

BACHELOR OF ENGINEERING EXAMINATION, 2017

(1st Year, 1st Semester, Supplementary)

(CHEMICAL, F. T. B. E., PRODUCTION)

PHYSICS IB (OLD)

Time : Three hours

Full Marks : 100

Answer *any five* questions.

1. a) Given two vectors $A = \sqrt{3}/2 i + 3/2 j + k$ and $B = i + \sqrt{3} j + 2\sqrt{3} k$. Calculate angle between A and B . Find projection of A on B and vice versa. Calculate a unit vector perpendicular to both A and B .
 b) Write the equations for polar to Cartesian coordinate transformation in two dimension. Express polar unit vectors \hat{r} and $\hat{\theta}$ at any point (r, θ) in terms of Cartesian unit vectors, Derive expressions of velocity and acceleration in polar coordinate. 8+12
2. a) What is a conservative force field. Explain relation of such field with a potential function.
 b) Show that force is perpendicular to an equipotential surface.
 c) Compute force field for potential $V = x^2yz + 2xz^2 + xy^2z$.
 d) Explain the conditions of stable equilibrium. 5+5+5+5
3. a) State and prove Bernoulli theorem for fluid motion.
 b) Explain what is meant by viscosity of a liquid and define viscosity coefficient. Write its unit in CGS system.
 c) Derive Poiseuille's equation for steady flow of liquid through a narrow tube mentioning required condition for its validity. 7+5+8
4. a) Define angular momentum of a system of particles and explain its conservation law.
 b) What is moment of inertia of a body. Prove parallel axis theorem of moment of inertia.
 c) Calculate moment of inertia of a hollow sphere of inner and outer radii r_1 and r_2 respectively.
 d) Construct equation of motion of a simple pendulum consisting of a hollow spherical bob and a string of length l (from point of suspension to center of the bob). 5+5+6+4
5. Set up equation of motion of a damped harmonic oscillator clearly explaining its terms. Solve the differential equation and explain motion for different region of damping. How the natural frequency and damping coefficient can be measured. Discuss the phenomenon of resonance. 3+9+4+4

[Turn over

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6. a) Give the interpretation of pressure and temperature of a perfect gas according to kinetic theory.
- b) Write down Maxwell's speed distribution and explain its usefulness in calculating average speed, most probable speed and rms speed.
- c) Write Van der Waal's equation of state for a gas explaining origin of its terms. Find critical constants in terms of Van der Waal's equation. 7+5+8
7. a) State and explain the first law of thermodynamics.
- b) Explain with example concept of quasi static process in thermodynamics.
- c) A quantity of dry air at 27°C is compressed (i) slowly and (ii) suddenly to $1/3$ of its volume. Find the changes of system in each case, assuming γ to be 1.4 for dry air.
- d) Using the first law of thermodynamics prove that $C_p - C_v = R$. The symbols carry their usual significance. (2+2)+2+6+8
8. a) Write Clausius and Kelvin statement of second law of thermodynamics and show that they are equivalent.
- b) Explain reversible and irreversible processes with some examples. Describe the operation of Carnot's reversible heat engine and also find its efficiency.
- c) A carnot engine with its low temperature reservoir at 7°C has an efficiency 50%. To operate it at efficiency 70%. By how many degrees should the temperature of the source be increased? 3+(4+8)+5