B.E. PRODUCTION ENGINEERING, SUPPLEMENTARY EXAM-2019(old)
(First Year, First Semester)
Physics - I
Answer any *five* questions.
All questions carry equal marks.

Time: **Three Hours**   Full Marks: **100**

1. a) Find the value of $\vec{\nabla}\dfrac{1}{r^3}$ where $\vec{r} = r\hat{r}$ is the position vector.

   b) If $\vec{A} + \vec{B} + \vec{C} = 0$ show that $\vec{A} \times \vec{B} = \vec{B} \times \vec{C} = \vec{C} \times \vec{A}$

   c) Give the physical significance of the gradient of a scalar.

   d) Show that the gravitational field is conservative.   **5+5+5+5=20**

2. a) Find the work done in moving a body along a vector $\vec{r} = 3\hat{\imath} - 6\hat{\jmath} + 2\hat{k}$, if the force applied is given by $\vec{F} = 2\hat{\imath} - \hat{\jmath} + \hat{k}$.

   b) Find the velocity and acceleration of a particle in plane polar co-ordinate system.

   c) What do you mean by conservative force?

   d) Show that all central forces are conservative.

   e) Show that in a conservative force field the sum of the kinetic and potential energy of a particle at any point is constant.

                                               3+7+2+4+4=20

3. a) Describe the assumptions for the kinetic theory of gases. Assuming the expression for pressure from kinetic theory, prove the ideal gas laws.

   b) What is the kinetic interpretation of temperature?

   c) At what temperature the R.M.S. velocity of the molecules of an ideal gas will be double of its value at N.T.P.?

   d) Write down the expression for the distribution of velocities of gas molecules as proposed by Maxwell and interpret it graphically.

                                               10+3+4+3=20

4. a) How is Gauss's law modified in presence of dielectric medium? Introduce electric displacement vector and hence find its relation with electric field and polarization vectors.

   b) State and explain Ampere's circuital law. Apply it to find the magnetic field at an external point due to a long current carrying conductor.   **10+10=20**

5. a) State Faraday's law of electromagnetic induction and express it in differential form.

   b) Find the expressions for the growth and the decay of charge on a capacitor connected in series with a resistor. What do you mean by the time constant of the circuit? When can the transient be said to practically die out?

   c) A DC voltage of 80 volt is switched on to a circuit containing a resistor of 5 ohm in series with an inductance of 20 Henry. Calculate the rate of growth of current at the instant when the current is 6 amp.   **5+12+3=20**

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6. a) Explain the phenomenon of diffraction of light. How does it differ from the interference of light?

    b) Describe Fraunhofer diffraction due to single slit and deduce the positions of maxima and minima.

    c) A parallel beam of light is incident normally on a plane transmission grating having 4250 lines per cm and the second order spectral line is observed at an angle of 30°. Calculate the wavelength of light.

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4+10+6=20

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7. a) What are coherent sources? How many types of coherences are there?

    b) Explain the formation of Newton's rings and discuss how the wavelength of light can be determined by measuring their diameters.

    c) What will happen if we have a plane mirror instead of a glass plate underneath the lens?

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4+14+2=20

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8. a) State the Bohr's postulates of the atomic model. What will be the frequency of rotation of an electron in the first orbit of the Hydrogen atom?

    b) Obtain the expression of the energy possessed by an electron in the nth orbit of the Hydrogen atom. Find the (i) limiting wavelength and (ii) K_α wavelength of the Balmer series. $(R = 10\ 973\ 731.6\ m^{-1})$

    c) Explain the origin of continuous and characteristic X-Rays. What is limiting wavelength of X-ray emission? Deduce its expression.

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(3+2)+(4+4)+(4+3)=20

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