

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

SECOND YEAR [BATCH 2016-19]

B.A./B.Sc. FOURTH SEMESTER (January – June) 2018

Mid-Semester Examination, March 2018

Date : 14/03/2018

Time : 2 pm – 4 pm

PHYSICS (Honours)

Paper : IV

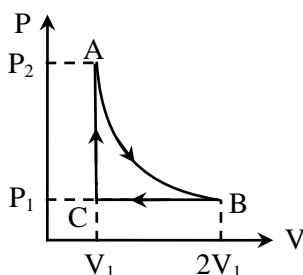
Full Marks : 50

Answer any five questions taking at least one from each group

[5×10]

Group – A

1. a) Explain the concept of quasi-static process and reversible process. [2+2]
- b) An ideal gas is taken through a cycle ABCA consisting of the following processes :
 - i) $A \rightarrow B$, isothermal expansion at temperature T_1 from volume V_1 to $2V_1$.
 - ii) $B \rightarrow C$, compression at constant pressure P_1 and from volume $2V_1$ to V_1 .
 - iii) $C \rightarrow A$, change of pressure from P_1 to P_2 at constant volume V_1 .

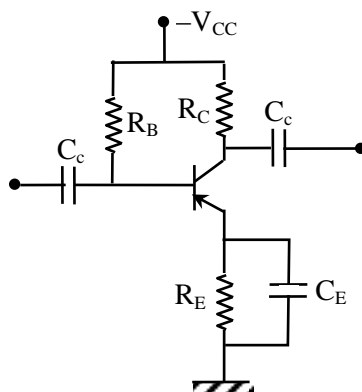


Find expressions for work done, the heat transferred and the change in internal energy for each part of the cycle. [6]

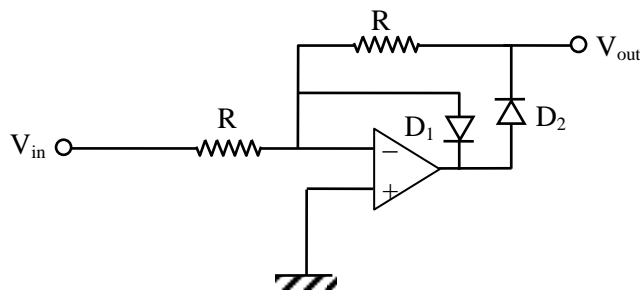
2. a) Give a brief description of Carnot's cycle explaining its theoretical importance. [3]
- b) Explain the meaning of entropy. Show that in all natural processes the entropy always increases. [2+3]
- c) A Carnot engine with the sink at 10°C has an efficiency of 30%. By how much must the temperature of the source be changed to increase its efficiency to 50%. [2]

Group – B

3. a) Derive the exact expressions of current gain, input impedance, output impedance and voltage gain using h-parameter equivalent circuit of a transistor in CE mode. [6]
- b) A PNP transistor having a dc current gain in CE mode equal to 100 is to be biased at $I_C = 5\text{mA}$ and $V_{CE} = 3.8\text{V}$. The collector load (R_C) has a resistance of 500Ω . If $V_{CC} = 10\text{V}$ and $V_{BE} = 0.3\text{V}$, Calculate the value of R_B and R_E . [4]



4. a) Explain with the help of a block diagram the working principle of a feedback amplifier. [3]
 b) Find out an expression for the voltage gain with negative feedback. [3]
 c) Prove that with the introduction of negative feedback the bandwidth of an amplifier can be increased. [4]
5. a) Compare oscillators and multivibrators. [2]
 b) A Wien-bridge oscillator has a frequency of 1 KHz and a capacitance of 100pF. Find the resistance of the tank circuit. If the amplifier gain is 10, obtain the ratio of the resistances in the other arms. [4]
 c) Describe the working principle of an Astable multivibrator. [4]
6. a) Draw the circuit diagram of an envelope detector and explain its operation. [4]
 b) Design an Adder circuit using OPAMP. In this context define virtual ground. [3]
 c) $v_{in} = 10\sin 2\pi t$ is applied in a circuit as shown below. Determine the output voltage v_{out} . [3]



7. a) In an a.c circuit an inductance of 1H, a capacitor of $0.2\mu\text{F}$ and a resistance of $3\text{K}\Omega$ are connected in series to a 10 volt a.c source of frequency $\frac{1000}{2\pi}\text{sec}^{-1}$. Find the peak current in the circuit and power consumed. [3]
 b) Draw phasor diagram of L-C-R circuit at resonance and define Q-value of this circuit. [1+1]
 c) Derive an expression for the width of depletion region across of an open circuited p-n junction. [5]

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