oe yeuee keâe eveMÛej Γ DevÙe oe yeuee keâ eveMÛej keâ yejeyej n~ Ùen Yee emeæ keâeepeS ekeâ ekeâvne yeuee keâe eveMÛej MevÙe n~

3. (a) Forces act at the vertices of a tetrahedron out-ward, being perpendicular to the opposite foces and equal to λ times their areas. Show that they are in equilibrium.
Skeâ Ûelel<heâuekeâ keâ Mee<e eyevoDee hej yeenje eoMee ce yeue keâeÙejle n, pee ekeâ eJehejele he‰ keâ uecyeJele leLee he‰oe keâ #e$eheâue keâ λ ievee keâ yejeyej n~ emeæ keâeepeS ekeâ yeue meleueve ce n~

(b) Define null line and null plane by giving an example. Find the null point of the plane x+y+z=0, for force system (X,Y,Z; L,M,N).
MevÙe jKee Deej MevÙe DeeleCe meceleue keâe heejYee<ee GoenjCe meenle oeepeS~ yeue evekeâeÙe (X,Y,Z; L,M,N) keâ eueS meceleue x+y+z=0 keâ MevÙe eyevo keâe Øeehle keâeepeS~

Unit-II / FkeâeF-II 4/7½

4. (a) Prove the differential equations of equilibrium of string :
[eje keâ meleueve keâe DeJekeâue meceekeâjCe keâe emeæ keâeepeS :

$$\frac{d}{ds}\left(T\frac{dx}{ds}\right)+mX=0$$

$$\frac{d}{ds}\left(T\frac{dy}{ds}\right)+mY=0$$

(b) If a chain is suspended from two points A, B on the same level, and depth of

A (Printed Pages 8)

S-676

B.A./B.Sc.(Part-II) Examination, 2015

Mathematics

Fourth Paper

(Mechanics)

Time Allowed : Three Hours] ***[Maximum Marks :*** B.A. : 25, B.Sc. : 50

Note : Answer five questions in all. Question No. 1 is compulsory. Attempt four more questions, selecting one question from each unit.
keâue heeÛe ØeMvee keâ Gòej oeepeS~ ØeMve me. 1 DeeveJeeÙe n~ ØelÙekeâ FkeâeF me Skeâ ØeMve Ûevele nS, Ûeej DevÙe ØeMve keâeepeS~

1. Answer the following : 10/20
evecveeueeKele keâ Gòej oeepeS :

(a) Define wrench and pitch of wrench. Also write the expression of pitch.
jÛe leLee jÛe keâe eheÛe keâe heejYee<ee keâeepeS~ jÛe keâe eheÛe keâe JÙepekeâ Yee eueeKeS~

(b) Define sag and span in common catenary. write the expression of span in terms of angle ψ.
meeceevÙe keâšveje ce meie Deej mheve keâe heejYee<ee keâeepeS~ keâeCe ψ keâ heoe ce mheve keâe JÙepekeâ Yee eueeKeS~

(c) Define virtual work. Write principle of virtual work for a system of coplanar forces acting on a particle.

keâeuhele keâeÙe keâe heejYeeef<ele keâeefpeS~ Skeâ keâCe hej ueieve Jeeue meceleueeÙe yeuee keâ evekeâeÙe keâ eueS keâeuhele keâeÙe keâe emeæele eueeKeS~

(d) Define stable, unstable and neutral equilibrium of a body.

ekeâmee eheC[keâ mLeeF, DemLeeF Je lešmLe meleueve keâe heejYeeef<ele keâeefpeS~

(e) Define centre of gravity of a body. Prove that a body can have only one centre of gravity.

Skeâ eheC[keâ ie™lJe keâvõ keâe heejYeeef<ele keâeefpeS~ emeæ keâeefpeS ekeâ ekeâmee eheC[keâe keâJeue Skeâ ne ie™lJe keâvõ ne mekeâlee n~

(f) Prove that the angular acceleration of the direction of motion of a point moving in a plane is $\frac{v}{\rho}\frac{dv}{ds}-\frac{v^2}{\rho^2}\frac{d\rho}{ds}$, where symbols have their usual meaning :

emeæ keâeefpeS ekeâ ekeâmee meceleue ce ieeleceeve eyevo keâe eoMee keâe keâeCeeÙe lJejCe n :

$\frac{v}{\rho}\frac{dv}{ds}-\frac{v^2}{\rho^2}\frac{d\rho}{ds}$, pene eÛevne Je Øeleekeâe keâe meeceevÙe DeLe n~

(g) Show that if the displacement of a particle in a straight line is expressed by the equation $x=a\cos nt+b\sin nt$, it describes a simple harmonic motion whose period is $\frac{2\pi}{n}$.

Ùeeo Skeâ keâCe keâe ekeâmee mejue jKee ce eJemLeeeve meceeekeâjCe $x=a\cos nt+b\sin nt$ Éeje oMeeÙee peelee n, leye emeæ keâeefpeS ekeâ Ùen Skeâ mejue DeeJeleeieele keâe JeeCele keâjlee n epemekeâe DeJeeOe keâeue $\frac{2\pi}{n}$ n~

(h) Obtain the following equation, where symbols have their usual meaning:

evecve meceeekeâjCe keâe Øeehle keâeefpeS, pene eÛevne Je Øeleekeâe keâ meeceevÙe DeLe n :

$$\frac{d}{dt}(mv)=P+u\frac{dm}{dt}$$

(i) Prove that a central orbit is always a plane curve.

emeæ keâeefpeS ekeâ keâvõeÙe keâ#ee nceMee Skeâ meceleueeÙe Je›eâ nelee n~

(j) For an elliptic orbit, at the end of minor axis, shon that $r=a$, where a is semimajor axis length.

oeleJeòeeÙe keâ#ee ce, ueIe-De#e keâ Dele eyevo hej emeæ keâeefpeS $r=a$, pene a DeOe oeIe-De#e keâe uecyeeF n~

Unit-I / FkeâeF-I 4/7½

2. (a) Define Poinsot's central axis and derive its equation.

heeÙevemeš keâ keâvõeÙe De#e keâe heejYee<ee oeepeS leLee Fmekeâe meceeekeâjCe emeæ keâeefpeS~

(b) If four forces are in equilibrium, show that the invariant Γ of any two is equal to that of the other two. Also show that the same invariant of any three is zero.

Ùeeo Ûeej yeue meleueve ce n, leye emeæ keâeefpeS ekeâ ekeâvne

Unit-IV / FkeâF-IV 3/7½

8. (a) Describe briefly the motion of first stage rocket.

ØeLece mle[jeÙe jekeâš keâe ieele keâe me#ehle ™he me JeCeve keâeepeS~

(b) A spherical raindrop, falling freely, receives in each instant an increase of volume equal to λ times its surface at that instant. Find the velocity at the end of time t and the distance fallen through in that time.

mJele$e ™he me eiejve Jeeuee ieeueekeâej Je<ee o keâ DeeÙeleve ce ekeâmee meceÙe me Gmekeâ he‰ keâe λ ievee oj me Jeæ nevee Me™ nelee n~ meceÙe t keâ Dele ce yeo keâe ieele SJe Gmee meceÙe ce eiejle nS leÙe keâe ieF oje keâe %eele keâeepeS~

9. (a) Find the law of force towards the pole under which the curve $r^n = a^n \cos n\theta$ can be described.

OeJe keâe Deej ueieve Jeeue keâvõeÙe yeue keâ eveÙece keâe %eele keâeepeS epemekeâ Deleiele Je›eâ $r^n = a^n \cos n\theta$ Øeehle ekeâÙee pee mekeâlee n~

(b) (i) If w be the angular velocity of a planet at the nearer end of the major axis, prove that its period is :

Ùeeo w oele-De#e keâ meceehe emLele emej hej ekeâmee «en keâe keâeCeeÙe Jeie ne, leye keâ#ee keâe heCe keâj ve keâe DeJeeOekeâeue n:

$$\frac{2\pi}{w}\sqrt{\frac{1+e}{(1-e)^3}}$$

(ii) Write the expressions for acceleration for three dimensional motion is cylindrical coordinates.

e$eeJeÙe ieele keâ eueS lJejCe keâe JÙepekeâ yeueeÙe eveoMeekeâ ce eueeKeS~

middle point below AB is $\frac{l}{n}$, where 2l is the lenght of the chain, show, that the horizontal span AB is equal to :

Ùeeo Skeâ Ûeve keâe Skeâ ne leue hej emLele oe eyevoDee A,B me yeeOekeâ j ueškeâeÙee peelee n, leLee ceOÙe eyevo keâe ienjeF AB me $\frac{l}{n}$ n, pene 2l Ûeve keâe uecyeeF n, emeæ keâeepeS ekeâ #eelepe mheve AB keâe ceeve n :

$$l\left(n-\frac{1}{n}\right)\log\left(\frac{n+1}{n-1}\right)$$

5. (a) Five weightless rods of equal length are joined together so as to form a rhombus ABCD with one diagonal BD. If a weight W be attached to C and system be suspended from A, show that there is a thrust in BD equal to $\frac{W}{\sqrt{3}}$.

meceeve uecyeeF Jeeuee Yeej jenle heeÛe Ú[e keâe pee[keâj meceÛeleYepe ABCD yeveeÙee peelee n epemekeâe Skeâ eJekeâCe BD n~ Ùeeo eyevo C me Yeej W yeeOekeâj evekeâeÙe keâe eyevo A me ueškeâeÙee peeS, leye emeæ keâeepeS ekeâ eJekeâCe BD ce ueieve Jeeue ØeCeeo keâe heejceeCe $\frac{W}{\sqrt{3}}$ n~

(b) A body consisting of a cone and a hemisphere on the same base, rests on a rough horizontal table, the hemisphere being in contact with the table. Show that the greatest height of the come, so that the equilibrium may be stable, is $\sqrt{3}$ times the radius of the hemisphere.

meceeve DeeOeej hej Skeâ Mekeâ leLee DeOe-ieeue me Ùeòeâ Skeâ eheC[n, pee ekeâ Skeâ #eelekeâ cepe hej eJeßeece keâe emLeele ce n, DeOeieeuee cepe keâ mehekeâ ce n~ mLeeF meleueve keâe emLeele ce emeæ keâeepeS ekeâ Mekeâ keâe DeeOekeâlece TÛeeF DeOeieeue keâe e$epÙee keâe $\sqrt{3}$ ievee n~

Unit-III / FkeâeF-III 4/7½

6. (a) Find the tangential and normal components of velocity and acceleration of particle moving in a plane curve in intrinsic coordinates.

ekeâmee meceleue ce Je›eâ keâ DeveeoMe ieeleceeve keâCe keâ Jeie leLee lJejCe keâ mheMee SJe DeeYeueye leškeâ vepe eveoMeekeâe ce Øeehle keâeepeS~

(b) A particle of mass m is attached to a light wire which is stretched tightly between two points with a tension T. If a and b are the distances of the particle from the two ends, prove that the period of small transverse oscillation of m is :

m õJÙeceeve Jeeuee Skeâ keâCe nukeâ leej hej yeOee n pee ekeâ oe eyevoDee keâ yeeÛe keâmekeâj yeOee ieF n, epemekeâe leveeJe T n~ keâCe keâe oevee emeje me oje ›eâceMe: a Je b n, emeæ keâeepeS ekeâ keâCe keâ Úeš DeveØemLe oeueve keâe DeJeeO eâeue n :

$$2\pi\sqrt{\frac{mab}{(a+b)}}$$

7. (a) A heavy particle hangs from a point O by

a string of length a . It is projected horizontally with a velocity v such that $v^2 = \left(2+\sqrt{3}\right)ag$ show that the string becomes slack when it has describe an angle $\cos^{-1}\left(-\frac{1}{\sqrt{3}}\right)$.

'a' uecyeeF Jeeuee [eje keâ eyevo O hej Skeâ Yeeje keâCe ueškeâeÙee peelee n~ Fme #eelepe DeJemLee ce v Jeie me Fme Øekeâej Øee#ehle ekeâÙee peelee n leeekeâ $v^2 = \left(2+\sqrt{3}\right)ag$, emeæ keâeepeS ekeâ [eje {euee he[peeÙeiee Jen GOJeeOej me $\cos^{-1}\left(-\frac{1}{\sqrt{3}}\right)$ keâeCe yeveeÙeiee~

(b) A particle projected vertically under gravity with a velocity U in air medium whose resistance varies as the square of the velocity. Pove that particle will return to the point of projection with velocity :

Skeâ keâCe GOJeeOej eoMee ce ie™lJe peevele lJejC keâ Deleiele nJee ce Øee#ehle ekeâÙee peelee n, nJee keâe DeJejeOe keâCe keâ Jeie keâ Jeie keâ meceeveheelee n~ emeæ keâeepeS ekeâ keâCe heve: Øe#ehe eyevo hej epeme Jeie me ueešiee, Jen n:

$$\frac{UV}{\sqrt{U^2+V^2}}$$

Where V is terminal velocity.

pene V Ûejce Jeie n~