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Pabna University of Science and Technology
 Department of Physics
 B.Sc. (Honours) 2nd Year 1st Semester Examination 2021
 Course Title: Heat and Thermodynamics
 Course No.: PHY 2101

Time: 03 Hours

Full Marks: 70

N.B.: (i) Answer any Five questions out of Eight.

(ii) Figures in the right margin indicate full marks.

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|--------|---|-----|
| 1. (a) | Define thermodynamic system. Distinguish among the various type of systems with example. | 1+4 |
| (b) | Explain extensive and intensive state quantities. | 3 |
| (c) | Deduce the relation $PV = RT$ for one mole of an ideal gas. | 4 |
| (d) | Show that $\left(\frac{\partial P}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_P \left(\frac{\partial T}{\partial P}\right)_V = -1$. | 2 |
| 2. (a) | Write down the essential features of the kinetic theory of ideal gases. | 5 |
| (b) | What do you mean by transport properties of gas? Obtain an expression for thermal conductivity of the gas. | 1+5 |
| (c) | Write a short note on Andrews curve. | 3 |
| 3. (a) | What are state variables? | 3 |
| (b) | Deduce the equation $TV^{\gamma-1} = \text{constant}$, for a perfect gas (the symbols have their usual significance). | 7 |
| (c) | Air is compressed adiabatically to half of its original volume. If the air was initially at 27°C and at atmospheric pressure, then calculate the final temperature and pressure [$\gamma = 1.41$ for air]. | 4 |
| 4. (a) | What do you mean by equilibrium state? Explain different types of equilibrium state. | 1+5 |
| (b) | Show that the isothermal work done of an ideal gas is $W = -nRT \ln \frac{V_2}{V_1}$. | 4 |
| (c) | Calculate the work done upon expansion of one mole of gas thermally from volume V_1 to a volume V_2 when the equation of state is $\left(P + \frac{a}{V^2}\right)(V - b) = RT$. | 4 |
| 5. (a) | Show that the Kelvin-Planck statement and the Clausius statement of the second law of thermodynamics are equivalent. | 6 |
| (b) | Draw and describe the Carnot cycle of an ideal gas with a temperature-entropy diagram. | 5 |
| (c) | Calculate the change in entropy when 5 Kg of water at 100°C is converted into steam at the same temperature (the latent heat of vaporization = 540 cal/gm). | 3 |
| 6. (a) | How do you formulate the second law of thermodynamics mathematically? | 5 |
| (b) | Define entropy. What is its physical significance? | 2+2 |
| (c) | State and prove the principle of increase of entropy. | 5 |
| 7. (a) | Write down the four thermodynamic relations of Maxwell. | 2 |
| (b) | Define specific heat at constant pressure and constant volume. | 3 |
| (c) | Considering entropy as a function of temperature and volume i.e., $S(T, V)$ show that $C_P - C_V = -T \left(\frac{\partial V}{\partial T}\right)_P^2 \left(\frac{\partial P}{\partial V}\right)_T$. | 5 |
| (d) | Use the above result to show that for Van der Waals gas, $C_P - C_V \cong R \left(1 + \frac{2a}{RTV}\right)$. | 4 |
| 8. (a) | Write is the Joule-Kelvin coefficient? | 6 |
| (b) | Deduce Gibb's phase rule. | 5 |
| (c) | Describe the Joule-Thomson throttling process and show that this process is isenthalpic. | 3 |

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B.Sc. (Honours) 2nd Year 1st Semester Examination 2020
Course Title: Heat and thermodynamics
Course Code: PHY 2101

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Five questions out of Eight.
(ii) Figures in the right margin indicates full marks.

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|--------|---|---|
| 1. (a) | Write down the fundamental assumptions of kinetic theory of gages. | 4 |
| (b) | Show that, $P = \frac{1}{3} \rho c^2$, where the symbols have their usual meanings. | 7 |
| (c) | Write a short note on intermolecular forces. | 3 |
| 2. (a) | What are the corrections involved in the kinetic theory of gases that lead to the equation of state for a real gas? | 3 |
| (b) | Argon with density 100 kg/m^3 under a pressure of 10 MPa is in pressure vessel. Considering argon under each pressure to be a Van der Waals gas, find its temperature. [$a = 0.136 \text{ Nm}^4/\text{mole}^2$, $b = 3.201 \times 10^{-5} \text{ m}^3/\text{mole}$]. | 3 |
| (c) | How can the critical points P_c , V_c , and T_c be fixed by the Van der Waals constants a and b ? | 4 |
| (d) | Using transport phenomenon of gases, obtain an expression for thermal conductivity of it. | 4 |
| 3. (a) | Define thermodynamic system. | 3 |
| (b) | State the zeroth law of thermodynamics. | 3 |
| (c) | Write the comparison between heat and work. | 3 |
| (d) | State and prove the first law of thermodynamics. | 5 |
| 4. (a) | What is adiabatic process? Derive the equation of work done during an adiabatic process. | 6 |
| (b) | Define reversible and irreversible process. Write the conditions of reversibility for any heat engine. | 6 |
| (c) | What is thermodynamic equilibrium? | 2 |
| 5. (a) | State the Kelvin-Planck as well as Clausius version of the second law of thermodynamics. | 3 |
| (b) | Show that the Kelvin-Planck and Clausius statements of second law of thermodynamics are equivalent. | 7 |
| (c) | What is refrigerator? Write the working mechanism of a refrigerator. | 4 |
| 6. (a) | State and prove Carnot's theorem. | 5 |
| (b) | Define entropy. Illustrate the Carnot's cycle in entropy-temperature (ST) diagram. | 4 |
| (c) | Calculate the entropy of one mole of an ideal gas. | 5 |
| 7. (a) | Define C_p and C_v and find their relation. | 6 |
| (b) | What do you mean by equilibrium state? Deduce the relation $PV^\gamma = \text{constant}$. | 6 |
| (c) | What is internal energy? | 2 |
| 8. (a) | What is phase transition? | 2 |
| (b) | Deduce the Clausius- Clapeyron equation. | 5 |
| (c) | Why the triple point temperature $T_{TP} = 273.16 \text{ K}$ is higher than the normal melting point temperature $T_{NMP} = 273.15 \text{ K}$? | 4 |
| (d) | Define chemical potential. Show that chemical potential is the Gibbs function per particle. | 3 |

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Department of Physics

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N.B.: (i) Answer any five questions out of eight.
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1.
 - a) What are the differences between real gas and ideal gas? 3
 - b) Explain the zeroth law of thermodynamics. How the concept of temperature is obtained from the law? 4
 - c) Show from the kinetic theory of gases that the mean kinetic energy of translation of one molecule of a perfect gas is $\frac{3}{2}kT$. 4
 - d) Explain the principle of equipartition of energy. 3
2.
 - a) What are the corrections in the kinetic theory of gases that led to the equation of state for a real gas? 3
 - b) Define mean free path. Show that the mean free path is inversely proportional to the macroscopic collision cross section. 1+7
 - c) The mean free path of the molecules of a gas is 2×10^{-5} cm, when there are 1.25×10^{19} molecules per cm³. Compute the diameter of the molecules. 3
3.
 - a) What are differences between reversible and irreversible process? 4
 - b) Using the first law of thermodynamics show that $C_p - C_v = \left[P + \left(\frac{\partial U}{\partial V} \right)_T \right] \left(\frac{\partial V}{\partial T} \right)_P$. Use this result to show
 - i) $C_p - C_v = R$, for an ideal gas. 2
 - ii) $C_p - C_v \approx R \left(1 + \frac{2a}{RTV} \right)$, for Van der Waals gas. 4

Note that $P + \left(\frac{\partial U}{\partial V} \right)_T = T \left(\frac{\partial P}{\partial T} \right)_V$.
4.
 - a) State and explain the first law of thermodynamics. 4
 - b) Deduce the relation $T P^{(1-\gamma)/\gamma} = \text{constant}$, where the symbols have their usual meaning. 5
 - c) Ten grams of oxygen are heated at constant atmospheric pressure from 27.0 to 127 °C. How much heat is transferred to the oxygen? What fraction of the heat is used to raise the internal energy of the oxygen? 3
 - d) An ideal gas is originally confined to a volume V_1 in an insulated container of volume $V_1 + V_2$. The remainder of the container is evacuated. The partition is then removed and the gas expands to fill the entire container. If the initial temperature of the gas was T , what is the final temperature? Justify your answer. 2
5.
 - a) Show that the efficiency of the Carnot engine depends only upon the temperature of the source and the sink. 6
 - b) A Carnot refrigerator extracts 35.0 kJ as heat during each cycle, operating with a coefficient of performance of 4.60. What are (i) the energy per cycle transferred as heat to the room and (ii) the work done per cycle? 5
 - c) Write the working mechanism of a refrigerator. 3

6. a) State and explain the Clausius theorem for a general reversible cyclic transformation. 5
- b) What do you mean by thermodynamic temperature scale? 3
- c) Show that, the thermodynamic and the ideal gas scales of temperature are identical. 4
- d) Consider a steam engine that operates between a maximum steam temperature of 500°C and an ambient temperature of 20°C . Find the efficiency of it. 2
7. a) What are the thermodynamic potential functions? 4
- b) State and explain the third law of thermodynamics. 4
- c) Deduce the four thermodynamic relations of Maxwell. 6
8. a) Explain Joule-Thomson effect. Show that this effect is isenthalpic. 3+3
- b) Show that the thermodynamic equation for Joule-Thomson coefficient is

$$\mu_{JK} = \frac{1}{C_p} \left[T \left(\frac{\partial V}{\partial T} \right)_P - V \right]$$
 5
- c) Write a short note on Gibb's phase rule. 3

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N.B.: (i) Answer any Six questions out of Eight.
 (ii) Figures in the right margin indicate full marks.

1. (a) Can we use any liquid as a thermometric substance? Explain. $\frac{2}{3}$
- (b) What do you understand by sensitive thermometer? $\frac{2}{3}$
- (c) Describe construction and working of a self-registering thermometer which has importance in meteorology. 6
2. (a) State Newton's law of cooling. Describe an experiment to prove the law. $\frac{2}{3}$
- (b) Establish the standard Fourier equation for one dimensional flow of heat when one end of a rod is heated. $\frac{2}{3}$
- (c) An ice box is built of wood 1.75 cm thick, lined inside with cork 3 cm thick. If the temperature of the inner surface of the cork is 0 °C and that of the outer surface of wood is 12 °C, what is the temperature of the interface? The thermal conductivity of wood and cork are 0.0006 and 0.00012 CGS units respectively. 3
3. (a) Discuss the fundamental assumptions of kinetic theory of gases. $\frac{3}{3}$
- (b) Write short note on 'Equipartition of energy'. $\frac{2}{3}$
- (c) State Van der Waal's equation of state and hence find Van der Waal's constants 'a' and 'b'. $\frac{5}{3}$
4. (a) Define System, wall and surrounding. $\frac{2}{3}$
- (b) Explain the reason, why isothermal process need conductor and extremely slow process. $\frac{2}{3}$
- (c) Derive an expression for work done in expansion of gas. $\frac{4}{3}$
5. (a) State and explain the first law of thermodynamics. $\frac{2}{3}$
- (b) Define C_p and C_v and explain why $C_p > C_v$, where symbols have their usual meaning. $\frac{4}{5}$
- (c) Derive the Mayer's relation, $C_p - C_v = R$, where symbols have their usual meaning. $\frac{4}{5}$
6. (a) Define Carnot's engine and write down the characteristics of Carnot's engine. $\frac{2}{3}$
- (b) Define the absolute thermodynamic scale and hence derive the absolute thermodynamic relation. $\frac{5}{3}$
- (c) Show that the absolute zero temperature is not attainable. $\frac{3}{3}$
7. (a) What is entropy? Write down the characteristic features of entropy. $\frac{2}{3}$
- (b) Proof that the entropy of a system increases in all irreversible processes. $\frac{4}{3}$
- (c) Explain that at absolute zero temperature isothermal and adiabatic processes are identical. $\frac{3}{3}$
8. (a) What do you mean by thermodynamical potentials? Write down their significance. $\frac{2}{3}$
- (b) Deduce the first order phase transition equation $\frac{dP}{dt} = \frac{L}{T(V_2 - V_1)}$, where symbols have their usual meaning. $\frac{5}{3}$
- (c) What is Helmholtz free energy function and why is it called free energy function? $\frac{3}{3}$

Pabna University of Science & Technology
Department of Physics
B.Sc. (Honours) 2nd Year 1st Semester Examination -2017
Course Title: Heat and Thermodynamics
Course no: PHY-2101

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Six questions out of Eight.
(ii) Figures in the right margin indicate full marks.

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|---|-----------------|
| 1. (a) Describe the concept of heat and explain the three states of matter in terms of heat energy and intermolecular force. | $\frac{6}{3}$ |
| (b) Write down the kinetic theory of matter. | 3 |
| (c) What do you understand by sensitive thermometer? | 2 |
| 2. (a) In what conditions real gas can be considered as ideal gas? Justify your answer. | 2 |
| (b) Deduce the Vander Waal's modified equation and describe the physical significance of Vander Waal's constants 'a' and 'b'. | 7 |
| (c) State the postulates of equipartition energy. Explain the kinetic interpretation of temperature. | $\frac{2}{3}$ |
| 3. (a) Discuss the fundamental assumptions of kinetic theory of gases. | 2 |
| (b) Write short note on 'equipartition energy'. | 4 |
| (c) State Vander Waal's equation of state and hence find Vander Waal's constants 'a' and 'b'. | $\frac{5}{3}$ |
| 4. (a) 'First law of thermodynamics is the law of conservation of energy.' Explain. | 3 |
| (b) What do you mean by isothermal and adiabatic process? Explain graphically. | 4 |
| (c) For adiabatic change in a perfect gas, show that $PV^\gamma = \text{constant}$. | $\frac{2}{3}$ |
| Q5 (a) State and explain the first law of thermodynamics. | $\frac{2}{3}$ |
| (b) What is enthalpy? Show that heat absorbed at constant pressure is equal to increase in enthalpy. | $1+\frac{3}{3}$ |
| (c) Prove that $TV^{\gamma-1} = \text{constant}$, where the symbols have their usual meaning. | 5 |
| 6. (a) Define heat engine and state the Carnot's theorem. | 2+2 |
| (b) Show that the area of the rectangle on the T-S diagram represents the external work done in a reversible Carnot's cycle. | $\frac{5}{3}$ |
| (c) 'Carnot's engine laid the basis of thermodynamic temperature scale' justify the statement. | 2 |
| 7. (a) What is entropy? Proof that entropy of a system increases in all irreversible processes. | 5 |
| (b) Why the adiabatic curves on the P-V diagram are called isentropic curves. | $\frac{2}{3}$ |
| (c) Show that in a cycle of reversible process total changes in entropy is always zero. | 5 |
| 8. (a) Write short notes on thermo dynamical potentials. | $\frac{2}{3}$ |
| (b) What does mean by first order and second order phase transition? Give some examples. | 3 |
| (c) Define latent heat. Deduce the first latent heat equation from the second thermo-dynamical relation. | $\frac{4}{5}$ |
| (d) What is Joule-Thomson effect? | 1 |

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Pabna University of Science and Technology
Department of Physics

B. Sc. (Honours) 2nd Year 1st Semester Examination 2021

Course Title: Optics

Course Code: PHY 2102

Time: 3 Hours

Full Marks: 70

N. B: (i) Answer any Five questions out of Eight.

(ii) Figures in the right margin indicate full marks.

1. (a) Define wavefront. Discuss briefly formation of wavefront. 1+2
(b) State and Explain Fermat's principle. 4
(c) Deduce the law of reflection using Fermat's principle. 7
2. (a) What is interference of light? 3
(b) Write down the condition for interference. 3
(c) Prove that the distance β between two successive bright fringes formed in Young's experiment is given by $\beta = \frac{D\lambda}{d}$. 8
3. (a) What are Newton's ring? 2
(b) Describe the method for the determination of wavelength of sodium light with their use. 4
(c) Describe the construction of Michelson's interferometer and explain its working. 8
4. (a) Describe the formation of light by a narrow slit. 3
(b) Distinguish between Fresnel's and Fraunhofer diffraction of light. 3
(c) Describe the intensity pattern of Fraunhofer diffraction of monochromatic light from a single slit. 8
5. (a) Define plane diffraction grating. What are its chief characteristics? 2+2
(b) Define resolving power. Obtain an expression for the resolving power of a plane diffraction grating. 2+8
6. (a) Explain the term 'plane polarization' and plane of 'vibration'. 4
(b) State and explain Brewster's law. Show that the polarizing angle of incidence, the reflected and refracted rays are mutually perpendicular to each other. 3+5
(c) The polarizing angle of certain type of glass is 54^0 . Find its refractive index. 2
7. (a) What is the abbreviation stands for LASER? What are the characteristics of LASER? 1+2
(b) Describe the construction and working principle of Ruby LASER. 6
(c) Explain different types of LASER. 3
(d) Mention few applications of LASER. 2
8. (a) What is holography? Distinguish between photography and holography. 2+2
(b) Discuss the basic principles of holography. 4
(c) Describe the recording and reconstruction process of a hologram. 6

Pabna University of Science and Technology
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B.Sc. (Honours) 2nd Year 1st Semester Examination 2020
Course Title: Optics
Course no: PHY 2102

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Five questions out of Eight.
(ii) Figures in the right margin indicate full marks.

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| 1. a) What are the methods for the determination of velocity of light? | 3 |
| b) State and explain Huygen's principle. | 6 |
| c) What is wavefront? Discuss the formation of wavefronts. | 5 |
| 2. a) What are coherent sources? Why coherent sources are needed to get interference fringes? | 2+2 |
| b) Mention the conditions for interference. | 3 |
| c) Explain the phenomenon of thin film interference by transmitted light. | 7 |
| 3. a) What are Newton's rings? Why Newton's rings are circular? | 2+2 |
| b) How do you determine the wavelength of light in Newton's ring method? | 4 |
| c) Derive the expression for the radius of the n^{th} bright and dark rings in the formation of Newton's rings by reflected light. | 6 |
| 4. a) What do you mean by diffraction of light? Write down the conditions for diffraction of light. | 1+3 |
| b) Distinguish between different types of diffraction of light. | 4 |
| c) Discuss the Fraunhofer diffraction of monochromatic light from a single slit. | 6 |
| 5. a) What is double refraction? | 2 |
| b) What is resolving power? Derive an expression for the resolving power of a plane diffraction grating. | 8 |
| c) Two spectral lines at $\lambda = 6200 \text{ \AA}$ have a separation of 0.652 \AA . Find the minimum number of lines a diffraction grating must have to just resolve this doublet in the second order spectrum. | 4 |
| 6. a) What do you mean by polarization of light? Name some crystals which produce polarization. | 2+2 |
| b) Explain ordinary and extra-ordinary rays. | 3 |
| c) Explain how Nicol prism can be used as a polarizer or as an analyzer? | 7 |
| 7. a) Write down the abbreviation of LASER. | 1 |
| b) Write down the basic features of LASER. | 3 |
| c) Mention some practical applications of LASER. | 3 |
| d) Describe the construction and working principle of Ruby LASER. | 7 |
| 8. a) Distinguish between photography and holography. | 3 |
| b) How can a hologram be produced and reproduced? | 3 |
| c) Describe the theory of holography. | 6 |
| d) Mention two applications of holography. | 2 |

Pabna University of Science and Technology

Department of Physics

B.Sc. (Honours) 2nd Year 1st Semester Examination 2019

Course Title: Optics

Course no: PHY-2102

Time: 3:00 Hours

Full Marks: 70

N.B.: (I) Answer any Five questions out of Eight.
 (II) Figures in the right margin indicate full marks.

1.
 - a) Explain the phenomenon of (i) reflection and (ii) refraction of light on the basis of wave theory. 5
 - b) State and explain Fermat's principle. 4
 - c) Deduce the law of reflection using Fermat's principle. 5
2.
 - a) Explain coherence. 2
 - b) Using Young's double slit experiment; obtain expression for the position of the bright fringes observed on the screen. Hence also find the expression of the fringe width. 5+2
 - c) In Young's double slit experiment; the separation of the slit is 2mm and the fringe spacing is 0.3mm at a distance of 1m from the slits. Estimate the wavelength of the light. 3
 - d) Can a person observe interference fringe from two headlights of a vehicle? Justify your answer. 2
3.
 - a) Derive Stoke's relations for optical reversibility and hence explain the meaning of the minus sign in the second relation. 2+2
 - b) Obtain expressions for maxima and minima due to multiple reflections from a plane parallel film. 4
 - c) Newton's rings are observed in reflected light having wavelength of 5.9×10^{-5} cm. diameter of the 10th dark ring is 0.50cm. Estimate the radius of the curvature of the lens and the thickness of the air film. 4
4.
 - a) What do you mean by diffraction of light? Write down the conditions for diffraction of light. 1+3
 - b) Distinguish between different types of diffraction of light. 4
 - c) Discuss the Fraunhofer diffraction of monochromatic light from a single slit. 6
5.
 - a) Explain the terms plane of polarization and plane of vibration. 3
 - b) Discuss the production of circularly and elliptically polarized light. How they can be detected? 4+2
 - c) State and explain Brewster's law of polarization. 5
6.
 - a) Define polarization of light. Explain the phenomenon of double refraction. 1+3
 - b) Describe the construction of a Nicol prism and show how it can be used as a polarizer or as an analyzer? 10
7.
 - a) What is the abbreviation stands for LASER? Mention some real applications of LASER. 1+2
 - b) Explain spontaneous emissions and stimulated emissions. 4
 - c) Describe construction and working principle of Ruby LASER. 7
8.
 - a) What is holography? How the hologram is produced? 2+3
 - b) Describe the theory of holography. 5
 - c) Classify hologram. Mention some applications of holography. 2+2

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N.B.: (i) Answer any Six questions out of Eight.
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1. (a) State and explain Huygen's principle. $\frac{2}{3}$
 (b) Deduce the law of refraction of light using Fermat's principle. 5
 (c) Describe the energy and frequency range of electromagnetic spectrum. 4
2. (a) Explain interference of light. $\frac{2}{3}$
 (b) Deduce the relation $I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos\delta$, where the symbols have their usual meaning and explain. 4+2
 (c) In Newton's ring experiment the radius of 9th dark ring is 0.27cm. Find the radius of curvature of lens. [$\lambda = 589 \text{ nm}$]. 3
3. (a) What is optical path? Obtain an expression for the thickness of the thin film in Young's double slit experiment. $\frac{2}{3}$
 (b) Define thin prism and biprism. 500 nm light incident on a biprism. If the separation of 10 fringes on a screen 2m away is 0.02m. Find the distance between two virtual sources. 2+3
4. (a) Distinguish between Fraunhofer and Fresnel's diffraction. $\frac{2}{3}$
 (b) Describe the theory of double slit Fraunhofer diffraction. 5
 (c) Deduce an expression for the resolving power of grating. 4
5. (a) Pictorially represent unpolarized light and linear polarized light. $\frac{2}{3}$
 (b) Obtain an expression for the elliptical polarized light. Hence show that linear and circular polarizations are the special case of it. 5+2+2
6. (a) What is population inversion? 1
 (b) Explain the methods of creating the population inversion. $\frac{2}{3}$
 (c) Establish the relationship among the Einstein's coefficients for radiative transitions. 5
 (d) Find the ratio of populations of the two states of hydrogen atom at room temperature and at temperature of 600 K. [$E_1 = -13.6 \text{ eV}$ and $E_2 = 3.39 \text{ eV}$]. 2
7. (a) Explain with diagram: (i) spontaneous emission and (ii) stimulated emission of radiation. 3
 (b) Describe the construction and working principle of CO₂ laser. 6
 (c) Write down the characteristics and applications of laser. $\frac{2}{3}$
8. (a) What are the difference between holography and photography? 3
 (b) How can a hologram be produced? 4
 (c) How does a hologram record phase? 2
 (d) Give some uses of hologram. $\frac{2}{3}$

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Course no: PHY-2102

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N.B.: (i) Answer any Six questions out of Eight.
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|---|----------------|
| 1. (a) State and explain Fermat's principle. | $2\frac{2}{3}$ |
| (b) Deduce the law of reflection of light using Fermat's principle. | 5 |
| (c) Discuss the law of internal reflection from the wave theory of light. | 4 |
| 2. (a) What are coherent sources? Why coherent sources are needed to get interference fringes? | $2\frac{2}{3}$ |
| (b) Give the analytical treatment of interference of light. | 4 |
| (c) What are different types of interferometers? Describe in brief the construction of Michelson's interferometer. | 4 |
| 3. (a) What are Newton's rings? Why the rings are circular? | $2\frac{2}{3}$ |
| (b) How do you determine the wavelength of light in Newton's ring method? | 4 |
| (c) In Newton's ring experiment the diameter of the 15 th ring was found to be 0.59cm and that of 5 th ring was 0.336cm. If the radius of the Plano-convex lens used was 100cm, calculate the wavelength of light used. | 4 |
| 4. (a) Distinguish between Fresnel and Fraunhofer diffractions. | $2\frac{2}{3}$ |
| (b) Define slit and grating. Write the grating equation and explain all the terms appeared in this equation. | 3 |
| (c) Obtain the expressions for the amplitude and intensity for diffraction of a single slit. | 6 |
| 5. (a) What do you mean by polarization of light? Name some crystals which produce polarization. | $2\frac{2}{3}$ |
| (b) What are ordinary and extra-ordinary rays? | 2 |
| (c) Explain how Nicol prism can be used as a polarizer and also as an analyzer? | 7 |
| 6. (a) Explain the phenomenon of polarization by double refraction. | 3 |
| (b) Describe a polarimeter. How will you use it to determine the specific rotation of sugar solution? | $1+5$ |
| (c) Find the polarizing angle for a glass with refractive index 1.52. | $2\frac{2}{3}$ |
| 7. (a) What is LASER? | $2\frac{2}{3}$ |
| (b) Describe the construction and working principle of Ruby LASER. | 7 |
| (c) Discuss the basic principle of LASER. | 2 |
| 8. (a) What is holography? | $2\frac{2}{3}$ |
| (b) Describe the theory of holography. | 5 |
| (c) Describe the recording and reconstruction process of a hologram. | 4 |
| (d) Write down two applications of holography. | 1 |

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Pabna University of Science and Technology
 Department of Physics
 B.Sc. (Honours) 2nd Year 1st Semester Examination 2021
 Course Title: Basic Electronics
 Course Code: PHY 2103

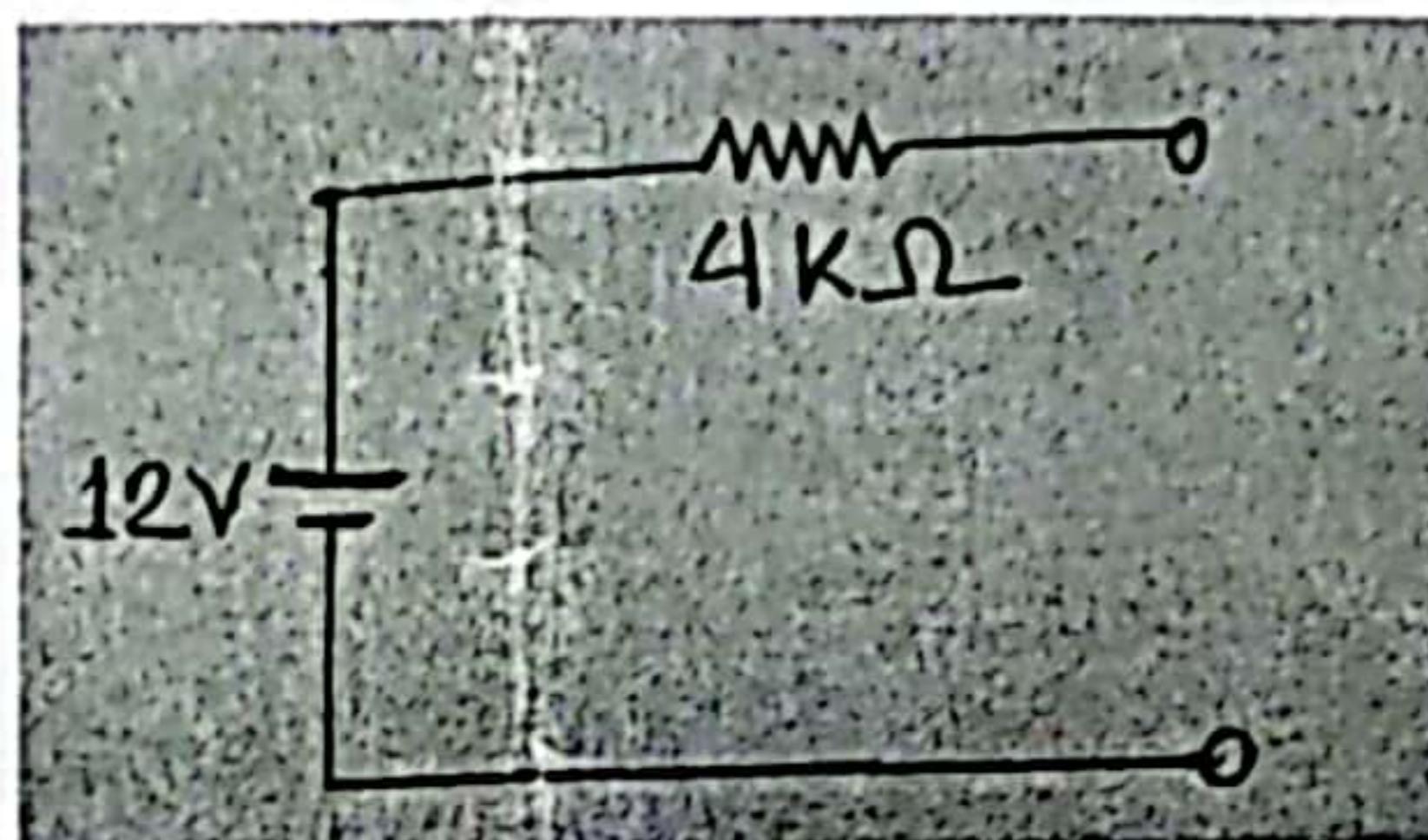
Time: 3 hours

Full Mark: 70

N.B: (i) Answer any Five questions out of Eight

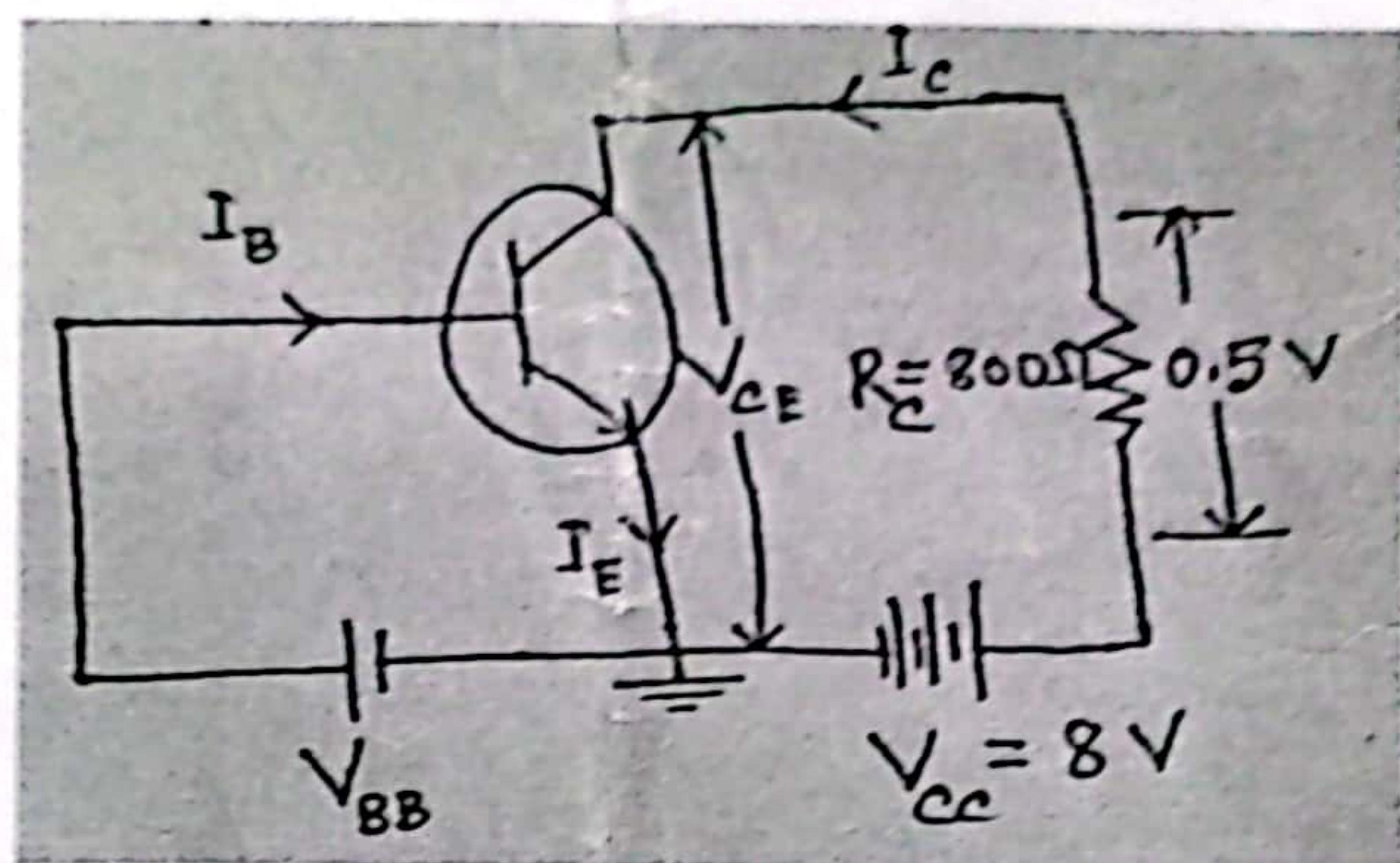
(ii) Figures in the right margin indicate full marks.

1. (a) Define electronics and electronic devices. ✓ 2
 (b) Explain some important functions of electronic devices. ✓ 4
 (c) What is constant voltage source? How can you convert a voltage source into a current source? ✓ 1+3
 (d) Convert the following voltage source into equivalent current source: ✓ 4

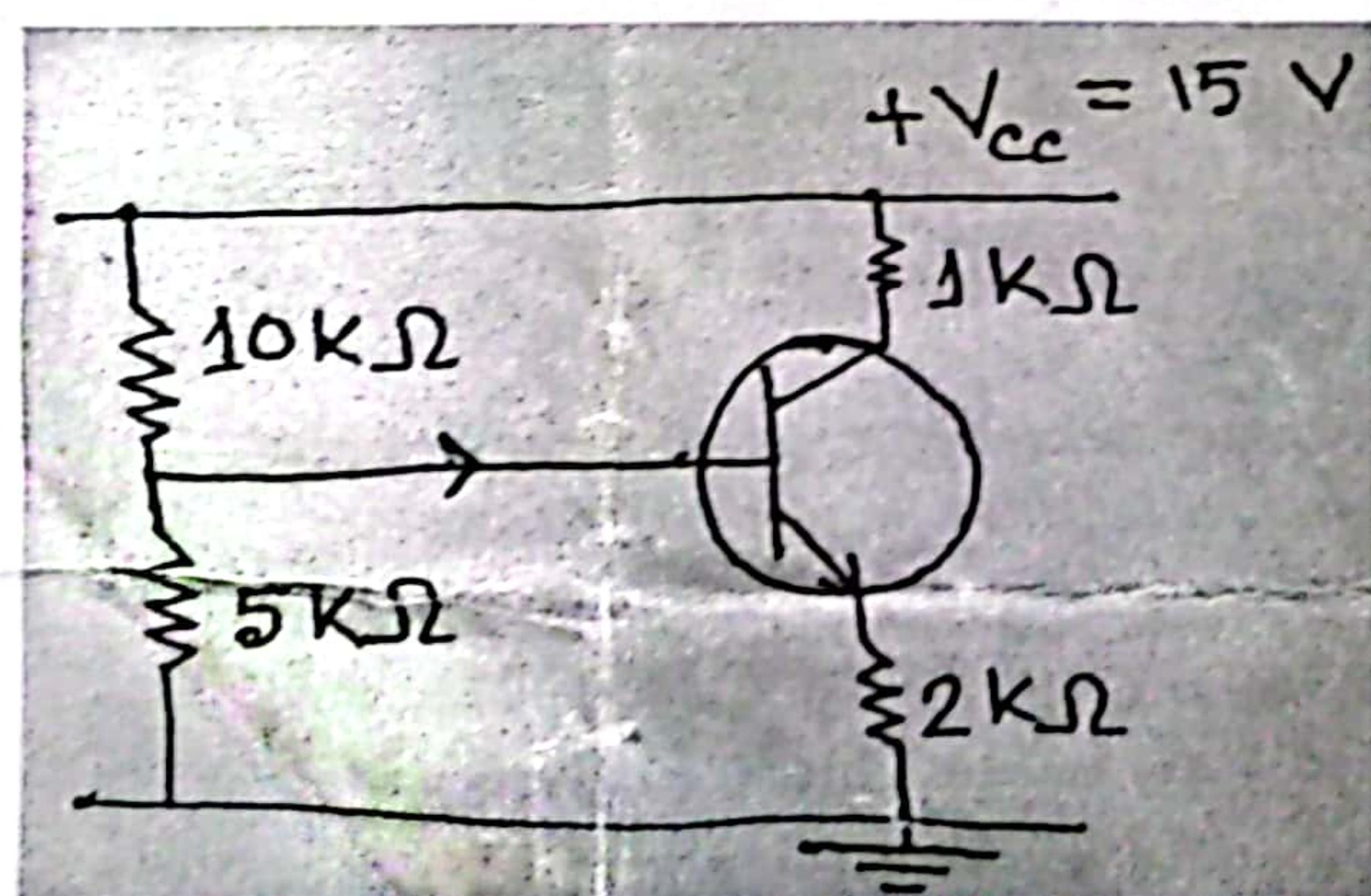


2. (a) What is meant by a vacuum tube? Classify vacuum tubes in terms of number of electrodes. 3
 (b) Explain the construction and operation of a vacuum diode. 6
 (c) Define plate resistance and classify the plate resistance of a diode. 2
 (d) The plate current in a diode is 10 mA and plate voltage of 100 V when operating in the space charge limited region. What is the plate voltage necessary to double the plate current? 3
3. (a) Explain semiconductor on the light of band theory of solid. ✓ 3
 (b) Define intrinsic and extrinsic semiconductors. Explain the mechanism of converting intrinsic semiconductor into p-type and n-type semiconductor. ✓ 7
 (c) Shortly explain majority and minority carriers with suitable sketch. ✓ 4
4. (a) What is a pn junction? Explain its formation procedure. ✓ 1+4
 (b) Why is a semiconductor an insulator at ordinary temperature? ✓ 2
 (c) Explain the formation of potential barrier in a pn junction. ✓ 4
 (d) What is peak inverse voltage? What is its importance? 1+2
5. (a) Draw the circuit diagram of a centre-tap full-wave rectifier and explain its operation. 6
 (b) Show that, the efficiency of a full-wave rectifier is $\eta = \frac{8}{\pi^2} \times \frac{R_L}{r_f + R_L}$. Also show that the maximum efficiency of full-wave rectifier is 81.2 %. 5
 (c) What is ripple factor? A power supply A delivers 10 V dc with a ripple of 0.5 V r.m.s while the power supply B delivers 25 V dc with a ripple of 1 mV r.m.s. Which is better power supply? 1+2

6. (a) Define a semiconductor diode with its use. 2
- (b) Explain the formation and operation of a full wave bridge rectifier. Mention its advantages and disadvantages. 8
- (c) What is Zener diode? How Zener diode can be used as a stabilizer? 4
7. (a) What is transistor? Why is it so called? 1+1
- (b) Explain the procedure of determining the output characteristics of an npn transistor in CE configuration. 4
- (c) Establish the relation $I_C = \frac{\alpha}{1-\alpha} I_B + \frac{1}{1-\alpha} I_{CBO}$. 4
- (d) For the following circuit, if $\alpha = 0.96$, determine i) collector-emitter voltage (V_{CE}) and ii) base current (I_B). 4



8. (a) What is faithful amplification? Mention the conditions to be fulfilled to achieve faithful amplification in a transistor amplifier. 1+2
- (b) Describe potential divider bias method with proper circuit diagram and find its stability factor. 6
- (c) Assuming the transistor to be of silicon draw the d. c. load line and determine the operating point for the following circuit: 5



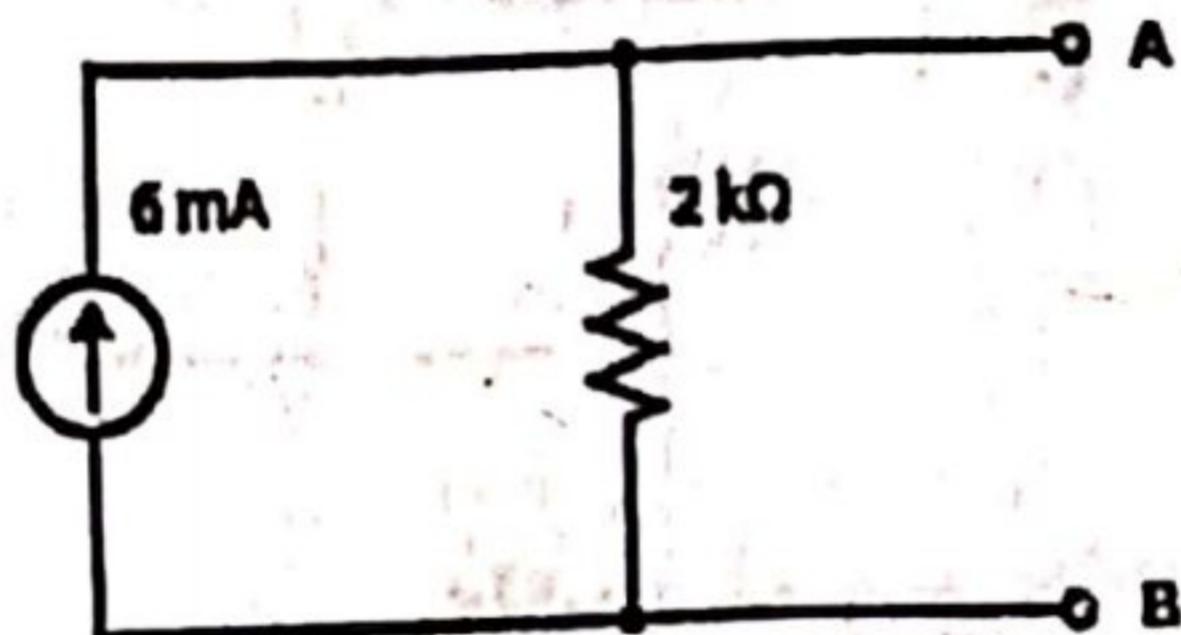
Pabna University of Science and Technology
Department of Physics
B.Sc. (Honours) 2nd Year 1st Semester Examination 2020
Course Title: Basic Electronics
Course no: PHY 2103

Full Marks: 70

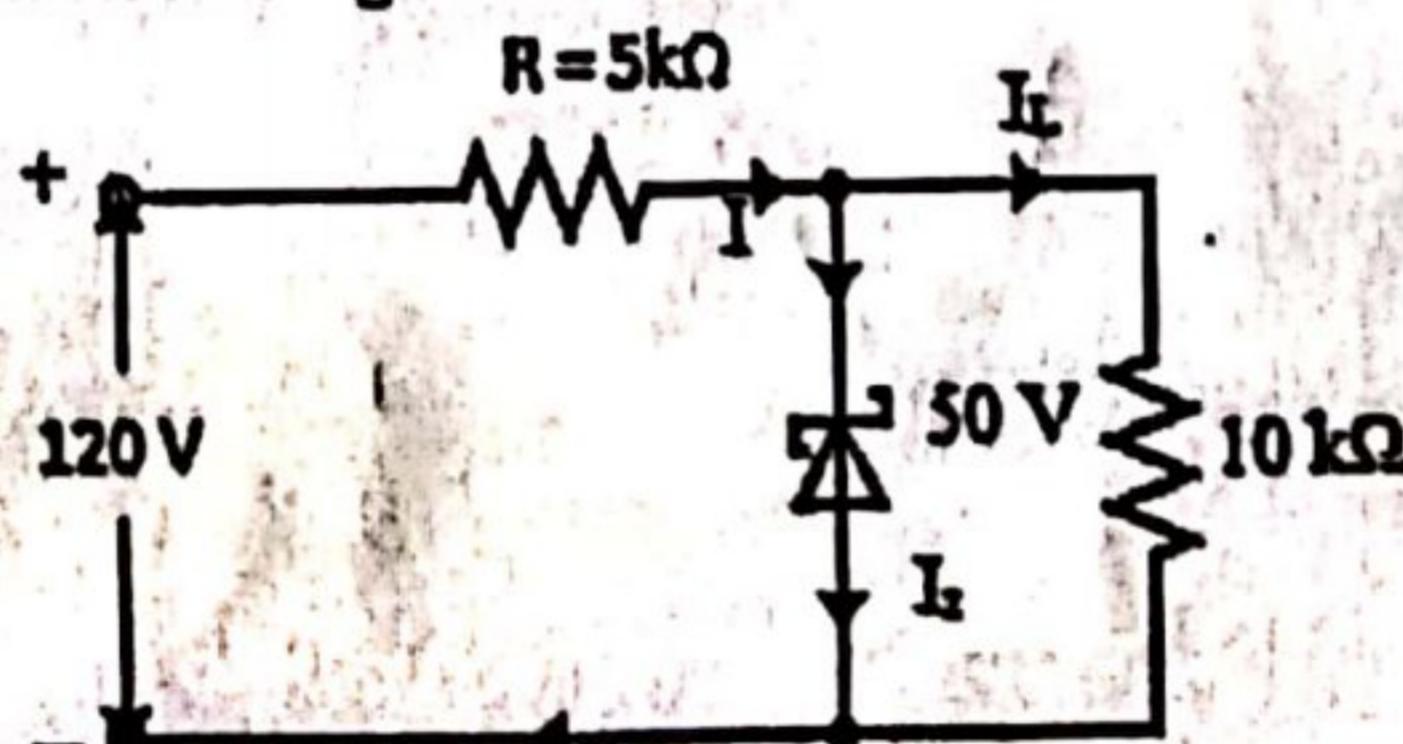
Time: 3:00 Hours

N.B.: (I) Answer any Five questions out of Eight.
 (II) Figures in the right margin indicate full marks.

1. **a)** Explain the differences between electricity and electronics. ✓ 3
b) Distinguish between voltage source and current source. ✓ 2
c) What is constant current source? How can you convert a current source into voltage source? ✓ 1+4
d) Convert the following current source into equivalent voltage source: ✓ 4



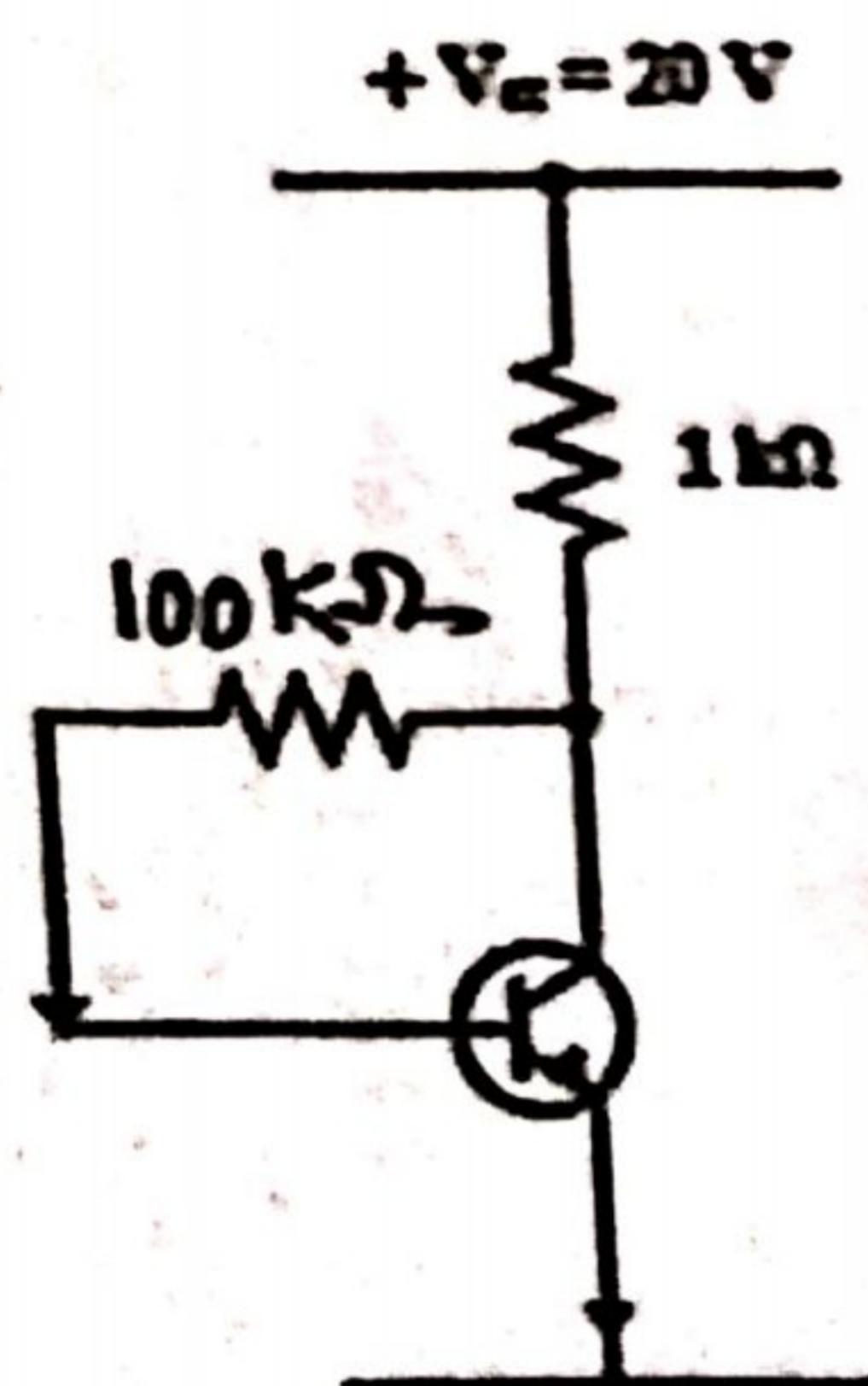
2. **a)** Explain different types of vacuum tubes. 5
b) Describe the characteristics of a vacuum triode. 6
c) What are vacuum tube constants? 3
3. **a)** What are the characteristics differences between conductor and semiconductor? ✓ 4
b) Explain the different types of semiconductors. ✓ 6
c) Describe the mechanism to convert an intrinsic semiconductor to an extrinsic semiconductor. ✓ 4
4. **a)** Explain the terms: i) Breakdown voltage, ii) Knee voltage and iii) PIV. 6
b) What is pn junction? Discuss the behavior of a pn junction under forward and reverse biasing. ✓ 1+7
5. **a)** What do you mean by rectifier? 3
b) Describe the working principle of a full wave rectifier. 5
c) Explain tunnel diode and photodiode. 6
6. **a)** What is Zener diode? What is its equivalent circuit? 1+2
b) Explain how Zener diode maintains constant voltage across the load. 5
c) For the following circuit, find: i) the output voltage, ii) the voltage drop across series resistance and iii) the current through Zener diode. 6



7. **a)** Draw the block diagram of npn and pnp transistor and explain their working principle. 1+6
b) Define operating point and d.c. load line. How will you draw d.c. load line on the output characteristics of transistor? 2+3
c) In a transistor circuit, collector load is 4 kΩ whereas zero signal collector current is 1 mA.
 i) What is the operating point if $V_{cc} = 10$ V? 2
 ii) What will be the operating point if $R_c = 5$ kΩ?

8.

- a) What do you understand by transistor biasing? What is its need?
- b) Explain biasing with feedback resistor method for transistor biasing.
- c) A silicon transistor shown below is biased by feedback resistor method. Determine its operating point. Given $\beta = 100$.



Pabna University of Science & Technology

Department of Physics

B.Sc. (Honours) 2nd Year 1st Semester Exam-2019

Course Title: Basic Electronics

Course Code: PHY-2104/PHY-2103(Imp.)

Full Marks: 70

Time: 3:00 Hours

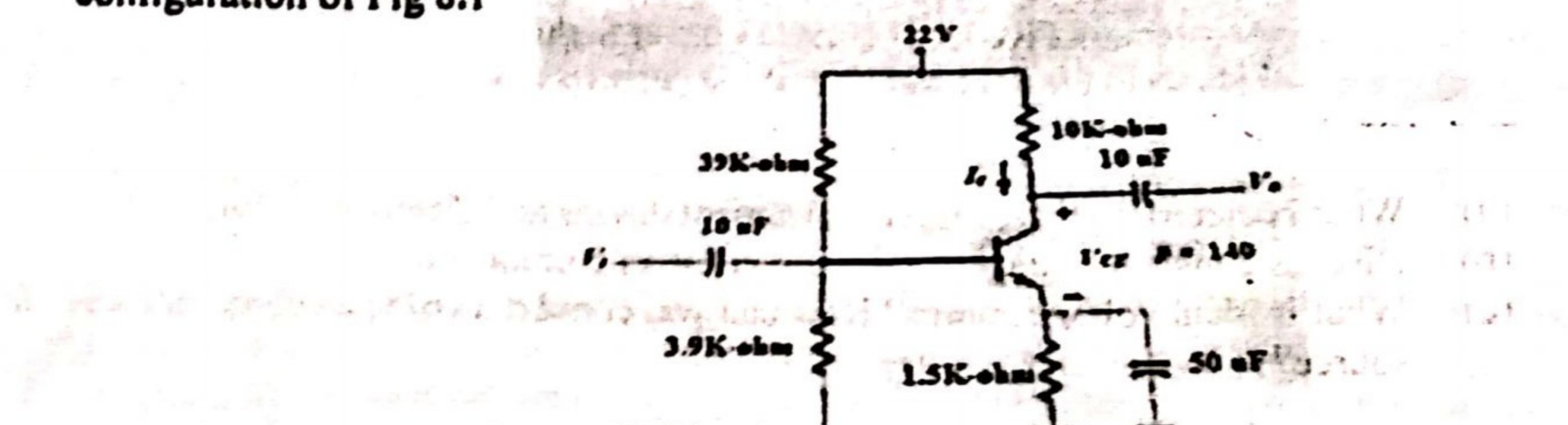
N.B: (i) Answer any Five set of questions out of Eight set.
 (ii) Figures in the right margin indicate full marks.

- | | | |
|----|---|-----|
| 1. | (a) What is electricity? Distinguish electrical device and electronic device. | 1+4 |
| | (b) Discuss constant voltage source and constant current source. | 4 |
| | (c) What is ideal voltage source? How can you convert a voltage source into current source? | 1+4 |
| 2. | (a) What is semiconductor? Mention some of the properties of semiconductor. | 1+3 |
| | (b) Define intrinsic and extrinsic semiconductor. Why do we need extrinsic semiconductor? | 3+2 |
| | (c) What is a pn junction? Explain the formation of potential barrier in a pn junction. | 1+4 |
| 3. | (a) Derive expressions for rectification efficiency and ripple factor of a full wave rectifier. | 6 |
| | (b) Explain the formation of n-type semiconductor material. | 4 |
| | (c) Why does an LED emit light but a normal pn junction diode doesn't? | 4 |
| 4. | (a) Write short notes on: (i) Zener diode and (ii) LDR. | 3+3 |
| | (b) Will a transistor result if two diodes are connected back to back? | 3 |
| | (c) A half wave rectifier is used to supply 50V d.c to a resistive load of 800Ω . The diode has a resistance of 25Ω . Calculate a.c voltage required. | 5 |
| 5. | (a) Explain the mechanism of current flow in NPN transistor with neat diagram. | 4 |
| | (b) Draw the CB, CE and CC configurations for NPN and PNP transistor. | 6 |
| | (c) Why is collector region wider than emitter region in bipolar junction transistor? | 4 |
| 6. | (a) What do you mean by stability factor and thermal runaway? | 2+2 |
| | (b) Describe the potential divider biasing method. How stabilization of operating point is achieved by this method. | 6 |
| | (c) In a bipolar junction transistor, emitter current is 12 mA and the emitter current is 1.02 times the collector current. Find the base current. | 4 |
| 7. | (a) Define the different operating regions of transistor. | 4 |
| | (b) What is faithful amplification? Explain the conditions to be fulfilled to achieve faithful amplification in a transistor amplifier. | 1+4 |
| | (c) In a transistor circuit, if $V_{cc} = 12V$ and $R_c = 6 K\Omega$, zero signal base current | 5 |

$I_B = 20 \mu A$ and $\beta = 50$. Draw the dc load line and determine the Q point.

8. (a) Deduce the expression of emitter bias CE configuration for n-p-n transistor.
(b) Determine the dc bias voltage V_{CE} and the current I_c for the voltage divider CE configuration of Fig 8.1

4
4



- (c) How to use transistor as AND, OR and NOT logic gate? 6

6

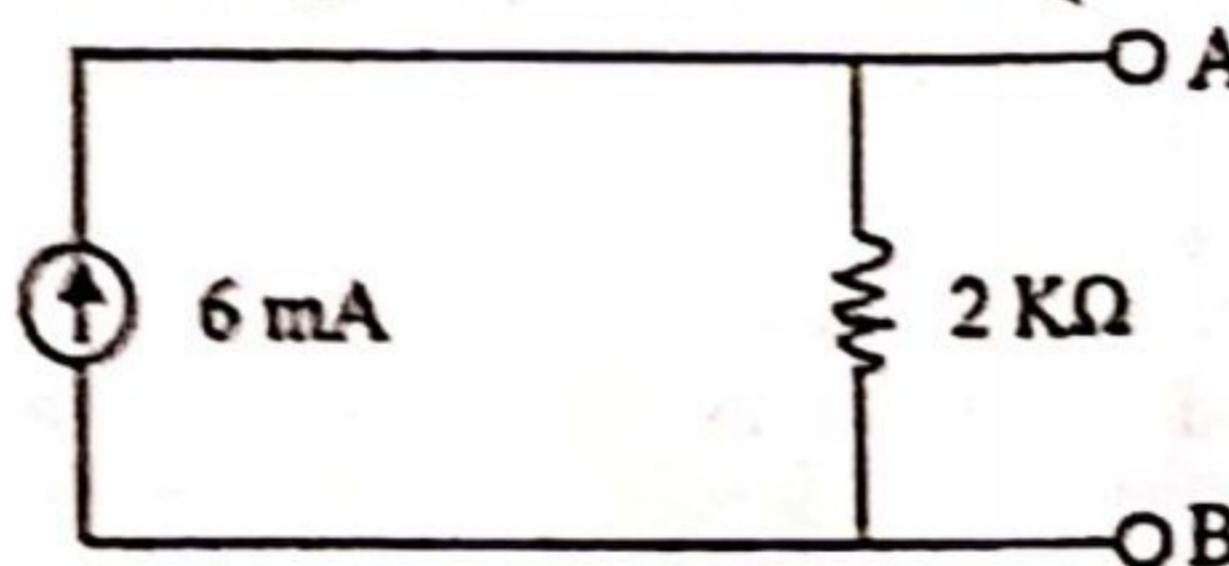
Pabna University of Science and Technology
 Department of Physics
 B.Sc. (Honours) 2nd Year 1st Semester Examination 2018
 Course Title: Basic Electronics
 Course no: PHY-2103/PHY-2104

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Six questions out of Eight.
 (ii) Figures in the right margin indicate full marks.

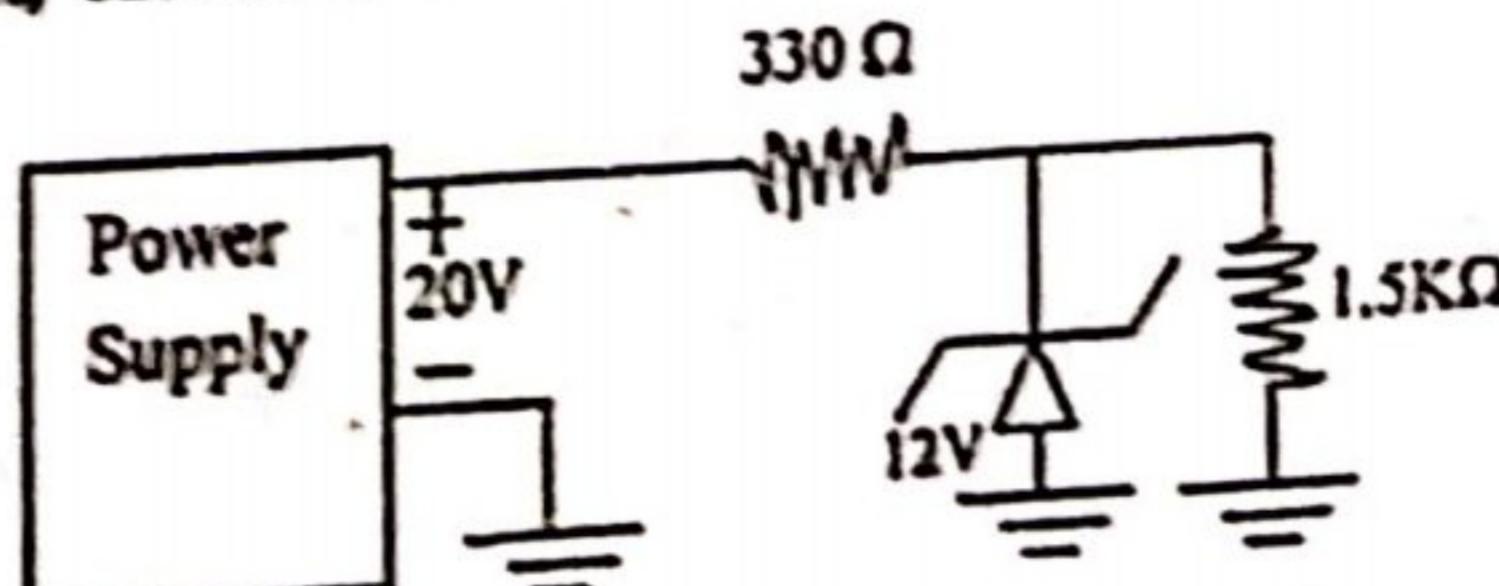
1. (a) What are free electrons? Define conductors, insulators, and semiconductors in terms of free electrons. $\frac{2}{3}$
 (b) Explain constant voltage and constant current sources. 4
 (c) Explain how can you convert a constant current source into a constant voltage source. 2
 (d) Convert the following current source into equivalent voltage source: $\frac{3}{3}$



2. (a) Describe the construction and working principle of a vacuum triode. 4
 (b) Define plate resistance, transconductance and amplification factor of a triode and establish the relationship among them. 5
 (c) The plate current in a diode is 10mA at a plate voltage of 100V when operating in the space charge limited region. What is the plate voltage necessary to double the plate current? $\frac{2}{3}$
3. (a) Give the mechanism of hole current flow in a semiconductor. $\frac{2}{3}$
 (b) What is pn junction? Discuss the behavior of a pn junction under forward and reverse biasing. 1+6

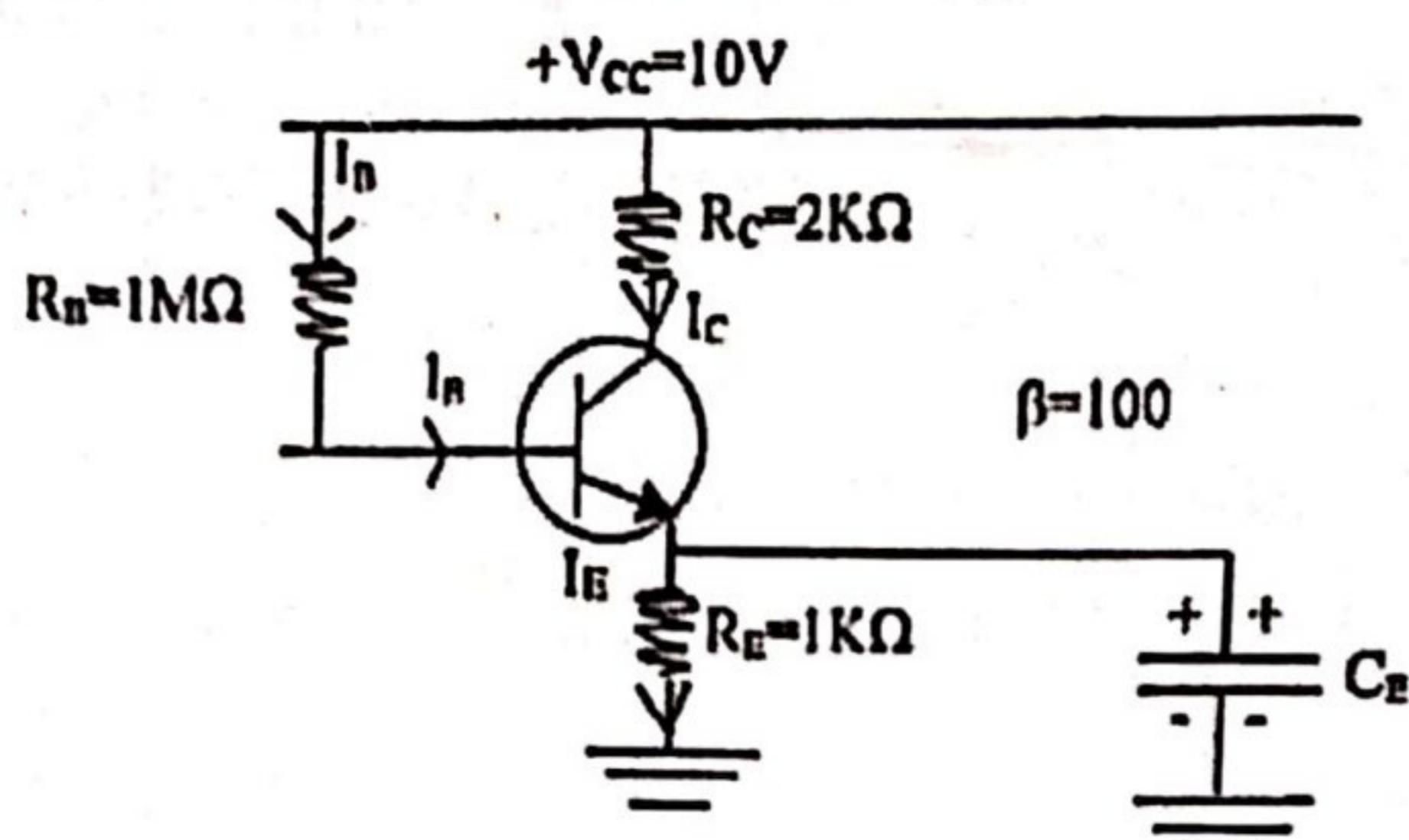
4. (a) Differentiate between half and full wave rectifiers. 4
 (b) Derive an expression for the efficiency for a full-wave rectifier. 5
 (c) A full-wave rectifier uses two diodes, the internal resistance of each diode may be assumed constant at 20Ω . The transformer r.m.s. secondary voltage from centre tap to each end of secondary is 50V and load resistance is 980Ω . Find (i) mean load current, (ii) RMS value of load cur

5. (a) What is a zener diode? Draw the equivalent circuit of an ideal zener diode in the breakdown region. 1+3
 (b) Explain how zener diode maintains constant voltage across the load. $\frac{2}{3}$
 (c) For the following circuit, calculate current through (i) 330Ω resistor, (ii) zener diode and (iii) $1.5\text{ k}\Omega$ load. 3



6. (a) Explain the working of npn transistor. $\frac{2}{3}$
 (b) Define β . Show that $\beta = \frac{\alpha}{1-\alpha}$; where the symbols have their usual meanings. 1+4

(c) Calculate the values of three currents in the following circuit:



7. (a) What do you mean by stabilization of operating point? 3
(b) Define stability factor. Derive an expression for the same for fixed bias circuit. 6
(c) Determine the bias resistor R_B for fixed bias circuit. Given $V_{CC} = 12\text{ Volt}$ and $I_B = 0.3\text{ mA}$. 2
2/3
8. (a) What is faithful amplification? Explain the conditions to be fulfilled to achieve faithful 1+2/3 amplification in a transistor amplifier.
(b) Describe base resistor method for transistor biasing. 4
(c) A silicon transistor with $\beta = 100$ is biased by base resistor method with $R_B = 530\text{ k}\Omega$, $R_C = 2\text{ k}\Omega$ and $V_{CC} = 6\text{ V}$. Draw the d.c load line and determine the operating point. What is 4
4 its stability factor?

Pabna University of Science & Technology
Department of Physics
B.Sc. (Honours) 2nd Year 1st Semester Examination - 2017
Course Title: Basic Electronics
Course no: PHY-2104

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Six questions out of Eight.
(ii) Figures in the right margin indicate full marks.

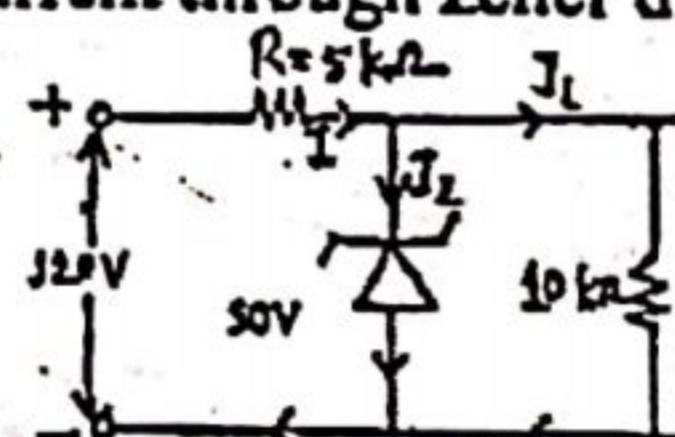
1. (a) What is electronics? Mention some important applications of electronics. ✓ 1+2
(b) What are valence electrons? Explain how valence electrons determine the electrical properties of a material. ✓ 1+2
(c) Explain how can you convert a constant voltage source into a constant current source. ✓ 2
(d) Convert the following current source into equivalent voltage source: ✓ 3

$$\begin{matrix} \text{I}_S = 1\text{mA} \\ \text{V}_S = ? \end{matrix}$$
 2

2. (a) Explain the construction and working of a vacuum diode. 2
(b) Give the procedure of determining the static plate characteristics, mutual characteristics and constant current characteristics of a vacuum triode. What inferences do you draw from these curves? 5
(c) What do you understand by intrinsic and extrinsic semiconductors? 03
What is a p-n junction? Explain the formation of potential barrier in a p-n junction. 05
Discuss the effect of temperature on semiconductors. 2

$$\frac{3}{3}$$
3. (a) With a neat sketch, explain the working of a half-wave rectifier and hence derive an expression for its efficiency. 2
(b) What is ripple factor? What is its value for a half-wave and full-wave rectifier? 5
(c) What is a zener diode? For the following circuit find (i) output voltage, (ii) the voltage drop across series resistance and (iii) the current through zener diode. 3

$$\frac{2}{3}$$



4. (a) Write short notes on: (i) Photodiode, (ii) Varactor diode and (iii) Tunnel diode 2
(b) What is transistor? Describe the transistor action in detail. 11
(c) Explain the operation of transistor as an amplifier. 3
(d) Draw and explain I_c-V_c characteristics curves for an NPN transistor using CB configuration. 3

$$\frac{2}{3}$$
5. (a) Define operating point and d.c load line. 2
(b) How will you draw d.c load line on the output characteristics of a transistor? What is its importance? 2
(c) In a transistor circuit, if V_{CC}=12V and R_C=6 kΩ, zero signal base current I_B=20μA and β=50. (i) Draw the dc load line and (ii) determine the Q point. 5

$$\frac{2}{3}$$
6. (a) What do you understand by transistor biasing? What is its need? 3
(b) Describe the potential divider method in detail. How stabilization of operating point is achieved by this method? 6
(c) A transistor uses potential divider method of biasing with R₁=50kΩ, R₂=50kΩ, R_E=50kΩ and V_{CC}=12V. Find (i) the value of I_C; given V_{BE}=0.1 V and (ii) the value of I_C; given V_{BE}=0.3V. 2

$$\frac{2}{3}$$

Pabna University of Science and Technology
Department of Physics

B. Sc. (Honours) 2nd Year 1st Semester Examination 2021

Course Title: Mathematical Methods in Physics II

Course no: PHY-2104

Time: 3 Hours

Full Marks:

70

N. B: (i) Answer any Five questions out of Eight.

(ii) Figures in the right margin indicate full marks.

1. (a) Define beta and gamma functions. Establish the relation

$$\int_0^{\frac{\pi}{2}} \sin^p \theta \cos^q \theta d\theta = \frac{\Gamma(\frac{p+1}{2}) \Gamma(\frac{q+1}{2})}{2 \Gamma(\frac{p+q+1}{2})}$$

1+4

- (b) Evaluate the integrals: (i) $\int_0^{\infty} \frac{x^{n-1}}{1+x} dx$, (ii) $\int_0^1 x^{m-1} (1-x^a)^n dx$ and $\int_0^1 \frac{x^3}{32} \sqrt[3]{1-x} dx$.

9

2. (a) Define Laplace transformation and explain its properties.

1+4

- (b) Find Laplace transform of $\cos ht$ and $\cos at$.

6

- (c) Evaluate $L\{\sin 2t + 2\cos 3t\}$.

3

3. (a) Define hypergeometric function. Derive confluent hypergeometric function from hypergeometric equation.

2+4

- (b) Define Legendre polynomials. Express $f(x) = x^4 + 2x^3 + 2x^2 - x - 3$ in terms of Legendre polynomials.

1+4

- (c) Show that $p_n(-x) = (-1)^n p_n(x)$.

3

4. (a) Derive the Cauchy-Riemann condition for the complex function to be analytic. Are the conditions sufficient?

6

- (b) Evaluate the following integrals (i) $\int_0^{\infty} \frac{\sin x}{x} dx$ (ii) $\int_{-\infty}^{\infty} \frac{dx}{1+x^2}$.

8

5. (a) State and prove Poisson's integral formulas for a circle.



5

- (b) State and prove the Residue theorem.

4

- (c) Find the Residues of $f(z) = \frac{z^2 - 2z}{(z+1)^2(z^2+4)}$ at all its poles in the finite plane.

5

6. (a) Define adjoint of a matrix. Show that $\text{adj}(\text{adj}A) = |A|^{n-2} \cdot A$

4

- (b) If $A = \begin{bmatrix} 2 & 5 & 3 \\ 3 & 1 & 2 \\ 1 & 2 & 1 \end{bmatrix}$. Find $\text{adj } A$ and A^{-1} .

$$f_0 = \left(\frac{\sqrt{4b}}{\sqrt{-a}} \right) X f_1$$

6

- (c) Find the eigen value and Eigenvector of $\begin{bmatrix} 8 & 3 \\ 2 & 7 \end{bmatrix}$.

4

7. (a) What is tensor? Why is it important in Physics?

1+2

- (b) What do you mean by spaces of N-dimensions?

2

- (c) Define transformation of coordinates from one frame of reference to another.

3

- (d) Write the law of transformation for the tensors: i) A_{jk}^l , ii) B_{ijk}^{mn} and iii) C^m .

6

8. (a) What is Christoffel's symbol? Derive transformation law for the Christoffel symbols of the first and the second kind.

5

- (b) Determine the Christoffel's symbols of the first kind in (i) rectangular and (ii) spherical coordinates.

6

- (c) Find the components of the metric tensor in cylindered coordinates.

3

- a) Explain real number system with their graphical representation.
- b) What is complex variable? Perform the following operation both analytically and graphically.

$$(-3+5i) + (4+2i) + (5-3i) + (-4-6i)$$

1+9

- c) Define analytic function. Construct an analytic function $f(z)$ whose real part is $e^x \cos y$

1+3

Pabna University of Science and Technology

Department of Physics

B.Sc. (Honours) 2nd Year 1st Semester Examination 2020

Course Title: Mathematical Methods in Physics-II

Course no: PHY-2104

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Five questions out of Eight.
 (ii) Figures in the right margin indicate full marks.

- | | | |
|--------|--|-----|
| 1. (a) | Define odd and even functions with example. | 3 |
| (b) | What is Fourier series? Show that an even function can have no sine term in its Fourier series. | 1+5 |
| (c) | Find the Fourier series of $f(x) = \begin{cases} -\cos x; & -\pi \leq x \leq 0 \\ \cos x; & 0 \leq x \leq \pi \end{cases}$. | 5 |
| 2. (a) | State and prove Walli's formula. | 4 |
| (b) | A particle is attached toward a fixed point O with a force inversely proportional to its instantaneous distance from O. Applying the knowledge of gamma function, show that if the particle is released from rest the time for it to reach O is given by $T = a \sqrt{\frac{\pi m}{2k}}$. | 4 |
| (c) | Prove the following identities:
i) $\Gamma(-\frac{1}{2}) = -2\sqrt{\pi}$, ii) $\int_0^{\pi/2} C \rho t \theta d\theta = \frac{1}{2} \Gamma(1/4) \Gamma(3/4)$ and iii) $\int_0^{\pi/2} \sin^6 x dx = 5\pi/32$. | 6 |
| 3. (a) | Define Bessel's function, Laguerre polynomials and hypergeometric function. | 3 |
| (b) | Prove the following identities:
i) ${}_2F_1(\alpha, \beta; \gamma; x)_{x=0} = 1$, ii) $\frac{d}{dx} [{}_2F_1(\alpha, \beta; \gamma; x)]_{x=0} = \frac{\alpha \beta}{\gamma}$ and
iii) $x J_n'(x) = n J_n(x) - x J_{n+1}(x)$. | 6 |
| (c) | State and prove Parseval's identity. | 5 |
| 4. (a) | Define Hermite polynomials and show that $H_n'(x) = 2nH_{n-1}(x)$. | 4 |
| (b) | Show that $H_{2n}(0) = \frac{(-1)^n (2n)!}{n!}$. | 2 |
| (c) | Define Dirac Delta function. Obtain Fourier Dirac Delta function. | 5 |
| (d) | Find the Laplace transform of $\sin^3 2t$. | 3 |
| 5. (a) | Define complex number, Perform the following operations (both analytically and graphically): (i) $(2+3i) + (4-5i)$ and (ii) $(6-2i) - (2-5i)$. | 7 |
| (b) | What is harmonic function? Prove that the function $u = \cos x \cosh y$ is harmonic. | 4 |
| (c) | Show that $\frac{dz}{dx}$ does not exist anywhere. | 3 |
| 6. (a) | State and prove Rouche's theorem. | 5 |
| (b) | What is residue? How can you calculate it? | 4 |
| (c) | Find the residues of $f(z) = \frac{z^2+4}{z^3+2z^2+2z}$ at all its poles. | 5 |
| 7. (a) | Define tensor with its importance in physics. | 3 |
| (b) | Define: i) Covariant tensor, ii) Contravariant tensor, iii) Mixed tensor, iv) Summation convention, v) Dummy index, vi) Free index and vii) Symmetric tensor. | 7 |
| (c) | Show that (i) $\frac{\partial x^p}{\partial x^q} = \delta_q^p$ and (ii) $\frac{\partial x^p}{\partial x^q} \cdot \frac{\partial x^q}{\partial x^r} = \delta_r^p$. | 4 |
| 8. (a) | Define Kronecker delta and Christoffel's symbols. | 4 |
| (b) | A covariant tensor has components xy , $2y-z^2$, xz in rectangular coordinates. Find the covariant components in spherical coordinates. | 6 |
| (c) | What is Quotient law. | 2 |
| (d) | What is rank of a tensor? | 2 |

Pabna University of Science and Technology

Department of Physics

B.Sc. (Honours) 2nd Year 1st Semester Examination 2019

Course Title: Mathematical Methods in Physics-II

Course no: PHY-2103

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Five questions out of Eight.
 (ii) Figures in the right margin indicate full marks.

1 a) Define Gamma and Beta function. 2

b) Prove that 5

$$\int_0^{\frac{\pi}{2}} \sin^p x \cos^q x dx = \frac{\Gamma\left(\frac{p+1}{2}\right)\Gamma\left(\frac{q+1}{2}\right)}{2\Gamma\left(\frac{p+q+2}{2}\right)}.$$

c) Prove the following identities 3.5+3.

$$i) \Gamma\left(\frac{1}{2}\right) = \sqrt{\pi} \quad \text{and} \quad ii) \int_0^{\infty} e^{-x^2} dx = \frac{\sqrt{\pi}}{2}. \quad 5$$

2 a) Define even function, odd function and periodic function. Give example each of them. 3

b) Write down the Legendre polynomial $P_n(x)$ and hence evaluate $P_3(x)$. 4

c) Establish the Rodrigues formula $P_n(x) = \frac{2^n}{n!} \frac{d^n}{dx^n} (x^2 - 1)^n$. 7

3 a) Define Laplace transform. Find the Laplace transform of $t \cos 3t$ 4

b) Solve the following differential equation using Laplace transform: 6

$$\frac{d^2y}{dx^2} + 9y = \cos 2t; y(0) = 1, y\left(\frac{\pi}{2}\right) = -1.$$

c) Evaluate 4

$$\mathcal{L}^{-1}\left\{\frac{6s-4}{s^2-4s+20}\right\}.$$

4 a) Define analytic function. Find the values of a, b, c and d such that the function $f(z) = x^2 + axy + by^2 + i(cx^2 + dxy + y^2)$ is analytic. 5

b) Show that the function $u = e^{-x}(x \sin y - y \cos y)$ is harmonic. Find its harmonic conjugate v such that $u + iv$ is harmonic. 6

c) Prove that $\lim_{z \rightarrow 0} \frac{z}{z}$ does not exist. 3

5 a) Define symmetric matrix. If P and Q are symmetric matrices then show that PQ is symmetric if and only if P and Q commute. 3

b) Decompose the matrix A into two parts. Where 6

$$A = \begin{bmatrix} 1 & 5 & 7 \\ 4 & 3 & 2 \\ 5 & 9 & 2 \end{bmatrix}.$$

c) Determine the eigen value and eigen vector of $\begin{bmatrix} 7 & 3 \\ 2 & 8 \end{bmatrix}$. 5

- 6 a) State and Prove Cauchy's theorem. 5
- b) Use Cauchy's theorem to evaluate $\oint_c \frac{z+4}{z^2+2z+5} dz$, where $c|z + 1| = 1$. 3
- c) State Cauchy's integral formula. Evaluate $\oint_c \frac{e^{2z}}{(z+1)^5} dz$, where c is the circle $|z| = 4$. 6
- 7 a) A covariant tensor has the components $2x - z, x^2y, yz$ in rectangular coordinates. Find its covariant components in spherical coordinates. 6
- b) Define Kronecker Delta. Prove that Kronecker Delta is a mixed tensor of the second rank. 5
- c) Prove $[pq, r] = g_{rs} \{ \begin{smallmatrix} s \\ pq \end{smallmatrix} \}$. 3
- 8 a) Find the covariant derivative of $A_k^l B_n^{lm}$ with respect to x^q . 4
- b) Prove that $A_{p,qr} - A_{p,rq} = R_{pqr}^n A_n$, where A_p is an arbitrary covariant tensor of rank one. 6
- c) Show that the inner product of two tensors A_r^{pq} and B_t^s is a tensor of rank three. 4

Pabna University of Science and Technology

Department of Physics

B.Sc. (Honours) 2nd Year 1st Semester Examination 2018

Course Title: Mathematical Methods in Physics-II

Course no: PIIY-2104/PIIY-2103

Full Marks: 70

Time: 3:00 Hours

N.B.: (i) Answer any Six questions out of Eight.
 (ii) Figures in the right margin indicate full marks.

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|--------|---|------------------|
| 1. (a) | Find the relation between Beta and Gamma functions. | $5\frac{2}{3}$ |
| (b) | Show that $\Gamma(n+1) = n\Gamma(n)$. | 3 |
| (c) | Find the value of $\Gamma(\frac{1}{2})$. | 3 |
| 2. (a) | Define: (i) even function, (ii) odd function and (iii) Fourier series. | 3 |
| (b) | Show that an even function can have no Sine term in its Fourier series. | 4 |
| (c) | Find the Fourier series of $f(x) = \begin{cases} 0, & -\pi \leq x \leq 0 \\ \pi, & 0 \leq x \leq \pi \end{cases}$. | $4\frac{2}{3}$ |
| 3. (a) | State and prove the linear property of Laplace transformation. And hence evaluate $L\{\sin 2t + 2\cos 3t\}$. | 2+3 |
| (b) | Define Legendre polynomials. Express $f(x) = x^4 + 2x^3 + 2x^2 - x - 3$ in terms of Legendre polynomials. | 1+4 |
| (c) | Define hypergeometric function. | $1\frac{2}{3}$ |
| 4. (a) | Define an analytic function. | $1\frac{2}{3}$ |
| (b) | Find the values of constants a, b, c and d such that the function $f(z) = z^2 + axy + by^2 + i(cx^2 + dxy + y^2)$ is analytic. | 6 |
| (c) | Deduce Cauchy-Riemann equations. | 4 |
| 5. (a) | State and prove Rouche's theorem. | 4 |
| (b) | What is residue? How can you calculate it? | $3\frac{2}{3}$ |
| (c) | Find the residues of $f(z) = \frac{z^2+4}{z^3+2z^2+2z}$ at all its poles. | 4 |
| 6. (a) | Define matrix. If $A = [x \ y \ z]$, $B = \begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix}$ and $C = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ then evaluate ABC. | 1+4 |
| (b) | A store has in stock 30 dozen shirts, 15 dozen trousers and 25 dozen pairs of socks. If the selling prices are Tk. 200 per shirt, Tk. 100 per trouser and Tk. 50 per pair of socks, then find the total amount the store owner will get after selling all the items in the stock. | $6\frac{2}{3}$ |
| 7. (a) | Define adjoint and inverse of a square matrix. | 4 |
| (b) | If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & 3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, find A^{-1} and show that $A^3 = A^{-1}$. | $7\frac{2}{3}$ |
| 8. (a) | Explain how you can compute inverse of a square matrix with the help of the linear equations. And hence find the inverse of $A = \begin{bmatrix} 2 & -1 & 3 \\ 1 & 1 & 1 \\ 1 & -1 & 1 \end{bmatrix}$. | $2+2\frac{2}{3}$ |
| (b) | Investigate for what values of λ and μ , the simultaneous equations: $x+y+z=6$, $x+2y+3z=10$ and $x+2y+\lambda z=\mu$ have (i) no solution, (ii) unique solution and (iii) infinite solution. | 6 |
| (c) | State Cayley Hamilton theorem. | 1 |

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Pabna University of Science and Technology
Department of Physics
B.Sc. (Honours) 2nd Year 1st Semester Examination 2021
Course Title: Bangladesh Studies
Course no: PHY 2105

Time: 03 Hours

Full Marks: 70

N.B.: (i) Answer any Five questions out of Eight.
(ii) Figures in the right margin indicate full marks.

1. (a) What is Permanent Settlement? Discuss the basic features of Permanent Settlement. 3+4
(b) Discuss the merits and demerits of Permanent Settlement. 7
2. (a) What is two nation theory? 4
(b) Why was British-India divided into two independent nations namely India and Pakistan based on two nation theory? Explain. 10
3. Discuss the contribution of Language Movement of 1952 in the rise of Bengali Nationalism in East Pakistan. 14
4. (a) What was the Six-points programme? 6
(b) Why is Six-points programme seen as a roadmap for the liberation of Bangladesh? Discuss. 8
5. Discuss the basic economic problems of Bangladesh with its possible solutions. 7+7
6. What is Constitution? Describe the silent features of Bangladesh Constitution of 1972. 3+11
7. What is Development and Underdevelopment? How GDP measured? Discuss. 6+8
8. Write short notes on:
(a) Operation Searchlight. 7
(b) Power and functions of Prime minister of Bangladesh. 7

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Pabna University of Science and Technology
Department of Physics
B.Sc. (Honours) 2nd Year 1st Semester Examination 2020
Course Title: Bangladesh Studies
Course no: PHY-2105

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Five questions out of Eight.
(ii) Figures in the right margin indicate full marks.

1. What are the salient features of the Constitution of Bangladesh? Do critically analyse the major amendments of the constitution and their impacts on political development in the country. 7+7
2. Discuss major characteristics and functions of the three organs of government. Write an evaluation on the role of executive organ of the government during Covid-19 pandemic in Bangladesh. 7+7
3. Elucidate the key points of the historic 7th March speech. Exound the significance of the 7th March speech on Bengali nationalism and independency. 6+8
4. Explain the role of India and UN in our Liberation war, 1971. 14
5. What are the main traditional festivals of Bangladesh? Delineate the impact of Globalization and social media trends on our Bengali culture in present days. 6+8
6. What were the causes behind partition of Bengal in 1905? Elucidate the impacts of partition of Bengal in 1905. 14
7. What is Development? Explain the major determinants of economic development. Write a discussion paper on the present challenges and prospects of the economy of Bangladesh. 2+4 +8
8. Write short notes on:
(a) Budgeting Process in Bangladesh
(b) Function of ECNEC 14

Pabna University of Science and Technology

Department of Physics

B.Sc. (Honours) 2nd year 1st Semester Examination-2019

Course Title: Bangladesh Studies

Course no: PHY-2105

Time: 3:00 Hours

Full Marks: 70

**N.B.: (i) Answer any FIVE questions out of EIGHT.
(ii) Figures in the right margin indicate full marks.**

- 1. (a) What do you know about Permanent Settlement? Discuss the background of Permanent Settlement. 3+5
(b) Elucidate the merits and demerits of Permanent Settlement. 3+3**

- 2. (a) Briefly describe the background and causes of Liberation War. 7
(b) Discuss the formation of Mujibnagar government. 7**

- 3. What are the salient features of the Constitution of Bangladesh? Identify the major contradictions among the fundamental principles of Bangladesh Constitution. 7+7**

- 4. "Historic 7th March speech was a turning speech in the history of Bangladesh's struggle for independence"-Explain. 14**

- 5. What are the main organs of government? Describe the major functions and the interrelationships among the three organs of the government. 14**

- 6. 'Six-points were Bengalis' charter of freedom'. Do explain the statement with evaluating its impact on the struggle for autonomy and independence of Bengali nation. 14**

- 7. What are the basic economic problems of Bangladesh and recommend its solution. 14**

- 8. Write short notes on
(a) Shamsuddin Iliyas Shah.
(b) Judicial System of Bangladesh. 14**

Pabna University of Science & Technology
Department of Physics
B.Sc. (Honours) 2nd Year 1st Semester Examination 2018
Course Title: Bangladesh Studies
Course no: PHY-2105

Time: 3:00 Hours

Full Marks: 70

N.B.: (i) Answer any Six questions out of Eight.
(ii) Figures in the right margin indicate full marks.

- ~~1.~~ (a) What is partition of Bengal? 3
(b) Discuss the causes of partition of Bengal in 1905. 5
(c) How did the people of Bengal react to the partition of Bengal of 1905? 2
 $\frac{3}{3}$
- ~~2.~~ (a) Describe the background of Six Point Movement. 2
(b) "Six Point Movement is the solid foundation of our liberation war"- Discuss. 5
 $\frac{3}{3}$
 $\underline{6}$
- ~~3.~~ (a) Write down the main point of Historic 7th March, 1971. 2
(b) Discuss the formation of Mujibnagar Government and role of Mujibnagar Government in our liberation war. 5
 $\frac{3}{3}$
 $\underline{6}$
- ~~4.~~ Discuss the economic disparity between East Pakistan and West Pakistan. 11
 $\frac{2}{3}$
- 5 Define development. Discuss the major challenges and opportunities of development in Bangladesh. 2+5+4
 $\frac{2}{3}$
- 6 Elucidate the Judiciary system of Bangladesh. 11
 $\frac{2}{3}$
- 7 Define the term "Constitution". What are the salient features of Bangladesh 1972 constitution? Discuss. 11
 $\frac{2}{3}$
- ~~8~~ Write short notes on:
(a) Operation Search Light and 11
(b) Permanent Settlement $\frac{2}{3}$