

Paper Code: 32861105

Roll No.: 19312915038

**FINAL EXAMINATION – THEORY**

Semester I, Year – 2019

B. Tech (IT & Mathematical Innovations)

Paper I.5 (Physics at work I: Deconstructing Machines)

Marks: 40

Duration: 2 hours

**INSTRUCTIONS, READ CAREFULLY:**

- Write your roll no on the question paper. You are forbidden to share or exchange your question paper with any other student during the examination.
- Use of scientific non-programmable calculator is permitted.
- Try to answer the questions in the order in which they appear in the question paper.
- Use the last pages of the answer sheet for rough work, strike-off these pages before submitting the answer sheet for evaluation

**Answer any eight questions**

- A rocket takes off vertically in a constant gravitational field. What is the velocity of the rocket at an arbitrary time  $t$ ? (take  $v=0$  when  $t=0$ ). [5]
- Show that gravitational force is conservative. Give an example of a non-conservative force. [5]
- Derive the time period of Simple Pendulum. Describe four lab activities using this. [5]
- Derive the expression for the time period of a Bar Pendulum. How do we use this expression in the lab to measure the value of  $g$ ? [5]
- Solve the equation of motion of a damped harmonic oscillator using complex variables. [5]
- Discuss resonance and Q factor in a lightly damped forced harmonic system. [5]
- Write the equation of motion of a coupled pendulum? Draw the symmetric mode, anti-symmetric mode and the general behavior of the coupled pendulum. [5]
- Describe two gear designs and their industrial applications. [5]
- Describe in detail the theory and experimental design of ATWOOD MACHINE [5]
- Given a set of observations  $(x_i, y_i), i = 1, \dots, N$ . [5]

$x_i$	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5
$y_i$	4.4	5.5	8.3	10.2	12.7	13.6	15.4	18.3	20.7	22.9

If the data confirms to a linear behavior  $y = ax + b$ , find  $a$  and  $b$  using least square fit method.