NETAJI SUBHAS OPEN UNIVERSITY

স্নাতকোত্তর পাঠক্রম **(P. G.)**

অনুশীলন পত্র **(Assignment) :** জুন, ২০২০/ ডিসেম্বর, ২০২০ **(June-2020/Dec.-2020)**

MATHEMATICS

Paper - 5A : Principles of Mechanics

পূর্ণমান : ৫০ **QUESTION PAPER CUM ANSWER BOOKLET** মানের গুরুত্ব : ২০%

(Full Marks : 50) (Weightage of Marks : 20%)

পরিমিত ও যথাযথ উত্তরের জন্য বিশেষ মূল্য দেওয়া হবে। অশুদ্ধ বানান, অপরিচ্ছন্নতা এবং অপরিষ্কার হস্তাক্ষরের ক্ষেত্রে নম্বর কেটে নেওয়া হবে। উপান্তে প্রশ্নের মূল্যমান সূচিত আছে।

Special credit will be given for precise and correct answer. Marks will be deducted for spelling mistakes, untidiness and illegible handwriting. The figures in the margin indicate full marks.

Name (in Block Letter) : .....

Enrolment No. | | | | | | | | | | | | |

Study Centre Name : ..... Code : .....

To be filled by the Candidate	Serial No. of question answered														**TOTAL**
For Evaluator's only	Marks awarded														

Q.P. Code : **PA/4/VA**

PG-Sc.-AP-17105

Signature of Evaluator with Date

NETAJI SUBHAS OPEN UNIVERSITY

স্নাতকোত্তর পাঠক্রম **(P. G.)**

STUDENT'S COPY

অনুশীলন পত্র **(Assignment) :** জুন, ২০২০/ ডিসেম্বর, ২০২০ **(June-2020/Dec.-2020)**

MATHEMATICS

Paper - 5A : Principles of Mechanics

Name (in Block Letter) : .....

Enrolment No. | | | | | | | | | | | | |

Study Centre Name : ..... Code : .....

Q.P. Code : **PA/4/VA**

PG-Sc.-AP-17105

Received Answer Booklet
Signature with seal by the Study-Centre

জরুরি নির্দেশ / Important Instruction

আগামী শিক্ষাবর্ষান্ত পরীক্ষায় **(T.E. Exam.)** নতুন ব্যবস্থা অর্থাৎ প্রশ্নসহ উত্তর পুস্তিকা **(QPAB)** প্রবর্তন করা হবে। এই নতুন ব্যবস্থার সঙ্গে পরীক্ষার্থীদের অভ্যস্ত করার জন্য বর্তমান অনুশীলন পত্রে নির্দেশ অনুযায়ী প্রতিটি প্রশ্নের উত্তর নির্দিষ্ট স্থানেই দিতে হবে।

New system *i.e.* Question Paper Cum Answer Booklet (QPAB) will be introduced in the coming Term End Examination. To get the candidates acquainted with the new system, assignment answer is to be given in the specified space according to the instructions.

Detail schedule for submission of assignment for the PG Term End Examination June-2020/Dec.-2020

1.	Date of Publication	: 20/06/2020
2.	Last date of Submission of answer script by the student to the study centre	: 19/07/2020
3.	Last date of Submission of marks by the examiner to the study centre	: 16/08/2020
4.	Date of evaluated answer scripts distribution by the study centre to the students (Students are advised to check their assignment marks on the evaluated answer scripts and marks lists in the study centre notice board. If there is any mismatch / any other problems of marks obtained and marks in the list, the students should report to their study centre Co-ordinator on spot for correction. The study centre is advised to send the corrected marks, if any, to the COE office within five days. No changed / correction of assignment marks will be accepted after the said five days.)	: 23/08/2020
5.	Last date of submission of marks by the study centre to the Department of C.O.E. on or before	: 31/08/2020

এখানে কিছু লিখবেন না

Do Not Write Anything Here

(All symbols have their usual meanings)

Answer Question No. 1 and any *four* from the rest.

1. Answer any *five* questions : $2 \times 5 = 10$

a) If a generalized coordinate is absent in the Lagrangian, will it be also absent in the Hamiltonian ? Justify.

b) Show that the dynamical system for which $2T = r_1 r_2(\dot{r}_1^2 + \dot{r}_2^2)$ and $V = \frac{1}{r_1} + \frac{1}{r_2}$ can be expressed as one of Liouville's type.

c) Show from Lagrange's equations that the orbit of a particle in a central force field lies in a plane.

d) Show that the transformation $Q = -p$, $P = q + \lambda p^2$ (λ, a constant) is canonical.

e) If for a certain mechanical system $H = p^2 q^2 - \mu\, pq$, where μ is a real constant, then show that pq is a constant of motion.

f) Show that the quantity $E = \sum_i \dot{q}_i \frac{\partial L}{\partial \dot{q}_1} - L$ remains constant during the motion of a closed system.

g) Show that linear momentum is a constant of motion for infinitesimal spatial displacement.

First Answer :

Second Answer :

Third Answer :

Fourth Answer :

Fifth Answer :

2. a) Deduce Lagrange's equation of motion for a conservative and unconnected holonomic system. 7

   b) Prove the virial theorem. 3

3. a) Solve the plane pendulum problem using the Hamilton's canonical equations. 5

   b) If all the coordinates of a system are cyclic then prove that the coordinates may be found by integration. Also prove that if the system be scleronomic then the coordinates are linear function of time. 5

4. Consider a mechanical system described by he generalized coordinates $q_1, q_2, \ldots, q_n$. Show that the kinetic energy can be formulated as $T = T_2 + T_1 + T_0$, where $T_2 = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} a_{ij}\dot{q}_1\dot{q}_j$, $T_1 = \sum_{i=1}^{n} b_i\dot{q}_1$, $T_0 = c$, and the quantities a_{ij}, b_i and c are to be determined by you. 10

5. a) In a dynamical system with two degrees of freedom the K.E. and P.E. are given by

   $$T = \frac{\dot{q}_1^2}{2(a+bq_2)} + \frac{1}{2}q_2^2\dot{q}_2^2,\ V = c + dq_2,$$

   where a, b, c and d are constants. Show that the value of q_2 in terms of time is given by the equation of the form :

   $$(q_2 - k)(q_2 + 2k)^2 = h(t - t_0)$$

   where h, k and t_0 are constants. 7

   b) The Lagrangian of a system with two degrees of freedom is given by

   $$L = x\dot{y} + y\dot{x}^2 + \dot{x}\dot{y}$$

   obtain the corresponding Hamiltonian. 3

6. Define angle variables. A particle of mass m moves in two dimensions (x, y) having potential $V(x,y) = \frac{1}{2}m\omega_x^2x^2 + \frac{1}{2}m\omega_y^2y^2$ $(\omega_x \neq \omega_y)$. Obtain the action variables expressing the energy in terms of these and hence find the angle variables. 2 + 5 + 3

7. a) Find the equation of the curve which makes the surface area of revolution generated by rotating the curve $y = y(x)$ around the x-axis. 5

   b) A particle of unit mass is projected so that its total energy is h in a field of force whose potential is $\phi(r)$ at a distance r from the origin. Show that the differential equation of the path is given by

   $$C^2\left[r^2 + \left(\frac{dr}{d\theta}\right)^2\right] = r^4[h - \phi(r)]$$

   with C as constant. 5

First Answer :

Second Answer :

Third Answer :

Fourth Answer :