T_o$=20 °C is used for chemical processing at 320 °C. If the vessel wall thickness is h=24 mm. (i) Determine the diametral expansion and elongation caused by an operating pressure of $p_i$=0.8 Mpa, knowing that this pressure produces hoop stresse $\sigma_\theta=p_ir_m/h$ and axial stress $\sigma_z=p_ir_m/2h$. (ii) What is the strain energy stored in the vessel wall material? Take E=200 GPa, $\nu$=0.3, and $\alpha=11\times10^{-6}$ °C.

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