Electrical Engineering

Paper-I

Time Allowed: Three Hours **Maximum Marks: 300**

Note: 1. *The figures in the margin indicate full marks for the questions.*

2. *Candidate should answer questions No. **1** and **5** which are compulsory and any **three** of the remaining questions, selecting at least **one** from each section.*

SECTION – A

1. (a) Give reasons for any **four** of the following: 5×4=20

(i) The transformer core is laminated?

(ii) The primary mmf must be equal and opposite to the secondary mmf in an ideal transformer?

(iii) A short circuit test is performed at rated current only?

(iv) The rotor of a polyphase induction motor can never attain synchronous speed?

(v) Salient pole alternators have large diameter and small core length?

(b) Draw the exact equivalent circuit of a transformer and describe the various parameters involved in it. 20

(c) A 400V, 30 hp, 50 Hz, 4-pole, delta-connected induction motor gives the following test data:

No-load test: 400-V, 12-A, 1.2kW.

Short circuit test: 100-V, 40-A, 3kW.

Find out: (i) stator current and power factor; (ii) starting torque; (iii) full-load torque; (iv) maximum torque; (v) efficiency at full-load. 20

2. (a) Explain three types of characteristics of a DC shunt generator. Why does the external characteristic of a shunt generator turn back as the generator is overloaded? 20

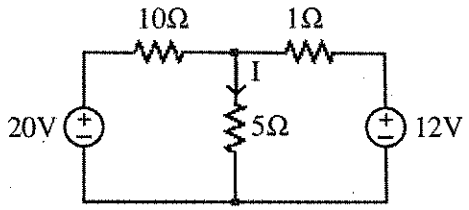
(b) Explain with the help of neat diagrams variable voltage & variable frequency speed control of induction motors. What happens if the frequency is smaller than or greater the normal frequency? 20

(c) A10 kVA, 400V, three phase star-connected synchronous generator has an armature resistance of 0.8 Ω per phase and synchronous reactance of 1.4 Ω per phase. (i) Find the voltage regulation of the alternator at full-load at power factors of (a) 0.8 lagging and (b) 0.8 leading. (ii) Calculate the power factor at which the voltage regulation becomes zero. 20

3. (a) Explain the **'Two Reaction Theory'** as applied to salient pole synchronous machines and draws its phasor for a lagging p.f. load. 20

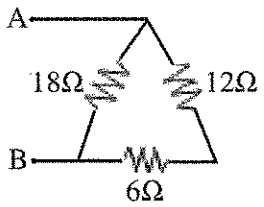
(b) A 2500-V, 3-phase, star connected motor has a synchronous reactance of 5 Ω per phase. The motor input is 1000 kW at rated voltage and an excitation emf of 3600V (line). Calculate the line current and power factor. 20

(c) Find the current I using node-voltage analysis in the figure below: 20



4. (a) Derive the relation between star to delta and delta to star transformations. Prove that in case of balanced star and delta conversions $R_{\Delta} = R_{Y}$. 20

(b) If a DC supply of 180V is connected across terminals AB in Fig below, find current in 6 Ω resistor. 20



(c) The output voltage of a series R-L-C circuit driven by a voltage source of constant voltage and variable frequency is taken across the resistance. Find the locus of the tip of the phasor for the transfer function in the complex plane. 20

SECTION – B

5. (a) Answer briefly any **four** of the following: 5×4=20

(i) D-MOSFETs are sometimes used in series to construct a cascade high-frequency amplifier to overcome the loss of high input impedance. Why?

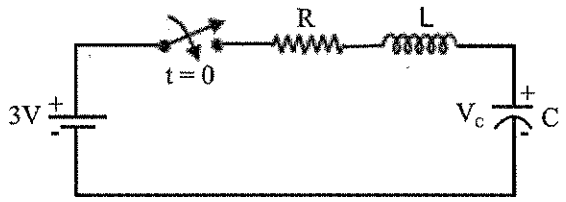
(ii) Zener diodes are used in transistor for temperature regulation, why?

(iii) Breakdown voltage and pinch-off voltage of a JFET are different terms for the same voltage level, Why?

(iv) Q point is made stable in transistors, why?

(v) Collector is the largest part of transistor, why?

(b) In the circuit given below $R=\frac{1}{2}$ ohm , L= 1 Henry and $C=\frac{1}{4}$ Farad. Find $i(0^+)$, $di(0^+)/dt$ and $d^2i(0^+)/dt^2$ if $V_c(0)$= 1v 20



(c) (i) Using standard Notation and diagram, derive the expression for Gain in case of: (i) Inverting Amplifier. (ii) Non-inverting Amplifier. (iii) Unity follower. 10

(ii) Simplify: (i) **(AB+C) (AB+D)** & (ii) De-morganize the expression: **((A+B) (C+D))′**. 10

6. (a) Write a Karnaugh map for two inputs OR and XOR Gates. Using Karnaugh map Method minimize the expression Y=A′ B′ C′+A B′ C. 20

(b) Differentiate between multiplexer and Demultiplexer? Using NOT, AND and OR gates, implement a 4-1 multiplexer and write its truth table. 20

(c) A three phase fully-controlled bridge converter is fed from a supply voltage of 230 V per phase and frequency of 50 Hz. The source inductance is 3 mH. The load current on DC side is constant at 20 A. If the load consists of a DC source voltage of 400 V having an internal resistance of 1.5 Ω. Compute the following: (i) Firing angle & (ii) Overlap angle. 20

7. (a) Explain the operation of half controlled bridge with resistive load and find the expression for average load voltage and load current. How does the operation get modified with R-L load? 20

(b) Comparison between MOSFET and IGBT and explain construction, principle and applications of MOSFET. 20

(c) For the excitation as given in the Figure (a) and clamping circuit in Figure (b), calculate and plot to scale the steady-state output. $R_f = R_s = 100\ \Omega$, $R = 100\ K\Omega$, $C = 0.1\ \mu F$, $T_1 = 100\mu s$ and $T_2 = 1000\mu s$. 20

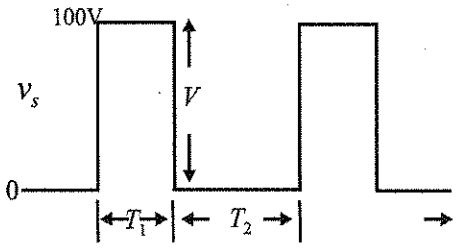


Figure (a)

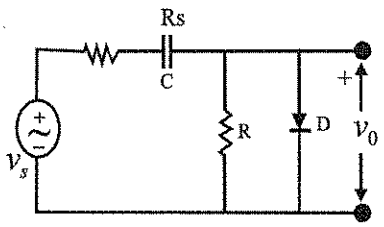


Figure (b)

8. (a) Define Gain and Radiation Efficiency of antenna. Find the power Gain of an antenna if the directivity is 1.5, efficiency factor is 50% and the VSWR at antenna input is 3 and the input power is 1. Also find the power radiated. 20

(b) State Maxwell's equations and Derive the Maxwell's equation in differential and integral form for the cases (i) general case of time varying field & (ii) static fields. 20

(c) What do you understand by Modulation. Briefly explain the methods of Modulation and compare between AM and FM. 20