09/1

2006

ELECTRICAL ENGINEERING

Paper 1

Time : 3 Hours] *[Maximum Marks : 300*

INSTRUCTIONS

Candidates should attempt ***all*** *the questions in Parts A, B & C. However, they have to choose only* ***three*** *questions in Part D. The number of marks carried by each question is indicated at the end of the question.*

Answers must be written in English.

This paper has four parts :

A	20 marks
B	100 marks
C	90 marks
D	90 marks

Marks allotted to each question are indicated in each part.

SEAL

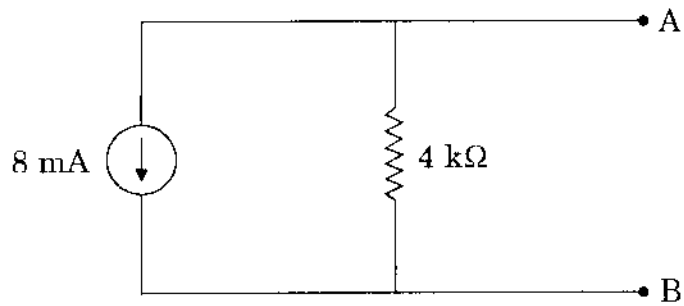
PART A

4×5=20

Answer all 4 questions (parts). Each question carries 5 marks.

1. (a) A d.c. source generating 440 V has an internal resistance of 800 ohms. Find the power delivered to load, if the load current is 0·5 Amp.

(b) A current source with relevant parameters is given in the following figure. Draw its equivalent voltage source and show the values of corresponding parameters.



(c) Convert the Boolean expression $(A + B\overline{C})$ into a logic circuit using different logic gates.

(d) Find the eigen values of the matrix,

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

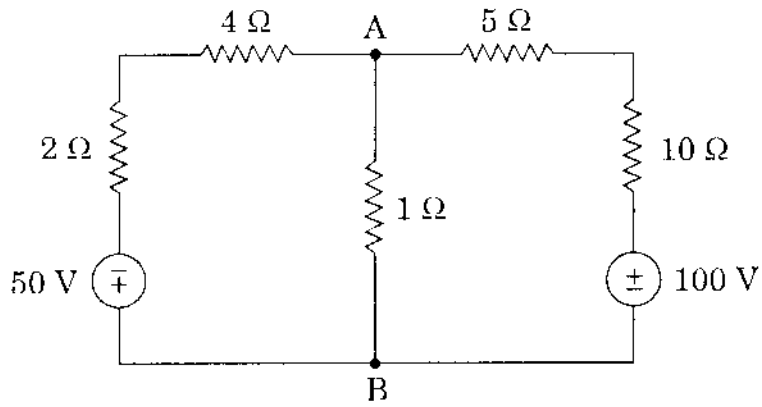
PART B

10×10=100

Answer all 10 questions. Each question carries 10 marks.

2. (a) State the superposition theorem as applicable to a.c. networks.

(b) In the following circuit, using superposition theorem, find the value of current in branch A to B.



3. (a) Define and explain the following terms related to the transfer function of a system :

(i) Poles

(ii) Zero's

(iii) Characteristic equation

(b) The transfer function of a system is given by,

$$T(s) = \frac{k(s+8)}{s(s+3)(s+4)(s^2+7s+10)}$$

Determine the poles and zero's. Show the plot of poles and zero's in s-plane.

4. (a) State the Coulomb's law and give its mathematical expression.

(b) Three identical point charges each Q coulombs are placed at the vertices of an equilateral triangle 30 cm apart. Calculate the force on each charge.

5. (a) With the help of a diagram, explain the construction and working principle of moving coil instruments.

(b) Indicate application of moving coil instruments, their advantages and disadvantages.

6. With the help of a circuit diagram, explain the operation of transistor as an amplifier.

7. (a) Explain the difference between voltage amplifier and power amplifier.

(b) Give comparison of voltage and power amplifiers with respect to various components.

8. (a) With the help of diagrams, show the different types of generators classified according to the way in which their fields are excited.

(b) A shunt d.c. generator delivers 400 amp at 220 volts and the resistance of the shunt field and armature are 40 ohms and 0·02 ohm respectively. Calculate the generated e.m.f.

9. Give some applications of different types of d.c. generators.

10. A 50 kVA single phase transformer has 500 turns on the primary and 50 turns on the secondary windings. The primary is connected to 2000 V, 50 Hz supply. Find the full load primary and secondary currents, the secondary e.m.f. and the maximum flux in the core.

11. A 3-phase induction motor is wound for 4 poles and is supplied from 50 Hz system. Calculate, the synchronous speed, the rotor speed when slip is 5% and rotor frequency when rotor runs at 900 r.p.m.

PART C

6×15=90

Answer all 6 questions. Each question carries 15 marks.

12. (a) Give the definition of Laplace transform.

(b) Obtain the Laplace inverse of

$$F(s) = \frac{10(s+2)}{(s+3)(s+1)^2}$$

13. (a) Explain the problems in parallel operation of two identical series d.c. generators and give the remedial measures for successful parallel operation.

(b) Two shunt d.c. generators A, B operating in parallel, deliver a total current of 200 A. Generator A is rated 80 kW and generator B is rated 160 kW. The voltage rating of both machines is 400 V, and regulation of generator A is 5% and generator B is 4%. Assuming linear characteristics, determine the terminal voltage.

14. (a) Draw the circuit diagram of a practical single stage transistor amplifier. Explain the function of each component.

(b) Explain how d.c. equivalent circuit and a.c. equivalent circuit for the above are obtained. Show the equivalent circuits.

15. (a) With the help of a circuit diagram, explain the operation of a transistor R-C coupled amplifier.

(b) Describe the advantages, disadvantages and its applications with reference to the frequency response of the above amplifier.

16. (a) With the help of circuit diagram, describe the principle of phase shift oscillators and explain its operation.

(b) Discuss its advantages and disadvantages.

17. (a) With usual notations derive the expressions for voltage of a d.c. shunt motor.

(b) Discuss the efficiency of d.c. shunt motor under normal conditions and under the condition of maximum power of the motor.

PART D

3×30=90

*Answer any **three** of the following questions. Each question carries 30 marks.*

18. (a) Explain the various methods of speed control of d.c. series motors.

(b) A 220 V series d.c. motor takes 40 amperes when giving its rated output at 1200 r.p.m. Its resistance is 0·2 ohm. Find what resistance must be added to obtain rated torques at 900 r.p.m.

19. (a) Define the efficiency of a single phase transformer.

(b) With usual notations, deduce the condition for maximum efficiency.

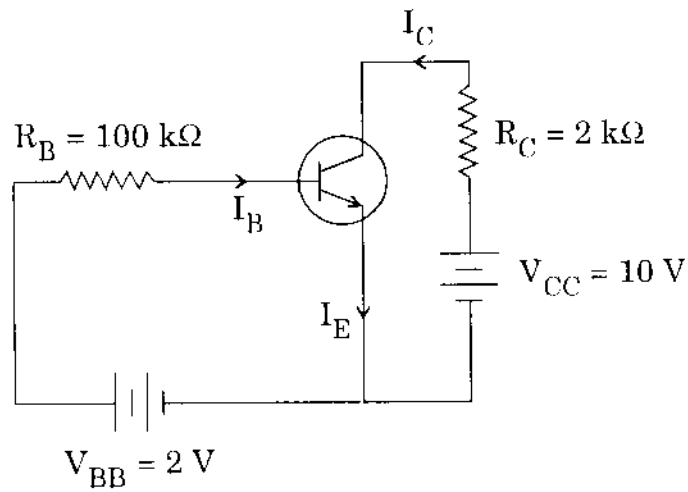
(c) A 500 kVA single phase transformer when working at unity power factor has an efficiency of 90% at full load and also at half load. Determine its efficiency when it operates at unity power factor and 60% of the full load.

20. (a) What is the need for transistor biasing ?

(b) Mention the essentials of a biasing circuit.

(c) Explain a method of transistor biasing.

(d) With usual notations the following figure shows biasing with base resistor method. Determine the collector current I_C and collector-emitter voltage V_{CE}. Neglect small base-emitter voltage. Given that $\beta = 50$.

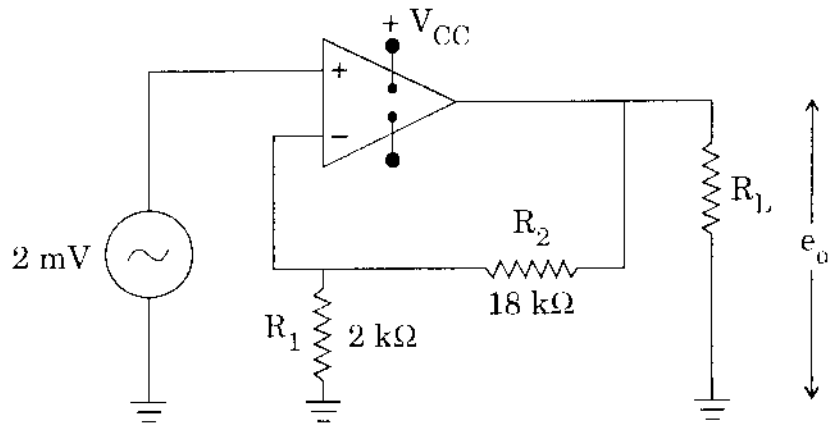


21. (a) With the help of a circuit diagram, show a negative voltage feedback amplifier and derive an expression for the gain of negative voltage feedback amplifier.

(b) Show the feedback circuit and explain how it provides feedback in amplifier.

(c) Discuss the advantages of negative voltage feedback.

(d) The following figure shows a negative voltage feedback amplifier. If the gain of the amplifier without feedback is 5000, find the feedback fraction, overall voltage gain and output voltage, if the input voltage is 2 mV.



22. (a) With usual notations draw the exact equivalent circuit of an induction motor.

(b) What are the assumptions made to obtain the approximate equivalent circuit of an induction motor ?

(c) The maximum torque of a 3-phase induction motor occurs at a slip of 10%. The motor has an equivalent secondary resistance of 0·1 ohm/phase. Calculate the equivalent load resistance R_L, the equivalent load voltage V_L and the current at this slip, if the gross power output is 8000 watts.

09/2

2006

ELECTRICAL ENGINEERING

Paper 2

Time : 3 Hours] *[Maximum Marks : 300*

INSTRUCTIONS

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Answers must be written in English.

This paper has four parts :

A	20 marks
B	100 marks
C	90 marks
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Marks allotted to each question are indicated in each part.

SEAL

PART A

4×5=20

Answer all 4 questions (parts). Each question carries 5 marks.

1. (a) The time response c(t) of a system to an input r(t) is given by the following differential equation,

$$\frac{d^2c(t)}{dt^2} + 7\frac{dc(t)}{dt} + 12c(t) = 12r(t)$$

Find the transfer function of the system.

(b) A remote bus had a load of 500 kVA with 0·8 lagging power factor. A capacitor compensation of 100 kVAR is provided to improve the power factor. Find the value of improved power factor.

(c) A power station consists of two synchronous generators A and B. Generator A is rated 200 MVA, its reactance 0·2 p.u., inertia 1·5 p.u. on its own base. Generator B is rated 600 MVA, its reactance 0·15 p.u., inertia 1·2 p.u. on its own base. Find the equivalent p.u. reactance and p.u. inertia of the combined system on 100 MVA common base.

(d) Name any 5 large power stations in India, owned by different power utilities and using different types of power generation.

PART B

10×10=100

Answer all 10 questions. Each question carries 10 marks.

2. (a) State the advantages and limitations of Routh's method with respect to stability of a control system.

   (b) Find the range of values of k for stability of the system with characteristic equation,

   $$s^4 + 2s^3 + 2s^2 + 3s + (s + 1)k = 0.$$

3. With usual notations and suitable assumptions, obtain the condition for maximum power output for 3-phase induction motor.

4. What is ripple factor ? Derive the expressions for finding the ripple factors for full-wave rectification and half-wave rectification.

5. With the help of a circuit diagram, explain working of a three phase full-wave rectifier using diodes.

6. With the help of a suitable circuit diagram, explain the working principle of a single phase inverter using SCRs.

7. (a) Give the spectrum of various radio frequency ranges used in different communication applications.

   (b) Explain the need for modulation of audio frequency signals in transmitting.

8. A 3-phase, 120 km long, 50 Hz transmission line delivering 60 MW at a power factor 0·8 lagging and 110 kV to a balanced load. The line parameters are :

   Resistance R = 0·1 ohm/km, Inductance L = 0·001 H/km,
   Capacitance C = 0·01 μF/km.

   Find the sending end voltage.

9. An insulator string for a 33 kV line has 3 discs. The shunt capacitance between each joint and metal work is 15% of the capacitance of each disc. Find the string efficiency.

10. (a) With respect to power system stability, explain the swing equation.

(b) Explain the point by point method of solving the swing equation.

11. Determine the efficiency of a high frequency induction furnace which takes 12 minutes to melt 2 kg of aluminium, the input to the furnace being 5 kW and the initial temperature 20 degrees Centigrade. Given that the specific heat of aluminium is 0·212, melting point is 660 degrees Centigrade and latent heat of fusion of aluminium is 76·8 kcal/kg.

PART C

6×15=90

Answer all 6 questions. Each question carries 15 marks.

12. (a) Explain briefly the concept of 'root locus' with respect to closed loop control system.

(b) Plot root locus of the system having,

$$G(s) \cdot H(s) = \frac{k}{s(s+2)}$$

13. (a) With the help of a neat sketch, explain the working of full-wave bridge rectifier.

(b) What are the advantages and disadvantages of full-wave bridge rectifier ?

14. (a) What are the general types of filters used in rectifier applications ? Show the schematic diagram of each type.

(b) Explain the working of a shunt capacitor filter with respect to a half-wave rectifier.

15. (a) With the help of a circuit diagram, explain the working principle of a chopper. Find the expression for average d.c. output voltage.

(b) A chopper supplied by a 300 V d.c. has ON time of 30 msec and OFF time 10 msec. Determine the value of the average d.c. output voltage.

16. (a) What are the methods of an audio frequency signal modulation with a radio frequency carrier wave ?

(b) Explain a method of modulation with sample example.

17. (a) Give general features of synchronous motor and explain the principle of its operation.

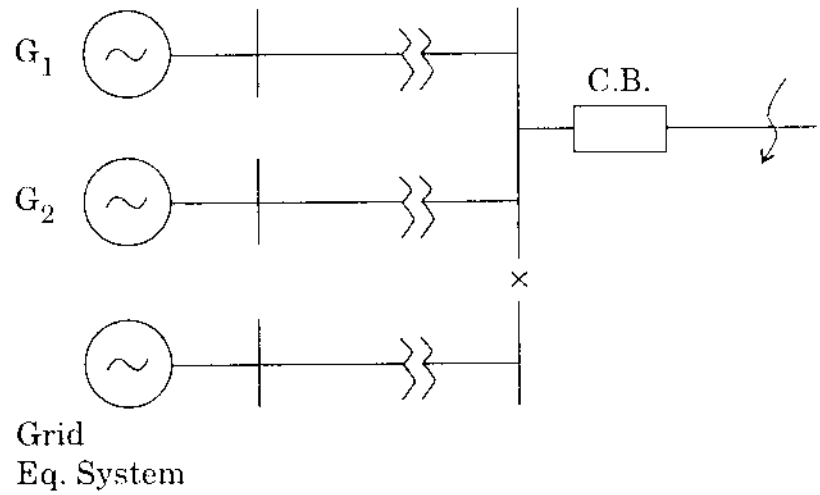
(b) Explain the method of starting a synchronous motor.

PART D

$3 \times 30 = 90$

*Answer any **three** of the following questions. Each question carries 30 marks.*

18. An industrial captive power plant as shown in figure has two generating units each of 50 MVA capacity with generator positive sequence reactance of 10%. The generating units are connected to 33 kV bus-bar through 50 MVA transformer each with 15% reactance. Outgoing feeder from the 33 kV bus-bar has a circuit breaker of 800 MVA capacity. It is proposed to connect the 33 kV bus-bar with the grid through a 100 MVA transformer having 15% reactance. The grid equivalent short circuit MVA is given as 1000 MVA.



(a) Find the 3-phase fault short circuit level on the feeder close to 33 kV bus-bar,

(i) with two generating units in operation and no grid connection.

(ii) with two generating units in operation and also with grid connection.

(b) Discuss the adequacy of the circuit breaker.