

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

SECOND YEAR [BATCH 2014-17]

B.A./B.Sc. FOURTH SEMESTER (January – June) 2016

Mid-Semester Examination, March 2016

Date : 17/03/2016

Time : 11 am – 1 pm

PHYSICS (Honours)

Paper : IV

Full Marks : 50

[Use a separate Answer Book for each group]

Group – A

(Answer any four questions)

[4×10]

1. a) Draw the circuit diagram of a full wave rectifier with PN diode and resistive load. Calculate its dc load current, ripple factor and rectification efficiency. [1+5]
b) Explain briefly the operation of a π -type filter. [2]
c) A 5.6V, 1W zener diode is used in a regulator circuit with maximum input voltage of 12V. Find the minimum value of series resistance and its wattage. [2]
2. a) Indicate clearly with a diagram that different current components in a PNP transistor with base emitter junction forward biased and base collector junction reverse biased. [3]
b) In CE mode deduce an expression for collector current in terms of base current and collector reverse saturation current. [3]
c) What is load line and Q point? Give the circuit diagram for drawing the characteristics curves of an NPN transistor in CE mode. [2+2]
3. a) State “Barkhausen criteria” for sinusoidal oscillator. [2]
b) Find expressions of frequency and condition of oscillation for generalized oscillator. [4]
c) What is astable, monostable and bistable multivibrators. Give circuit diagram of bistable multivibrator and give its operation. [1+1+2]
4. a) In an ideal op amp voltage gain is not infinity, will it produce any problem in designing an amplifier, justify your answer. [1+1]
b) What is virtual ground in an ideal op amp? If voltage gain of op amp is not infinity will it be remain virtual ground? [2]
c) Show how an Op Amp can be used as a difference amplifier. [4]
d) What is the use of Op Amp buffer. [2]
5. a) Find an expression for low frequency voltage gain in a common emitter transistor amplifier, with an input capacitor and with a very large value emitter capacitor. State what will be the voltage gain if emitter bypass capacitor's value is very low. [4+1]
b) Draw a hybrid pi equivalent model of a single stage transistor amplifier circuit. Find the expressions of voltage gain, current gain, and input impedance using this model. [1+2+1+1]
6. a) Show that the average power supplied to an inductor over one complete cycle is zero? Explain with necessary figure. [5]
b) What are the disadvantages of phasor diagram? [2]
c) The circuit, having two impedances of $Z_1 = (8+j15)\Omega$ and $Z_2 = (6 - j8)\Omega$ in parallel, is connected to a single phase ac supply, and the current drawn is 10A. Find each branch current, both in magnitude and phase, and also the supply voltage. Draw also the resultant phasor diagram with total input current as reference. [3]

Group – B
(Answer any one question)

7. a) State the essential difference between the first and second law of thermodynamics. [2]
b) What is Carnot's theorem? Establish the theorem assuming the validity of the second law of thermodynamics. [1+3]
c) Two bodies with temperature independent heat capacities C_1 and C_2 are used as reservoirs for a Carnot engine. Derive an expression for the total work obtainable. [4]
8. a) State and establish the Clausius' theorem. [3]
b) Show that the entropy of the 'universe' increases in an irreversible process. [3]
c) A body of constant heat capacity C_p and at a temperature T_i is put in contact with a reservoir at a higher temperature T_f . The pressure remains constant while the body comes to equilibrium with the reservoir.
Show that the entropy change of the universe is positive and is equal to $\Delta S = C_p[x - \ln(1+x)]$; where $x = (T_i - T_f) / T_f$. [4]

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