

**M.Tech. – ADVANCED INFORMATION
TECHNOLOGY – AUTOMOTIVE ENGINEERING
(MTECHAE)**

00264

Term-End Examination

December, 2014

MINI-061 : MECHANICAL SYSTEMS

Time : 3 hours

Maximum Marks : 100

Note :

- (i) *Section I is **compulsory**.*
- (ii) *In Section II, answer any **five** questions.*
- (iii) *Assume suitable data wherever required.*
- (iv) *Draw suitable sketches wherever required.*
- (v) *Italicized figures to the right indicate maximum marks.*

SECTION I

1. Aquatech Industries has manufactured a device used in a process plant. The fluid flow through the device is governed by a velocity vector.

Consider the velocity vector in a fluid flow is given by $V = 2x^3i - 5x^2yj + 4tk$.

Find the velocity and acceleration of a fluid particle at (1, 2, 3) at time $t = 1$.

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2. Cadbury India Ltd. has newly erected an equipment to prepare milk toffee bars in their toffee plant.

Note the following data regarding the set-up :

The equipment contains a closed vessel having the slurry up to a height of 2.5 m.

Over the surface of slurry, there is air having a pressure of 8.5 N/cm^2 . At the bottom of the vessel there is an orifice of diameter 5 cm. Coefficient of discharge (c_d) = 0.65, Density of slurry = 1.5 grams / cc.

For filling the mould cavity they need to determine the rate of flow of slurry from an orifice fitted in the equipment. Use the above data and determine the rate. You may make necessary assumptions.

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SECTION II

3. (a) Show the nature of propagation of disturbance in a compressible flow when Mach number is
- (i) less than one. 3
 - (ii) equal to one. 3
 - (iii) more than one. 3
- (b) A continuity equation based on the principle of conservation of mass is required to be stated. State your views on the feasibility of the same. 5
4. (a) Among the various methods of preventing separation of boundary layer, which one will you suggest in case of a large bearing used in a roller conveyor ? 7
- (b) What is the effect of pressure gradient on boundary layer separation in this case ? 7
5. An experimenter wants to find an expression for the power absorbed in overcoming the viscous resistance for a shaft rotating in a journal bearing having viscous oil in the clearance between the shaft and the bearing.
Find the expression and clearly mention the notations used. 14
6. (a) Derive Bernoulli's equation on the basis of Euler's equation. 8
- (b) State and justify the assumptions used in the derivation. 6

7. (a) What is the significance of Mach number in compressible fluid flows ? 8
- (b) How can you use SIMPLE Type Methods of Solution for the Navier-Stokes Equations ? 6
8. What is the significance of Von Karman momentum integral equation in the design of the following :
- (i) Guide rails of a lift having capacity of 15 persons. 7
- (ii) Sluice gate in a large hydraulic power plant. 7
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