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Annual Examination - 2017

B.Sc.-II

MATHEMATICS

Paper - III

MECHANICS

Max.Marks : 50

Time : 3 Hrs. **Min Marks : 17**

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¹¡ãq ß h½»¡ 'ı' t¡ Ày ı âmvi£ÙàÊã ZàÎÀà Ñ¡, âkÀÑ¡ Ñv §ýÊÀàà ı âÀàwàu¡ Ñ¡ ñ h½»¡ 'r' t¡ vi£ÙàÊã ZàÎÀà h½»¡ 'y' t¡ Àã i¡ £ÙàÊãu ZàÎÀà Ñ¡ ñ h½»¡ 'ı' §ýà¡ yry¡ qÑv¡ Ñv §ýÊ¡ ñ

Note: Section 'A' , containing 10 very short answer type questions, is compulsory. Section 'B' consists of short answer type questions and Section 'C' consists of long answer type questions. Section 'A' has to be solved first.

h½»¡-'ı'(Section-'A')

âÀàÈÀàà¡à§ým ı âm vi¡£ÙàÊãu ZàÎÀàà¡ §ý £ÙàÊ ÀâãK¥ ñ (Answer the following very short-answer-type questions) (1x10=10)

ZàÎÀà-1. **§ý0Ìqm §ýàu¡ â§ýy¡ §ýÑm¡ Ñ?**

What is virtual work?

ZàÎÀà-2. **yàtàÂu §ýà¹¡ÀàÊã §ýà §ýàmJu ytã§ýÊ½à âvâh¥ ñ**

Write Cartesian equation of the common catenary.

ZàÎÀà-3. **§ýÂôãu ı Õà §ýà¡ qáÊsãàxm §ýLâk¥ ñ**

Define central axis.

ZàÎÀà-4. **ÎàÂu Êhà¥ â§ýy¡ §ýÑm¡ Ñ?**

What are null lines?

ZàÎÀà-5. **Ñ§ý §ýà âÂàut âvâh¥ ñ**

Write Hooke's Law.

P.T.O.

ZàÎÀà-6. ZàÕàÅu §ýà £V¦uÂà §ýàv â§ýy¦ §ýÑm¦ Ñ?

What is the time of flight for projectile?

ZàÎÀà-7. ¤ýkà¦ yÊÕà½à §ýà ây÷àm âvâh¥ ñ

Write the principle of conservation of energy.

ZàÎÀà-8. ÊâmÂàãj mnà Êâm¤ýj ârÀÀ¦ â§ýy¦ §ýÑm¦ Ñ?

What is Perihelion and Aphelion?

ZàÎÀà-9. yãtàÅm w³à â§ýy¦ §ýÑm¦ Ñ?

What is Terminal velocity?

ZàÎÀà-10. r¦vÂàãu âÂàÀÎàà§ý §ý qÀà¦ t¦ â§ýyã §ý½à §ýà ¾wÊ½à rmà¢¥ ñ

Write the acceleration of a particle in terms of cylindrical co-ordinates.

h½»¦-'r' (Section-'B')

âÂàÈÀàà¦â§ým vi¦ £ÙàÊãu ZàÎÀàà¦ §ý £ÙàÊ Àãåk¥ ñ (Answer the following short-answer type questions) **(3x5=15)**

ZàÎÀà-1. ây÷ §ýÊà¦ â§ý uâÀ ¥§ý ârÀÀ¦ qÊ â§ýuàÎààv mãÂà rv yàÈuàwÐnà t¦ Ña¦ mà¦ Zà¾u§ý rv ¡Âu Àà¦ §ý rãj §ý §ýà½à §ýL ³uà §ý ytàÀàqàâm§ý Ñàmà Ñ ñ

Prove that if three forces, acting at a point be in equilibrium then each force is proportional to Sine of the angle between the other two.

OR

¥§ý ¹¦vãªààÄý mà Ê 40 ªàk §ýL ÀÊã qÊ 0Ðnm Àà¦ hÈsà¦ y¦ v¹¦§ýàuà ªàuà Ñ ñ uâÀ Ià v 1 Äý¹¦ Ña¦ ¡àÊ ZàâmÄý¹¦ mà Ê §ýà sàÊ ¡àoà ¡ày Ña¦, mà¦ ÀÎàà¢u¦ â§ý Zà¾u§ý hÈs¦ t¦ Õàâmk q¦v vªàsªà $\frac{1}{2}$ *cwt* Ñ ñ

A telegraph wire is supported by two poles 40 yards apart. If the sag be one foot and the weight of the wire per foot is half an ounce, show that the horizontal pull on each pole is nearly $\frac{1}{2}$ *cwt* .

A particle is describing a plane curve. If the tangential and normal accelerations are each constant through the motion, prove that the angle , through which the direction of motion turns in time is given by $V = Ve^{kt} \log(1+Bt)$

OR

¥§ý §ý½à ¤ýÁwà¦oÊ ytmv t¦ ¥§ý âÀu¦ Ñ¥ ÛýÕà w§ý qÊ ªàÛý¾w §ý ¡¦mªàm Âàãj §ýL ¡àÊ âhy§ýmà Ñ, ªàâm Öàâm §ýLâk¥ ñ

A particle slides down a rough curve in a vertical plane under gravity, discuss the motion.

ZàÎÀà-5. ¥§ý §ý½à *V* w³à y¦ ¥§ý âj§ýÂà Õàâmk ytmv qÊ ¥y¦ tàÁut t¦ ZàÕàâqm â§ýuà kàmà Ñ, âky§ýL Zàâm ¢§ýa¢¦ yÑâm qÊ ZàâmÊà¦o (w³à) Ñ ñ ÀÎàà¢u¦ â§ý ytu §ý qÎjàm¦ §ý½à §ýà w³à ¡àÊ ¢y ytu t¦ jvã ªa¢¦ ÀÊã âÂàÈÀàà¦â§ým y¦ Àã kàmã Ñ ñ

uà $s = \frac{v}{k}\left(1 - e^{-kt}\right)$

A particle is projected with velocity *V* along a smooth horizontal plane in a resisting medium whose resistance per unit mass is *k* (velocity). Show that the velocity *v* after a time *t* and the distance travelled *s* in that time are given by $v = Ve^{-kt}$ and $s = \frac{v}{k}\left(1 - e^{-kt}\right)$

OR

o¦wãu âÂàÀÎàà§ýà §ý qÀà¦ t¦ â§ýyã §ý½à §ýà ¾wÊ½à Öàâm §ýLâk¥ ñ

Find the acceleration of a particle in terms of polar coordinates.

----x----

ZàÎÂà-2. â§ýyã âÀu ªàu rv-âÂà§ýàu §ý §ýÂôàu ¡Õà §ýà ytâ§ýÊ½à Öààm §ýLâk¥ ñ

Find the equation of the central axis of any given system of forces.

OR

ÀÎààçu â§ý â§ýyã rvà §ý qáÊtà½à, kr ¥§ý rv âÂà§ýàu §ýà kà õàÊà âÀuà ªàuà Ñ Àà rÊàrÊ rvà y Ñ¹àm Ñ, ¥§ý ¡Õà §ý ¡ÀààÀÎà â§ýuàÎààv Ñ, ¥§ý ¡Âu rv §ýtÎàß

Ñ ñ

Show that the magnitude of the forces are, when A system of forces given by is replaced by two forces, on acting along the axis of x and another force respectively.

ZàÎÂà-3. ây÷ §ýLâk¥ â§ý ZàÕààÂu qn ¥§ý qÊwvu Ñàmà Ñ ñ

Prove that the path of a projectile is a parabola.

OR

¥§ý §ý½à ¥§ý ytmv t ¥§ý ¼wÊ½à, kà ytmv t yÀw ¥§ý âÂàöÎjm ârÂÀ §ýL ¡àÊ âÀ¯ Ñ, §ý ¡Âmªàm ªààm §ýÊmà Ñ ñ qn §ýà oÌwãu Ûýq t ¡w§ýv ytâ§ýÊ½à Öààm §ýLâk¥ ñ

A particle moves in a plane with an acceleration which is always directed to a fixed point in the plane; obtain the differential equation of its path in polar form.

ZàÎÂà-4. ¥§ý §ý½à ¥§ý ytmv w§ý qÊ ªààmtàÂà Ñ ñ uàÀ ÐqÎà Êhàu ¡àÊ ¡âsvàöÈr§ý ¼wÊ½à yÀw ¡jÊ ÊÑm Ñ, mà ây÷ §ýLâk¥ â§ý §ýà½à kà ªààm §ýL âÀÎàà ytu t ïtmã Ñ, ytâ§ýÊ½à õàÊà âÂàoàáÊm Ñàmà Ñ ñ

ZàÎÂà-2. Y½ âq½» §ýL yàÈuàwÐnà §ý Íuàq§ý Zàâmrîo Öààm §ýLâk¥ ñ

Find the general condition of equilibrium of a rigid body.

OR

ÀÎààçu â§ý â§ýyã sã rv-âÂà§ýàu §ýL ÎààÂu Êhà ¡à t y jàÊ â§ýyã ¡âmqÊwvu §ý kÂà§ý Ñàm Ñ, Àà kÂà§ýà §ý ¥§ý âÂà§ýàu §ý yÀÐu Ñàm Ñ ¡àÊ Àà ¡Âu âÂà§ýàu §ý ñ

Show that among the null lines of any system of forces four are generators of any hyperboloid, two belonging to one system of generators and two of the other system.

ZàÎÂà-3. ¥§ý yÊv Êhà t yÊv ¡àwm ªààm §ýÊm Ñ¥ ¥§ý ârÂÀ §ý wªà v_1 mnà Ñ krâ§ý çy§ýL §ýÂô y ÀáÊuà mnà Ñ ñ ÀÎàà ¡à â§ý ªààm §ýL ¡àwÙà§ýàv Ñ ß

$X(LX+MY+NZ)$ $\frac{\left[(MY+NZ)^2+L^2(Y^2+Z^2)\right]^{1/2}}{L}$ $2\pi\sqrt{\frac{x_1^2-x_2^2}{v_2^2-v_1^2}}$

A point in a straight line with S.H.M. has velocities and when its distance from the centres are and . Show that the period of motion is :

OR

¥§ý §ý½à ¥§ý ytàÂà §ýàâ½à§ý yâqv qÊ çy Zà§ýàÊ ªààmtàÂà Ñ â§ý çy§ýà ¼wÊ½à âØà³u ¼wÊ½à ÂàÑã Êhmà Ñ mà ây÷ §ýLâk¥ â§ý §ýà½àâu wªà ¡jÊ Ñ mnà wªà §ýà tàÂà mnà ¼wÊ½à r §ý ytàÂàqàmã Ñ ñ

A particle describes an equiangular spiral in such a manner that its acceleration has no radial component. Prove that its angular velocity is constant and that magnitude of the velocity and acceleration is each proportional to r.

P.T.O.

ZàÎÂà-4. **uâÀ** v_1 **w ªàÑ §ý Êâh§ý wªà Ñ krâ§ý uÑ yu y §ýtÎàß âÂà§ý¹mt w ÀÊÐn Ñ, ây÷ §ýLâk¥ â§ý**

If v_1 and are the linear velocities of a planet when it is respectively nearest and furthest from the sun, prove that .

OR

ªàÛý¼wà§ýx½à §ý ¡Âmªàm §ýà¢ §ý½à ¥§ý ¤ýÁwàoÊ ytmv t jà§ýÂà w§ý qÊ ªàtÂà §ýÊmà Ñ ñ uâÀ t **ytu t jâvm jàq §ý ytàÂàqàâm§ý Ñ mr w§ý §ýà Ûýq Öààm §ýLâk¥ ñ**

A particle describes a smooth curve under gravity in a vertical plane. If the arcual distance travelled in time t varies as . Find the shape of the curve.

ZàÎÂà-5. **¥§ý §ý½à ¡à§ýàÎà t ¡ jÊ ªàÛý¼wà§ýx½à §ý Zàsàw t ¥y tàÁut t ¤ýÁwàoÊ Êhà t ªààm §ýÊmà Ñ âky§ý ZààmÊàoã rv £y§ý wªà §ý ytàÂàqààm§ý Ñ ñ §ý½à §ýL ªààm §ýà ytã§ýÊ½à Öààm §ýLâk¥ ñ**

A particle falling under gravity (supposed constant) in a vertical line in a medium whose resistance varies as the velocity. Find the equation of motion of the particle.

OR

¥§ý §ý½à ¥§ý ¡wÊàoã tàÁut t âÀu ªàu §ýÂôàu ¼wÊ½à §ý ¡Âmªàm ªààm §ýÊmà Ñ ñ §ý½à §ýà qn âÀuà Ñ ñ ÀÎàà¢u â§ý ¡wÊào Ñ ß

A particle moves in a resisting medium with a given central acceleration P; the path of the particle being given, show that the resistance is :

h½»|-'y' (Section-'C')

âÂàÈÂààâ§ým Àãi! £ÙàÊãu ZàÎÂààµ §ý £ÙàÊ Àââk¥ ñ (**Answer the following long-answer type questions**) **(5x5=25)**

ZàÎÂà-1. **¥§ý À½»|, âky§ýà ªàÛý¼w §ýÂô £y ¡àÊ Àà sàªàà t âwsààkm §ýÊmà Ñ, ¥§ý âj§ýÂà ªààv §ý sâmÊ Êhã Ñ¢ Ñ ñ ÀÎàà¢u â§ý uâÀ ymâvm ¡wÐnà t Õààmk y £y§ýà I§ýàw Ñ ¡àÊ ªààv §ý §ýÂô qÊ À½»| §ýà½à ¡ÂmáÊm §ýÊmã Ñ, mà mÂààw**

A beam whose centre of gravity divides it into two portions a and b placed inside a smooth sphere : Show that if θ be its inclination to the horizon in the position of equilibrium and be the angle subtended by the beam at the centre of the sphere, then .

[illegible]

OR

vÈrà¢ a **§ýL ¥§ý »àÊã jàÊ ¥§ý ytàÂà i»à §ý ytjmsk §ý ²à¹ âw§ý½à §ýà rÂààmã Ñ, ytjmsk §ý Zà¼u§ý sk §ýL vÈrà¢ ¡àÊ sàÊ Ñ, kà ro Ñ¥ Ñ ñ uâÀ i»à ty ¥§ý §ýà Öààmk ¡wÐnà t ¹§ý âÀuà ªàuà Ñà, mà ây÷ §ýLâk¥ â§ý »àÊã t**

A string of length a forms the shorter diagonal of a number of four uniform rods, each of length b and weight w which are hinged together. If one of the rod be supported in a horizontal position, prove that the tension in the string is $\dfrac{2w\left(2b^2-a^2\right)}{b\sqrt{4b^2-a^2}}$