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## GUJARAT TECHNOLOGICAL UNIVERSITY

P.D.D.C. Sem- I Regular / Remedial Examination January. 2011

## Subject code:X11102 <br> Subject Name: Elements of Mechanical and Structural Engineering

Date: 10 / $01 / 2011$

## Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
Q. 1 (a) Define the following terms

Time: $10.30 \mathrm{am}-01.00 \mathrm{pm}$
Total Marks: 70
i) Power
ii) Heat
iv) Internal energy
v) Enthalpy
iii) Specific heat
vii) Efficiency
(b) State the different types of beam and draw it. State the different type of loads on beam.
Q. 2 (a) Explain the working of Vapour Compression Refrigeration system with line sketch diagram.
(b) A steam turbine is supplied with 1200 kg of steam per min. The steam enters the 07 turbine with velocity of $20 \mathrm{~m} / \mathrm{s}$ and leave it with a velocity of $150 \mathrm{~m} / \mathrm{s}$. During expansion in the turbine there is enthalpy drop of $425 \mathrm{~kJ} / \mathrm{kg}$ of steam. There is a heat loss of $24000 \mathrm{~kJ} / \mathrm{min}$ from the turbine casing to the surrounding. Assuming steady flow conditions determine the power in kW of the turbine.

## OR

(b) An engine operating on Diesel cycle has maximum pressure and temperature of 45 bar and $1500^{\circ} \mathrm{C}$. Pressure and temperature at the beginning of compression are 1 bar and $27^{\circ} \mathrm{C}$. Determine air standard efficiency of the cycle. Take $\gamma=1.4$ for air.
Q. 3 (a) Explain the working of Four stroke Diesel engine with neat sketch.

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(b) Give the classification of Governors. Explain the working of Watt Governor with 07 neat sketch.
Q. 3 (a) Explain the construction and working of Centrifugal pump with neat sketch.07
(b) A single stage, single acting compressor has a bore of 170 mm and stroke of 260 mm . It runs at 130 rpm . The suction pressure is 1 bar and delivery pressure is 9 bar. Find the indicated power if compression i) follows the law $\mathrm{pV}^{1.25}=$ constant and ii) is isothermal. Also find isothermal efficiency. Assume there is no clearance volume.
Q. 4 (a) Define the following terms
i) Stress
ii) Strain
iii) Hardness
iv) Toughness
v) Factor of Safety vi) Proof resilience
vii) Modulus of resilience
(b) Calculate the strain energy stored in a bar 200 cm long, 5 cm wide and 4 cm
Q. 4 (a) A solid shaft is subjected to a torque of 15000 N -m. Find the necessary diameter of the shaft, if the allowable shear stress is $6000 \mathrm{~N} / \mathrm{cm}^{2}$. The allowable twist of $1^{\circ}$ for every 20 diameter length of the shaft.
Take Modulus of rigidity $=0.8 \times 10^{7} \mathrm{~N} / \mathrm{cm}^{2}$.
(b) Explain the different types of stresses with sketch. State Hooke's law and explain in brief.
Q. 5 (a) Two steel plates of uniform cross section $10 \mathrm{~mm} X 85 \mathrm{~mm}$ are welded together. If an axial tensile force of 100 kN is applied to welded plates and inclination of welded joint
$\beta=30^{\circ}$, calculate a) normal stress perpendicular to weld and b) in-plane shear stress parallel to weld.
(b) Find reactions about support A and B for the simply supported beam as shown in figure below.

Q. 5 (a) A 25 mm diameter steel bar of length of 3 m is subjected to an axial pull of 30 kN . If modulus of elasticity in 200 GPa and poisson's ratio 0.25 (i.e. $\mathrm{m}=4$ ), find the change in length, diameter and volume.
(b) An aluminium rod of 20 mm diameter and 1.5 m long is subjected to rise in $\mathbf{0 7}$ temperature by $35^{\circ} \mathrm{C}$. Calculate i) natural expansion ii) if natural expansion is prevented, the stress developed in the bar iii) axial force in the bar.
Take $\mathrm{E}=70 \mathrm{GPa}$
Coefficient of thermal expansion $\alpha=18 \times 10^{-6}$ per ${ }^{\circ} \mathrm{C}$.

