INS - FORMAT-13

CIE (written Test -I) Format (2nd Year)

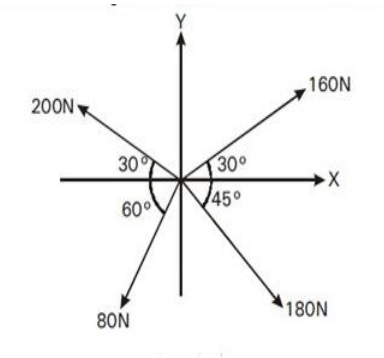
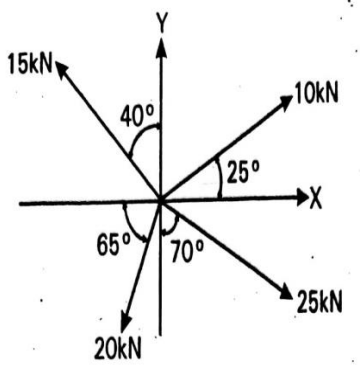
Institution Name: K. S. POLYTECHNIC **Institution Code: 465**

Name of the Program: CIVIL ENGINEERING **Academic year: 2022-23**

Course coordinator: Ramya Shree K K

Course Name	**Engineering . Mechanics. & Strength of materials**	**CIE (written Test)**	**I**	**Sem- III**	**Date 9/11/22**
Course Code	**20CE31P**	**Duration**	**80 min**	**Marks- 30**	
	Note: Answer one full question from each section.				

Section	Assessment Questions	CL	CO	PO	Marks
I	**1.** a) **Define:** Elasticity, Ductility, Plasticity b) **Define:** Stress, Strain, Hook's law **OR** **2.** a) **Define:** Force, Resultant of force , Young's modulus b) **Define:** volumetric strain, Brittle, Hardness	L1	1	1,2,4,7	**3+3=6**
II	**3. Name the types of the force system in each of following cases** a) Rope being pulled on the opposite side by the two people b) Force acting on the moving bus c) Weight of train acting on track when track is not in a straight line **OR** d) Reaction acting on legs of chair, placed on floor e) Force on a rod resting against a wall f) The benches in the class room (whole class)	L2	1	1,2,4,7	**1+1+1=3**
	4. Draw the diagram for the given forces to find out the magnitude and direction 20N towards east, 40N acting at 30º to north of east, 94N towards south, 57N acting south west 382 N acting to north of west 50N at 50º at west of north **OR** 30N towards south 600N in the north west 800N towards east 400N at 40 east of north 1000N at 30º south of west 750N Towards north	L2	1	1,2,4,7	**3+3=6**

III	**5. Determine the resultant of the coplanar forces any one of the following** **a)**  **OR** **b)**  	L3	1	1,2, 4,7	**7.5**
	6 a) The extension in rectangular steel bar of length 400 mm and10 mm thickness, 75mm width is found to be 0.21mm . If E for the bar is $2x10^5$ N/ mm^2 Determine the load on the bar . **OR** **b)** A circular rod of diameter 20mm and 500mm long is subjected to a tensile force of 45KN . the modulus of elasticity for the steel may be taken as200KN/mm^2 Find stress , strain and elongation of the bar due to load. Take Poisson's ratio 0.3	L4	1	1,2,4, 7	**7.5**

Signature of Paper Setter **Scrutinized by HOD** **Approved by IQAC Chairmen** **sig. of principal with seal.**

SCHEME OF VALUATION

SOM 1ST INTERNAL

1 a) Elasticity:

Elasticity: According to dictionary **elasticity** is the ability of an object or material to resume its normal shape after being stretched or compressed

Ductility:

The **ductility is a property of a material** which enables it to be drawn out into a thin wire.

Mild steel, copper, aluminium are the good examples of a ductile material.

Plasticity:

The **plasticity of a material** is its ability to undergo some permanent deformation without rupture(brittle).

Plastic deformation will take place only after the elastic range has been exceeded.

b) stress: the force of resistance per unit area offered by a body against deformation is known as stress.

Stress= applied force/ cross sectional area

Strain: when the body is subjected to external force there will be change in dimension of the body.

Strain= change in dimension of body / original dimension of the body

Hook's law: it states that stress is directly proportional to strain with in the elastic limit.

Stress/strain= a constant

OR

2a) Force : It is an external agency tends to produce or destroy motion. It is a vector quantity and its unit is N.

Resultant Forces : It is a single force which produces the same effect as that of all the given forces.
According to law of moments the algebraic sum of moments due to all forces acting on a body about any point is equal to the moment of their resultant about the same point

Conditions of Equilibrium : It states that the algebraic sum of all the external forces as well as moments about any point in their plane is equal to zero. $\sum V = 0$, $\sum H = 0$ and $\sum M = 0$.

b) VOLUMETRIC STRAIN: the ratio between the change in volume to original volime

Volumetric strain = change in volume/ original volume

Brittleness:

The **brittleness of a property of a material** which enables it to withstand permanent deformation.

Cast iron, glass are examples of brittle materials.

Hardness:

The resistance of a material to force penetration or bending is **hardness**.

The **hardness is the ability of a material** to resist scratching, abrasion, cutting or penetration.

Each definition carry 1marks: 3+3=6

3 a) coplanar concurrent force

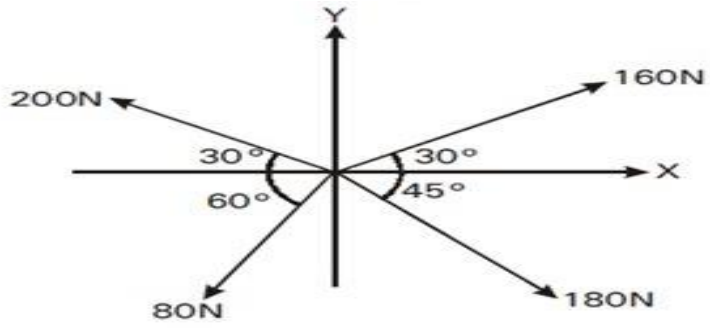
Coplanar force

Coplanar non concurrent force

b)

4. a)

5. a)



Solution:

Summation of horizontal and vertical forces

$$\sum F_x = 160\cos 30^0 - 200\cos 30^0 - 80\cos 60^0 + 180\cos 45^0 = 52.64N(\rightarrow)$$

And

$$\sum F_y = 160\sin 30^0 + 200\sin 30^0 - 80\sin 60^0 - 180\sin 45^0 = -16.56N(\downarrow)$$

Now resultant of the force:

$$R = \sqrt{\left(\sum F_x\right)^2 + \left(\sum F_y\right)^2} = \sqrt{(52.64)^2 + (-16.56)^2} = 55.18N$$

OR

b)

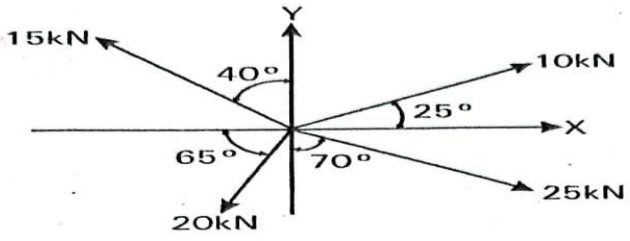


Fig. 1.21

Summation of horizontal and vertical forces

$$\sum F_x = 10\cos 25^0 - 25\sin 70^0 - 20\cos 65^0 - 15\sin 40^0 = -32.52kN(\leftarrow)$$

and

$$\sum F_y = 10\sin 25^0 - 25\cos 70^0 - 20\sin 65^0 + 15\cos 40^0 = -10.95kN(\downarrow)$$

Now resultant of the force:

$$R = \sqrt{\left(\sum F_x\right)^2 + \left(\sum F_y\right)^2} = \sqrt{(-32.52)^2 + (-10.95)^2} = 34.31kN$$

$$\tan\theta = \frac{\sum F_y}{\sum F_x} = \frac{10.95}{32.52} = 0.33$$

$$\theta = \tan^{-1}(0.33) = 18.26^0$$

6.a)

Solution:

Given: $t = 10\text{mm}, b = 75\text{mm}, l = 400\text{mm}, E = 2\times10^5\ \text{N/mm}^2,\ \delta l = 0.21mm$

Area, $A = b\times t = 75\times10 = 750mm^2$

Elongation, $\delta l = \dfrac{PL}{AE}$

Load, $P = \dfrac{AE\delta l}{L} = \dfrac{750\times2\times10^5\times0.21}{400} = 78750N = 78.75kN$

OR

b)

Given:

$d = 20\text{mm}, l = 500\text{mm}, P = 45\text{kN} = 45000\text{N}, E = 200kN/mm^2 = 200\times10^3\ N/mm^2, 1/\text{m} = 0.3$

Area, $A = \dfrac{\pi d^2}{4} = \dfrac{\pi\times20^2}{4} = 314.2mm^2$;

$\therefore$ Stress, $\sigma = \dfrac{P}{A} = \dfrac{45000}{314.2} = 143.22N/mm^2$

Elastic modulus, $E = \dfrac{\sigma}{\varepsilon}$; $\therefore$ Linear Strain, $\varepsilon = \dfrac{\sigma}{E} = \dfrac{143.22}{200\times10^3} = 0.71\times10^{-3}$

Also, Strain, $\varepsilon = \dfrac{\delta l}{l}$; $\therefore$ Elongation, $\delta l = \varepsilon\times l = 0.71\times10^{-3}\times500 = 0.355mm$

Change in volume

Volumetric strain, $\varepsilon_v = \varepsilon\left(1-\dfrac{2}{m}\right) = 0.71\times10^{-3}(1-2\times0.3) = 0.28\times10^{-3}$

Volume, $v = A\times l = 314.2\times500 = 157100mm^3$; Also, Volumetric strain, $\varepsilon_v = \dfrac{\delta v}{v}$

$\therefore$ Change in volume, $\delta v = \varepsilon_v\times v = 0.28\times10^3\times157100 = 43.99mm^3$