

2022

ELECTRICAL ENGINEERING

PAPER-II

Time Allowed — 3 Hours

Full Marks — 200

*If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.*

*Answers may be given either in English or in Bengali but all answers must be in one and same language.*

Answer any five questions.

1. (a) Deduce the EMF equation of D.C. Machine. 8
- (b) A 220 V d.c. series motor has armature and field resistances of  $0.15 \Omega$  and  $0.10 \Omega$  respectively. It takes a current of 30A from the supply while running at 1000 rpm. If an external resistance of  $1 \Omega$  is inserted in series with the motor, calculate the new steady state armature current and the speed. Assume the load torque is proportional to the square of the speed i.e.  $T_L \propto n^2$ . 8
- (c) Deduce the condition for maximum efficiency of a transformer. 8
- (d) A 8-pole, 3-phase, 50 Hz induction motor is running at full-load with a slip of 5%. The rotor is star connected and its per phase resistance and standstill reactance are  $0.35 \Omega$  and  $2 \Omega$  respectively. The EMF between slip rings is 150 V. Determine the rotor current per phase and rotor power factor. Assuming the slip rings are short-circuited. 8
- (e) Show that the locus of the tip of armature current phasor for a synchronous machine, is a circle, when the electromagnetic power is constant. 8
2. (a) What is MOSFET? Explain its construction details. Draw and explain the drain current ( $I_D$ ) vs drain-to-source voltage ( $V_{DS}$ ) characteristics curves of it. 2+3+5=10
- (b) Discuss the principle of operation of Chopper Circuit. Also explain the output voltage and current waveforms with time. Where it is used? 10
- (c) What is Switched-Mode Power Supply (SMPS)? Draw the block diagram of a mains operated AC/DC SMPS with output voltage regulation and explain each of the parts for obtaining DC output from AC input. 10
- (d) What is phase controlled rectifier? Draw the schematic diagram of phase controlled rectifier and explain the operation of it. 10

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3. (a) A synchronous motor is receiving 35% of the power that it is capable of receiving from an infinite bus. If the load on the motor is doubled, determine the maximum value of load angle  $\delta$  during the swinging of the motor around its new equilibrium position. 10
- (b) Write short notes on: 5×2=10
- (i) Use of FACTS and its remedies
- (ii) Static VAR Compensation (SVC)
- (c) Explain with a neat circuit diagram the differential protection scheme used to protect Y —  $\Delta$  transformers. 10
- (d) How the arc is formed in vacuum circuit breaker when it is interrupting short-circuit current? Discuss the main (at least four) advantages of using vacuum circuit breakers. 6+4=10
4. (a) In connection to "Generation and Utilisation" of electrical power, discuss the present scenario of it in West Bengal and India. 10
- (b) Discuss in brief, the main components of Hydel power plant. 10
- (c) Write short notes (*any two*): 10×2=20
- (i) Photovoltaic Solar Cells
- (ii) Pollution from energy sources
- (iii) Energy management and Audit
5. (a) What are the advantages of electric heating? What are the desirable properties the materials for heating element should have? 2+5=7
- (b) What is dielectric heating? Derive an expression for the heat produced in a dielectric material. State the laws of illumination. 2+3+5=10
- (c) Discuss the difference between electronic and magnetic ballast. 3
- (d) A hall 30 metres by 15 metres with a ceiling height of 5 metres is to be provided with a general illumination of 120 lumens/m<sup>2</sup>. Taking a coefficient of utilisation of 0.5 and depreciation factor of 1.4, determine the number of lamps required, their spacing, mounting height and total wattage. Take illumination efficiency of the lamp as 40 lumens/watt for 80 watt lamp. 20
6. (a) How the pulsating m.m.f. (magneto-motive force) will be developed in case of single-phase induction motor when it is supplied from single-phase A.C. source? 10
- (b) Write short notes on: 5×4=20
- (i) Zener diode
- (ii) Triac
- (iii) Half-controlled bridge converter
- (iv) Semi-conductor materials
- (c) Write short note on HVDC transmission line. 10

7. (a) Distinguish between Radial and Ring main electrical power distribution systems. 10
- (b) What do you mean by power system rotor angle stability? Explain with suitable example. 6+6=12
- (c) Find the per unit value for each component as shown in Fig.-1 and draw the impedance diagram: 18

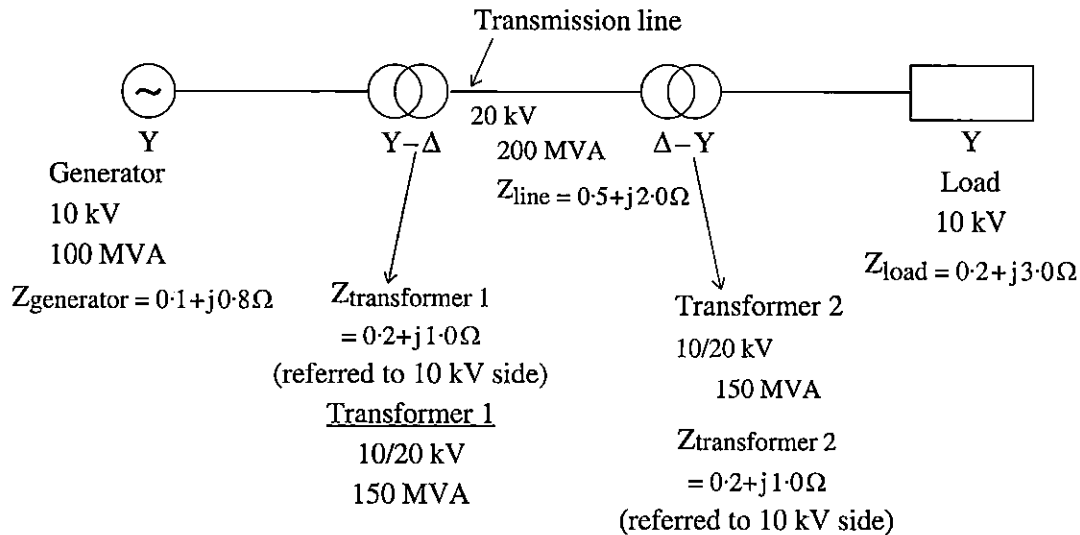


Fig.-1

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