N.B. : (1) Questions No. 1 is **compulsory** from **section 1**.
     (2) From remaining **four** attempt any **two** questions.
     (3) **Figures** to the **right** indicate **full** marks.
     (4) Assume **suitable** data and symbols if **required**.

Section I

1. Answer any **four** :–   20
    - (a) Explain the phenomenon of interference of light ? What are the conditions to get clear and distinct interference fringes ? Can interference be observed with two independence sources of light ?
    - (b) Distinguish between step index and graded index fibre ? What is multimode optical fibre ?
    - (c) Explain X-ray diffraction ? Derive Bragg's Law.
    - (d) Give the various uses of Lasers in medical, engineering and scientific field.
    - (e) Explain the term binding energy, mass defect of nucleus and 'Q' value of a nuclear reaction.
    - (f) Compare interference and diffractions phenomenon in optics . What is fundamental criteria between wavelength of light used and obstacle size in order to get the diffraction.

2. (a) What do you understand by the production of interference by division of amplitude method ? Obtain the condition for maxima and minima of the light reflected from a thin transparent film of uniform thickness.   8

   (b) A plane transmission grating having 6000 lines per cm is used to obtain a spectrum of light from a sodium lamp in the second order. Calculate the angular separation between the two sodium lines whose wavelengths are 5890 A° and 5896 A°.   7

3. (a) Explain the origin of continuous and characteristic X-rays spectra ? Derive the equation for it's minimum wavelength.   8

   (b) Calculate the velocity and kinetic energy of incident electrons and minimum wavelength of the emitted X-rays produced from X-ray tube operated at 35 K volts.   7

4. (a) Explain the construction and working of He-Ne Laser with energy level diagram.   8

   (b) Compute the energy equivalance of 1 a.m.u. ? Calculate the B.E. per nucleon of   7
   $_{82}pb^{206}$ with mass 206·0379 a.m.u. What is its Packing fraction ?
   Mass of Proton $= m_p = 1·008145$ a.m.u.
   Mass of neutron $= m_n = 1·009$ a.m.u.

5. Write short note (attempt any **three**) :–   15
    - (a) G. M. Counter
    - (b) Holography (Construction, Reconstruction and reconstruction of 3-D image)
    - (c) Bragg's X-ray spectrometer method for determination of crystal structure
    - (d) Non-reflecting film and it's applications
    - (e) Moseley's law and it's importance.

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Section II

N.B. : (1) Questions **6** is **compulsory**.
        (2) Attempt any **two** from question nos. **7** to **9**.

6. Attempt any **five** from the following :—   20
    (a) Define (i) Octane number   (ii) Cetane number. Write the significance of each.
    (b) Explain waterline corrosion.
    (c) What are plain Carbon Steels ? What are their main drawbacks ?
    (d) How alcohol is manufactured from sugarcane by fermentation process ?
    (e) How the percentage of volatile matter is determined during proximate analysis of coal ? What is its significance ?
    (f) Explain with a neat diagram, how the sacrificial anode methods is used for protection of underground pipeline ?
    (g) A sample of coal contains :—

         $C = 60\%$ $O = 33\%$ $H = 6\%$
         $S = 0.5\%$ $N = 0.3\%$ $Ash = 0.2\%$

         Calculate the gross and net caloritic values.

7. (a) What is the purpose of Making alloys ? Explain with examples.   6
    (b) Explain with examples, how the nature of the oxide film formed on the surface of metal influences the rate of corrosions.   4
    (c) Explain how sewage can be treated with activated sludge process.   5

8. (a) What is cracking ? Discuss moving bed catalytic cracking.   7
    (b) Explain how corrosions can be prevented by proper design and selection of material.   4
    (c) A sample of coal has the following percentage composition by mass :—   4
         $C = 70\%$ $H = 10\%$ $O = 5\%$
         $N = 2\%$ $S = 3\%$ and remaining ash.
         Calculate the minimum amount of air needed for complete combustion of 1 kg of coal.

9. (a) With the help of a neat diagram explain the manufacture of Gobar Gas. Write its composition properties and uses.   7
    (b) Write a note on solders.   4
    (c) Explain rusting of iron with the help of electro chemical theory of corrossion.   4