Total No. of Printed Pages-4 **Roll No. _____**

1(CCE-M)6

ELECTRICAL ENGINEERING-I

[09]

Time Allowed -3 Hours *Maximum Marks-300*

INSTRUCTIONS

i) Answers must be written in English.

ii) The number of marks carried by each question is indicated at the end of the question.

iii) The answer to each question or part there of should begin on a fresh page.

iv) Your answer should be precise and coherent.

v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.

*vi) Candidates should attempt **Five** questions. Question nos. **1** and **5** are compulsory. Answer any three questions from the remaining questions.*

vii) If you encounter any typographical error, please read it as it appears in the text book.

viii) Candidates are in their own interest advised to go through the General Instructions on the back side of the title page of the Answer Script for strict adherence.

ix) No Continuation sheets shall be provided to any candidate under any circumstances.

x) Candidates shall put cross (X) on blank pages of answer Script.

xi) No blank page be left in between answer to various questions.

xii) No programmable Calculator is allowed.

xiii) No stencil (with different markings) is allowed.

xiv) In no circumstances help of scribe will be allowed.

SECTION-A

1. Answer any **three** : **(3×20=60)**

a) Explain the significanace of mesh and nodal analysis in network theory?

Determine the current in all the branches of the network as shown in Fig. 1 using nodal analysis.

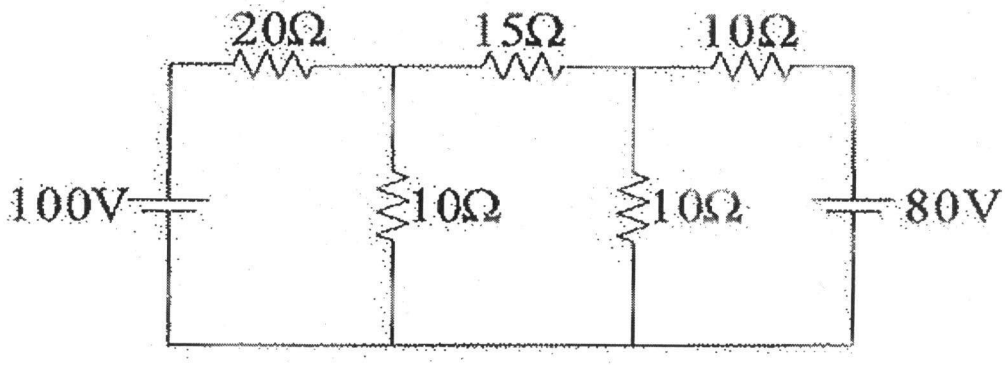

Fig. 1

b) State and explain maximum power transfer theorem. Derive the condition for maximum power transfer. Also, determine the maximum efficiency. Write the two applications of maximum power transfer theorem with suitable example.

c) Answer the following questions in reference to measurement of three-phase power using two single-phase wattmeter.
   i) What will you do if one of the wattmeter gives negative deflection?
   ii) Is this method applicable to unbalanced three-phase load? Explain.
   iii) If the load is purely resistive, what would be the readings of wattmeters?
   iv) If one of the wattmeter reads zero, what would be the power factor of the load ?

d) Three point charges of values +15 nC, +10 nC and +20 nC are located at points (0,0,0), (1,0,0) and (0,1,0) respectively. Find the force on each charge due to the other charges.

2. a) Find the value of shunt resistances to a multi-range dc ammeter having internal resistance of 25 Ω and full scale deflection current of 1 mA. The required ranges are 0-50 mA, 0-1 A and 0-5 A. **(20)**

b) With the help of neat diagram, explain the construction of PMMC instruments. Also, write the advantages and disadvantages of PMMC and moving iron instruments. **(20)**

c) The voltage wave of Fig. 2 is applied to 15 Ω resistor. If the cost of electical energy is Rs. 5 per kWh, how much would it cost to operate the circuit for 12 hours. **(20)**

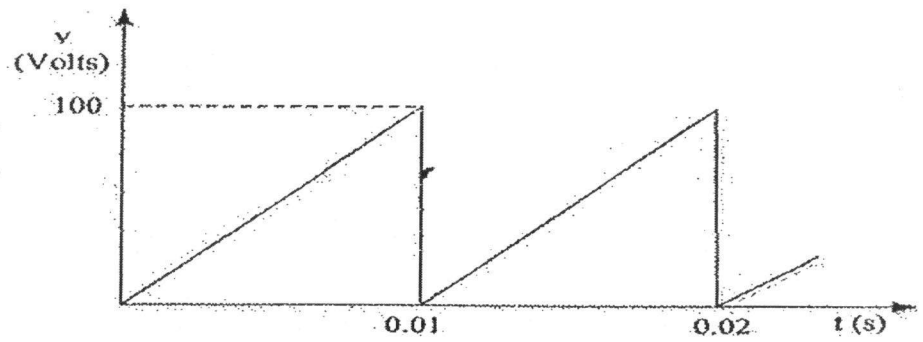

Fig. 2

3. a) Define the voltage regulation of a transformer. With the help of neat phasor diagram, derive the expression of voltage regulation at lagging and leading power factor? **(20)**

b) In the netwrok shown in Fig. 3, determine the total impedence, total current (I), the current I_1, I_2, active, reactive and apparent power. **(20)**

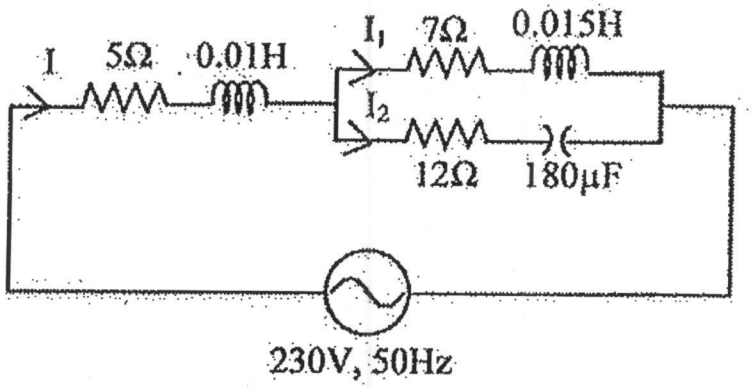

Fig. 3

c) Define the term resonance. Derive an expression for resonant frequency when an inductive coil is connected in parallel with loss free capacitor. A coil of resistance 0.2 Ω and inductance of 10 mH is connected across a 100 V, 50 Hz sinusoidal supply. Calculate the capacitance placed in parallel with the coil so that the resultant current is in phase with voltage. Determine the current under this condition. **(20)**

4. a) Consider a fixed single-turn rectangular loop of area A with its plane perpendicular to a uniform magnetic field. Find the voltage induced across the terminals of the loop if the magnetic flux density is given by:

i) $B(t)=2B_0te^{-at}$ and

ii) $B(t)=B_0te^{-2at}\sin(\omega t)$ **(20)**

b) The electric field amplitude of a uniform plane wave propagating in the a_z direction is 240 V/m. If $E=E_xa_x$ and $\omega=10^6$ radian/sec. Find

i) Frequency

ii) Wavelength

iii) The period

iv) The amplitude of H **(20)**

c) Write down the Maxwell's equations and discuss their significance. **(20)**

SECTION - B

Answer any three : **(3×20=60)**

5. a) What are the various methods to control the speed of DC motors? With the help of circuit diagram, explain any one method of speed control of DC shunt motor.

b) In a 25 kVA, 2000/200 V transformer, the iron and copper losses are 300 W and 350 W respectively. Calculate the efficiency of transformer at 0.85 power

factor at

i) Full load
ii) Half load
iii) Determine the load at which maximum efficiency will occur.

c) Draw the circuit of transistor in the common emitter configuration. Sketch the output characteristics and indicate the active, saturation and cut-off regions.

d) A BJT has α=0.99, $i_B=I_B=20\,\mu A$ and I_{CBO}=200 nA. Find the dc collector current, the dc emitter current and the percent error in emitter current when leakage current is neglected.

6. a) A 50 kVA, 2400 V/120 V transformer gives the following test results.
Open Circuit Test (Instruments on LV side): 120 V, 9.65 A, 400w
Short Circuit Test (Instruments on HV side): 92 V, 20.83 A,850 W
Determine the equivalent circuit parameters, efficiency and voltage regulation of the transformer at 0.8 power factor lagging. **(20)**

b) A shunt generator gives full load output of 35 kW at terminal voltage of 220 V. The armature and shunt field resistances are 0.05 Ω and 50 Ω respectively. the iron and frictional losses are 1050 W. Calculate the generated e.m.f., copper losses and efficiency of the generator. **(20)**

c) Derive the torque equation of a DC motor. Also explain the significance of back emf with respect to DC shunt motor. **(20)**

7. a) What are the different types of torques in indicating instruments? Explain the significance of each torque in these instruments. **(20)**

b) Explain the De-Sauty's method for the measurement of capacitance? Also derive the balancing conditions of De Ssauty's bridge. **(20)**

c) Explain the working of RS Flip Flop Circuit. What are the main drawbacks of RS Flip Flop and how it can be overcome using JK Flip Flop? **(20)**

8. a) Design a phase shift Oscillator to operate at a frequency of 5 kHz. Use a MOSFET with μ=55 and r_d=5 KΩ. The phase shift network is not to load down the amplifier.

i) Find the minimum value of drain-circuit resistance R_d for which the circuit will oscillate.
ii) Find the product RC.
iii) Choose a reasonable value of R and find the value of C. **(20)**

b) Draw the block diagram of feedback amplifier. Explain the function of each block. **(20)**

c) Explain the no load and blocked rotor test on three-phase induction motor.**(20)**
