RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

SECOND YEAR [BATCH 2017-20]

B.A./B.Sc. FOURTH SEMESTER (January – June) 2019

Mid-Semester Examination, March 2019

Date : 25/03/2019 **PHYSICS (Honours)**

Time : 2 pm – 4 pm Paper : IV Full Marks : 50

(Use a Separate Answer Book for <u>each group</u>)

Group – A

Anwer **<u>any four</u>** questions from question no. 1 to 7: [4×5]

1. a) What do you mean by cascading of amplifiers? Obtain an expression for voltage gain for a cascaded system.
   b) Give a circuit diagram of a class C amplifier. [1+2+2]
2. a) Draw the h-parameter circuit of a RC coupled amplifier in mid-frequency range.
   b) Obtain the expression for mid-frequency gain of the given amplifier. [2+3]
3. Discuss the principle of operation of a class B push-pull amplifier with suitable diagram. [5]
4. State how negative feedback can be utilized for (a) increasing stability of an amplifier and (b) reducing phase distortion. [2+3]
5. a) Discuss operation of a Buck type switching regulator.
   b) The open-loop gain of an amplifier changes by 5%. If 10 dB negative feedback is applied, calculate the percentage change of the closed loop gain. [3+2]
6. a) State Barkhauzen criteria for oscillation.
   b) Write a note on Hartley oscillator. [1+4]
7. a) Compare sinusoidal oscillator and relaxation oscillator.
   b) State the working principle of an Astable multivibrator. [1+4]

Group – B

Answer **<u>any six</u>** questions from question no. 8 to 16 [6×5]

8. a) For a spatially uniform ideal gas, how is the velocity distribution f(v) defined? [2]
   b) Determine the gas temperature at which the velocity distribution function f(v) for oxygen molecules will have the maximum value at c= 420 m/s. [3]
9. a) Define micro canonical and canonical ensemble. [1]
   b) From Maxwell's distribution law for molecules speed, calculate the fraction of molecules having speed between C_m and 1.01 C_m , where C_m is the most probable speed. [4]
10. a) The mass of H_2 molecule is 3.32×10^{-24} gm. If 10^{23} hydrogen molecules strike 2 cm^2 of the wall per sec at an angle of 45^o with the normal when moving with a speed of 10^5cm/s, what pressure do they exert? [3]
    b) Prove that total internal energy per molecule of a system is function of temperature only for an ideal gas. [2]
11. a) State the law of equipartition of energy. [2]

b) Assume that the energy E of a system can be given by the sum of n independent quadratic terms, so that $E = \sum_{i=1}^{n} \alpha_i x_i^2$, where α_i are constants, and x_i are some variables. Assume each x_i could take any value with equal probability. Calculate the mean energy. [3]

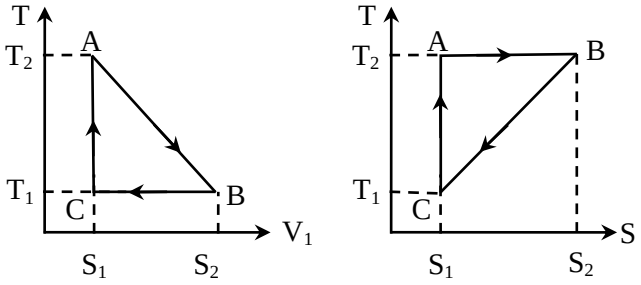
12. a) State the essential difference between the first and second law of thermodynamics. [2]

b) Calculate the work done by 1 mole of a gas during a quasistatic isothermal expansion from a volume V_i to a volume V_f when the equation of state is $PV = RT\left(1 - \frac{B}{V}\right)$ where B = f(T). [3]

13. a) Define entropy and state briefly its physical significance. [1+2]

b) Show that the entropy increases in natural processes. [2]

14. a) Compare the efficiencies of the cycles ABCA shown in the figure below. [3]



b) Two globes of volume V_1 and V_2 contains n_1 and n_2 moles respectively of two ideal gases at the same temperature. A valve containing the two is opened and the gases mix without any reaction. Show that the entropy change $\Delta S = n_1 \ln \frac{V_1 + V_2}{V_1} + nR \ln \frac{V_1 + V_2}{V_2}$ [2]

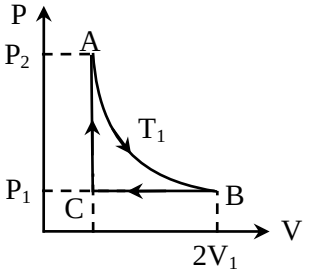
15. An ideal gas is taken through a cycle ABC consisting of the following processes:

$A \rightarrow B$: isothermal expansion at T_1 from volume V_1 to $2V_1$

$B \rightarrow C$: compression at constant pressure p_1 to volume V_1 and

$C \rightarrow A$: change of pressure at constant volume

Find expressions for the work done, the heat transferred and the change in internal energy for each part of the cycle and show that the sum of three terms is zero for the internal energy. [5]



16. a) Derive the poissons distribution from binomial distribution. [2]

b) A probability functions is given by $p(x) = xe^{-x^2/2}$ for $0 < x < \infty$. Find out the condition that p(x) is probability density function. Also find out $\langle x \rangle$ and $\langle x^2 \rangle$. [3]

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