

Shree Datta S.S.S.K. Ltd. Charitable Trust's
SHREE DATTA POLYTECHNIC COLLEGE, DATTANAGAR

Class test No -1

Course Name: **ME/CE/EE (2G)**
Subject: **Engineering Mechanics**
Marks: **25**
Institute Code: **1512**

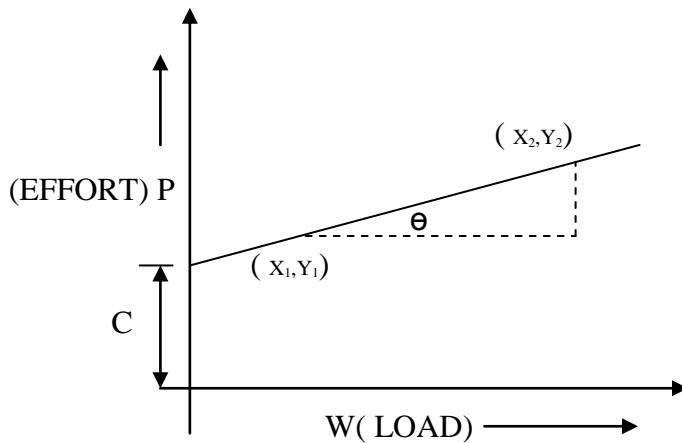
Semester: **2nd**
Subject Code: **17204**
Date: **25/01/2014**
Duration: - **1 hours**

Instruction:

1. All questions are compulsory.
2. Illustrate your answers with neat sketches whenever necessary.
3. Assume suitable data if necessary.
4. Use of pocket calculator is permissible.

MODEL ANSWER

Q.1 Answer any three of the following	3X3=09	MARK
<p>a) Define:-</p> <p>i) Efficiency:- The efficiency of a machine is the ratio of output to input of a machine and it generally expressed as a percentage.</p> $\eta = \frac{\text{M. A.}}{\text{V. R.}} \times 100$ <p style="text-align: center;">OR</p> $\eta = \frac{\text{OUTPUT}}{\text{INPUT}} \times 100$		1
<p>ii) Load:- The weight to be lifted is known as load.</p> <p>Effort :- The force applied to lift the load is known as effort.</p>		1
<p>iii) Mechanical Advantage:- It is the ratio of load lifted by machine to the effort applied to lift the load.</p>		1
<p>b) What is the law machine? Write Expression for law of machine with neat sketch.</p> <p>Law of machine:- The equation which gives relation between load lifted and effort applied in the form of slope, and intercept of a straight line is called as Law of machine.</p>		1



1

The law of machine is $P = mW + C$

Where P = Effort applied

m = Slope of line

W = Load lifted

C = Y- intercept

= Effort lost in friction when no load is applied.

1

$$m = \tan \theta = \frac{Y_2 - Y_1}{X_2 - X_1}$$

For getting this relation, effort is applied on a machine and corresponding values of loads are noted down.

Then graph of load against effort is plotted by taking load on x axis and effort on y axis.

The graph is straight line cuts the y axis giving the intercept 'C' which indicate the effort lost in friction when no load is lifted.

c) Define Force and write its S.I. unit.

Force:- an external agency either push or pull which tends to change the state of rest or uniform motion of a body, upon which it acts.

The SI unit of force is N or KN.

2

1

d) Define:- i) Engineering Mechanics ii) Statics iii) Dynamics

- i) **Engineering Mechanics:-** it is a branch of science which deals with study of forces and their effects on a body in motion or at rest. 1
- ii) **Statics:-** it is branch of applied mechanics which deals with action of forces on the body at rest. 1
- iii) **Dynamics:-** it is branch of applied mechanics which deals with action of forces on the body in motion. 1

Q. 2 Answer any two of the following. 4X2=08

- a) **A machine lifts a load of 400N and 600N by efforts of 60N and 80N respectively. Find law of machine and efficiency at a load of 800N if V.R. is 22.**

Solution:-

Given:- $W_1 = 400 \text{ N}$
 $W_2 = 600 \text{ N}$
 $P_1 = 60 \text{ N}$
 $P_2 = 80 \text{ N}$
 $W_3 = 800 \text{ N}$
 $V.R. = 22$

To find:- 1. Law of machine.
2. Efficiency at load of 800N.

We know that law of machine $P = mW + C$

$$60 = 400 m + C \dots\dots\dots \text{eq 1.} \quad 1$$

$$80 = 600m + C \dots\dots\dots \text{eq 2.}$$

Subtract equation 1 from 2

$$\text{We get } m = 0.1 \quad 1$$

Put value of m in eq 1.

$$\text{We get } C = 20 \quad 1$$

There for law of machine is $P = (0.1 W + 20) \text{ N}$.

$$\text{Efficiency } \eta = \frac{MA}{VR}$$

$$\text{Mechanical Advantage} = \frac{W}{P}$$

$$\text{Mechanical Advantage} = 8$$

$$\text{Efficiency} = \frac{8}{22} \times 100$$

$$\text{Efficiency } \eta = 36.36 \%$$

b) A screw jack lifts a load of 30KN with an effort of 400N with the length of handle of 60cm. if the pitch of screw is 15mm, calculate V.R., M.A. and Efficiency of the machine and state the type of machine.

Solution:-

Given:- Simple screw jack.

$$W = 30 \text{ KN}$$

$$= 30000 \text{ N}$$

$$P = 400 \text{ N}$$

$$L = 60 \text{ cm}$$

$$= 600 \text{ mm}$$

$$\text{Pitch} = 15 \text{ mm}$$

To find:- 1. V.R. = ?

2. M. A.=?

3. Efficiency = ?

4. Type of machine=?

$$\text{Velocity Ratio} = \frac{2 \pi l}{P}$$

$$= \frac{2 \times \pi \times 600}{15}$$
$$= 251.33$$

$$\text{Mechanical Advantage} = \frac{W}{P}$$

1

1

$$\text{Mechanical Advantage} = \frac{30000}{400}$$

$$\text{Mechanical Advantage} = 75.00$$

$$\text{Efficiency } \eta = \frac{\text{MA}}{\text{VR}} \times 100$$

$$= \frac{75}{251.33} \times 100$$

$$\text{Efficiency } \eta = 29.84\%$$

Type of machine:- Machine is nonreversible..... Efficiency $\eta < 50\%$

- c) In a double purchase crab, the two pinions have 12 teeth each and two spur wheels have 72 teeth each. The diameter of load drum is 22cm and that of the effort wheel is 65cm. find the velocity ratio.

Solution:-

Given:- Double purchase crab.

$$T_2 = T_4 = 12 \text{ Nos.}$$

$$T_1 = T_3 = 72 \text{ Nos.}$$

$$d = 22 \text{ cm}$$

$$D = 65 \text{ cm}$$

To find:- 1. V.R. = ?

$$\text{V.R.} = \frac{D}{d} \times \frac{T_1}{T_2} \times \frac{T_3}{T_4}$$

$$\text{V.R.} = \frac{65}{22} \times \frac{72}{12} \times \frac{72}{12}$$

$$\text{V.R.} = 106.36$$

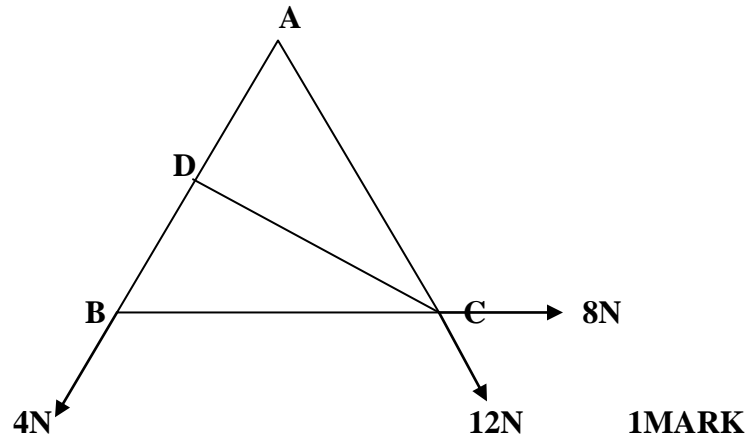
Q. 3 Answer any two of the following

4X2=08

- a) Three forces 4N, 8N and 12N are acting along sides of triangle AB, BC and AC respectively. Calculate the moments of all forces about the point C if AB=BC=AC=0.8m

Solution:-

Given:- AB=BC=AC=0.8m



To find moment about point 'C'.

Since line of action of forces **8N** and **12N** are passing through point C **their moments about point C is equal to zero**

Therefore only find out moment of 4N force about 'C'
To find distance 'CD'

ΔABC is equilateral triangle hence $AD=DB=0.4m$

ΔADC from Pythagoras theorem

$$AC^2 = CD^2 + AD^2$$

$$0.8^2 = CD^2 + 0.4^2$$

$$CD^2 = 0.8^2 - 0.4^2$$

$$CD = 0.693m$$

2MARK

Moment about point 'C' = -F * CD (-ve because anticlockwise moment)
= -4 * 0.693

Moment about point 'C' = -2.772N.m

1MARK

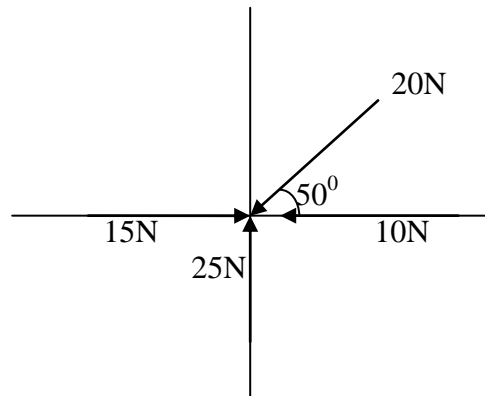
Or

Moment about point 'C' = 2.772N.m (if orientation of triangle is taken in clockwise direction)

b) The four forces 10N, 20N, 15N and 25N are acting on a point (all push type) at 0° , 50° , 180° and 270° respectively. Calculate the two rectangular components of each.

Solution:-

Given:-



For 10N Force

$$F=10\text{N}$$

$$\Theta=0^\circ$$

$$F_x = -F \cos \Theta$$

$$= -10 \cos 0^\circ$$

$$= -10\text{N}$$

$$F_y = F \sin \Theta$$

$$= 10 \sin 0^\circ$$

$$= 0\text{N}$$

1MARK

For 20N Force

$$F=20\text{N}$$

$$\Theta=50^\circ$$

$$F_x = -F \cos \Theta$$

$$= -20 \cos 50^\circ$$

$$= -12.86\text{N}$$

$$F_y = -F \sin \Theta$$

$$= -20 \sin 50^\circ$$

$$= -15.32\text{N}$$

1MARK

For 15N Force

$$F=15\text{N}$$

$$\Theta=180^\circ - 180^\circ = 0^\circ$$

$$F_x = F \cos \Theta$$

$$= 15 \cos 0^\circ$$

$$= 15\text{N}$$

$$F_y = F \sin \Theta$$

$$= 15 \sin 0^\circ$$

$$= 0\text{N}$$

1MARK

For 25N Force

$$F=25\text{N}$$

$$\Theta=270^{\circ}-180^{\circ}=90^{\circ}$$

$$F_x=F \cos \Theta$$

$$=25\cos 90^{\circ}$$

$$=0 \text{ N}$$

$$F_y=F \sin \Theta$$

$$=25\sin 90^{\circ}$$

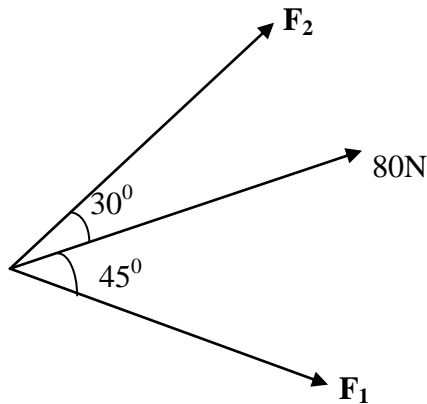
$$=25 \text{ N}$$

1MARK

c) A force of 80N is acting on a body. Find its components such that one component has an angle of 45° and the other has an angle of 30° with the force of 80N.

Solution:-

Given:-



$$F_1 = \frac{F \sin \theta_2}{\sin(\theta_1 + \theta_2)}$$

1MARK

$$F_1 = \frac{80 \sin 30^{\circ}}{\sin(45^{\circ} + 30^{\circ})}$$

$$F_1 = 41.41 \text{ N}$$

1MARK

$$F_2 = \frac{F \sin \theta_1}{\sin(\theta_1 + \theta_2)}$$

1MARK

$$F_2 = \frac{80 \sin 45^{\circ}}{\sin(45^{\circ} + 30^{\circ})}$$

$$F_2 = 58.56 \text{ N}$$

1MARK

