## **ENGINEERING MECHANICS**

## **METALLUGRY ENGG.**

1<sup>st</sup> SE

## Under SCTE&VT,Odisha

## PREPARED BY



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- Mechanics

Engineering mechanics is the branch of science which leaks with the laws and principles of mechanics, alongwith their applications to enginnesing problems .... al man alexisting

into sollowing two types. \* 9P is classified (1) static En 17 Physic Jos p. 4 (1) Dynamic

「アドリー」「「いいはかいいたい」

Ustatics-

Of is the branch of Engineering meeting nics, which deals with the forces and their essects while acting upon abodies at sest. publicast ph about in appretion installes (Dynamics :- Distillant sall packed at sheet of

Bit is the branch of engg mechanics which deals with the torces and their effects, while acting upon a bodies in c montrion while transferrers o motion. some a leve # gf is of two types, The sel p. no (D) kinetics 1. yeld

DVIR CIPPIN 1.B (b) kinematics the state of selling

Of is the branch of Lynamics, which deals with the bodies in motion due to she applycation of forces. Silver Starley

(my) at ( define)

(b) kinemalles -

St is the branch of Dynamics, which deals with the bodies in modion, without any rederence to the forces which are responsible for motion. In presente

is clarent price dullants and have applied Rigid body :-

Rigid body is a solid body in which detormation is zero or negligible.

「日本」」」、「「「「「「「「」」」を入ったり」 hard mich here is harden is harden to the state Force : mundel Marine Mines Alstan Merry

Force is defined as an external agent which produces or tends to produce destroy or tends to destroy the motion. of a body

Eldects of a force - many shine hours > It may change the motion of a body. -> If may retard the motion of a body > 98 balance the bordes already acting on a body

> If may give rise to the internal stores (AN KNICHTEREELCE) in the body.

characteristics of Force :- 1- 20 490 (3) Clork pickes > Magnitude of soores bill lice shows

-> The direction of the line, along which the torce acts, (3t is also known as line of detion)

> Nature of the torce ( c. e. Push or full point at which ( ? The Units of dorce :-On M.K.S System = Kilogram - Force [kg] 901 S.I. System = Newton (N) 97 C. 9. 5 system = Dyne 1N = 105 dyn => 1 dyn: 10-5 N System of Jorces - man isming When it two or more torces act on a body, they are called to form a system of Jorces . Million 1. Coplaner forces interning in the stability The forces, whose line of action lie on the same plane, are known as coplanes torces. 14+1+17 2. Colinear Forces :-The forces, whose lines of action lie on the same line , are known as co linear forces. MOSE PARA A PARA SIST (3) Cuscurrent bonces: The forces, which meet at one point ave known as curcussent forces. (4) coplannes concussent Josces :point and their line of aerion also lie on the same plane.

(5) coplaner non concurrent -The Jorces which don't meet at one point, but their lines of action also lie on the same plane. (6) Non coplanes concurrent deores :- 1 The dorces, which meet at one point but their lines of action lie on the same - MARCEN 14 16- K. MARCH plane . A manual strange (7) Non- coplaner non-concurrent Jorces The borces, which don't meet at one Point and their lines of action don't lie. on the same plane Principle of superposition in At The phinciple of super position of forces that the combained effect of a force system acting on a particle or a rigid body is the scen of the effects essects of Endividual Jorces. Freebody Diagram: (FBD) Forebody diagram is a sketch of an obsect of interest with our the suprounding objects stripped away and all of theme borces acting on the hody shown Action and Reaction of borces + 100 (1) An action force is a force that is applied to an object -> A seaction dorce is a consequence of an action dorce which is opposite in direction

Example of FBD :-16131 41 0 101 14 SON Starl, Sale Ma Mrs GON SON HON 10N Mol 16. 6.112 Pire part side an and RB 101 1901.110 11001 5.310 MARE STAN I MARAN BURNING a this of > Block ( PP ) I Product 9 cylinder KN An May 30N 20N CARING BRIED. Jan Chistophia grap. 30N 201 Praris A 136514 de; 186. 1.1 101 101 Acception company NO STOR 411000 Part 1 as the start way 19900 G Reso 4

Resolution of and The process of spliting up the given force into a no. of components, without change ing this effect on the body is called Resolution of forces, A force is generally resolved along two multially perpendiculas directions 30 dact, the resolution of a tora is the preverse action of the addition, of the icomponent vectors. Pornciples of Resolution: It states that," The algeboic sam of the desolved pasts, of a no. of forces, to a given direction, is equal to the resolved past of their resultant in the same disection. \* In general, the forces are resolved in the restical and hosizontal disections, 1 A BALLY A machine component 1.5 m long and weight Q. 1000N is supported by two bope AD and cp. Calculate the Fensions Ti and Tain the ropes AB and CD. T2 -1.5m. Sol. Given dafa. length = 1-000 1,5m, weight = 1000 N

Ti=?, Ta=?

T151060 72 sin 245 · 加西川南部1 TI 7 T2 = GIAT AND 45-T2 COS 45 60' Ticos 60 (F.B.D)1000 Resolving the forces non zontally, and equating the same, T, COS 60° = T2 COS 4510301 =)  $T_1 = T_{2X} \frac{\cos 45}{\cos 60'} = T_{2X} \frac{0.707}{0.5}$ => TI = 1.414 T2 Now. Resolving the borces vertically T1 510, 60 + T2 Cos 415 = 1000 => 1, 414 T2 sin 60 + T2 cos 451= 1 000 (Zoom egn (1) weget Ti) =) (1, 414 × 0.866) T2 + (0.707) T2 = 1000 => 1. 224 T2 + 0. 707 T2 = 1 500 2 10 > 72 (1.224 + 0.707) = 1.500 112911-124 =) == T2 × 1, 73 = 1000 (151)  $= 72 = \frac{1.600}{1.93} = 578.10$ From eggi 一边这一部的方面了 TI-= 1, 414 TZ MARTER ZIN VIRON VIR - 1, 414× 518.1 T1 = 732.6-North 2015,11-1,129 (Ans)

Method of Kesonution Parallelogram law ;= Rebultant Force :-It is a single force which produces the same effect as produced by all the given toxes acting on a body. > The resultant force may be determined by the following three laws of forces (1) Pasallelogsam law (1) Triangle law (11) Polygon law (1) Parallelogram law -If states that, If two forces, alling simultaneously on a pasticle, be represented in magnitude and disection by the two adjacent sides at a paralledo. gram, then their resultant may be represented in magnitude and disection by the diagonal of a pasallelogram which passes through their point of entersection let ces consider two Jorces pand à acting at angle o a at point o The resultant is given by office R= 1p2+22+2p2 coso

I she resultant (R) makes an angle a with the force s, then.  $\int tan \alpha = \frac{QSind}{PtQCOSO}$ Where, P, d = Forces whose resultant is sequired to be found out. OF Angle bern pond & a = Angle which she resultant Force makes with one of me forces. Minimum. Note: z.e when the forces act along the same line. 1. 90 0= 0 PULLED HE SHORT, OL R: PHF R= P+Q (2000) (1,1 COSO = I 2. 98 0 = 90° z. e when the forces at at sight angle  $R = \sqrt{p^2 + Q^2} \quad (: \cos qo' = 0)$ 3. It 0 = 180' Z. e. whe the torces alt along she same stragglit line but in opposite lidection. taspail às reput plut plus religno (i Cas 180 = -1) 4. 94 she two forces are equal z. e P=&= For then,  $R = \sqrt{F^2 + F^2 + 2F^2 \cos^2 \theta}$ St. South Anth Insta

R: V2F2 (1100) = J27 × 2 (052 (2) · · 1+ coso = 2 cos 10 (172x cos2 (2) DR: 2F Cos 2 C. Two Forces of 100N and 150N are alling semultaneoutily at a point what is the resultant forces, if the angle per them is ys? sal? Given data, Stair P= 100 N a = 150N 0 = 45 We know that, R= JP702+2P0 COSO = /(100)2+ (150)2+ 2×100×150×05 45']N Ary sector = 232 N. Q. Find the magnitude of two forces such that I they are at right angles their resul-tart is NON. But it they are at 60, their resultant is JI3 N. 2 18 40 1 40 1 4 gives data First of all, consider the two forces allingat rolght angles. We know that when the angle bet the two given Forces is qo', then the resultant force (R)

V10 = V P2 02 1 2 10 - HUNNI -10 = P2+02 - () (1. squaring + bodh sides. Similarly, when the angle bet? the two forces is so, then the resultant torge (R)  $\sqrt{13} = \sqrt{P^2 + 0^2 + 230} \cos 60^2$  . It is 13= p2+ 22 + 280×0.5 - ((i) saunsoing both) rates 250 PB = 50 1300 PBC = 13 - 1201 Parts the value of inviz buiter in magnitudes and lingertien by the two We hnow that is space acould be white Ne (P+0) + 550 P2+ 02+ 2pac acould be and him (P+0) + 550 P2+ 02+ 2pac acould be and him 2 (P+0) + 550 P2+ 02+ 2pac acould be and him 2 (P+0) + 550 P2+ 02+ 2pac acould be acould be and him 2 (P+0) + 550 P2+ 02+ 2pac acould be ac - Apear dread. 1 192100 = = 1000 + 3 × 2 di 10 - 00 - 00000 Pta = 16 = 4 - 0). = 16 of issife Tologen - in it Similarely to on a cost contrations of gardiness of the section of 301) escrited in model (SXS) - 0 - 28 - 00 - 10 codes: upen dheid(1) <u>pes</u>celhant [2] zejneeeerted in paired P-12 En Tyois 200 photompoor Now solving the intone ensure of aligned O les PAQ = 4 P-q=229 = 6 => P = 3

Now put the value of pinea" () P+Q=14 > d= 4-P - 4-3 Mini A Q=IN P= 3N& Q=IN Toriangle law: Of state's that it two forces, acting simu. Janeously on a particle, be represented in magnitude and direction by the two sides of a triangle taken in order, then there's resultant maybe represent to magnitude and direction by the ea third side of the triangle. taken in opposite order. · MARINE ! Polygon law :-Of states that it a nor of forces. acting simultaneously on a particle, se represented in magnitude and direction by sides of a polygon taken in contes, then their resultant is represented in apo magnitude and direction by the closing side of the polygon taken in opposite order,

Method of Resolution for the resultant force + 1. Resolve all the forces horizontally and find the algebric sum of all horizontal compo-(z. e EH) 2. Resolve all the forces vertically and find the algebore sum of all the vertical components (E. E EV). 3. The resultant R of the given forces will be given by.  $R = \sqrt{(\Xi H)^2} + (\Xi V)^2$ 4. The sesultant Josce will be Endined at an eingle Q, with the hooizontal.  $tan \theta = \frac{\Xi V}{\Xi H}$ > The value of angle & will vary depending apon the values of EV and EH. Notest ( I EV is the the resultant makes an angle i bet? o' and 180', But & Eves -ve when The the resultant makes an angle bet? <del>10' to 270</del>' 180° to 360' > Et is the, when the resultant makes an angle bet 0'- 90' or 270'- 360; But

resultant makes an EH is -ve ; when angle ber? 90'- 270'. FREE TO VINSISH MEPTER FILE State 15 the state of the state of the state Harry addie weat S. S. A Land N. Sp. The states of the states 1. 846m the first . Here Paris And Anna Anna Calls de avena 24年4月1日中国 The Arrive Section is The said the second stands 1) (Mars 1 - 1,4 C.). Field I show the reader of a reary line beer of The Property of the an ann an Arr P.W. in fel with some one No sa ma 44.14 · · · · mark ---- State TT. P 1115