SUBJECT: ELECTRICAL ENGINEERING: PAPER - 2 (Set-A)

Time: 3 Hours

Full Marks: 200

Note: Answer Question no. 1 and any four from the rest. All questions carry equal marks

1. Answer any ten (10):

10x4 = 40

8 x5 =40

- (a) What do you understand by insulation co-ordination?
- (b) What is the use of commutator in a D.C. machine?
- (c) What are bundled conductors? Why are they used in power transmission systems?
- (d) Differentiate between a NIBBLE and a BYTE.
- (e) Write two differences between a BJT and a FET.
- (f) Induction motors can never operate at synchronous speed. Why?
- (g) How is memory stored in an array? Explain with an example.
- (h) What is corona? What are the factors on which corona loss depends?
- (i) Differentiate between 'controllable' and 'observable' systems with examples.
- (j) Discuss the operation of an OP-AMP as a summer.
- (k) What is armature reaction in case of analysis of D.C.machines?
- (I) What are pointers in case of arrays? Explain 'call by value' and 'call by reference' in case of arrays.
- 2. Attempt any eight (8):
 - (a) How is open loop control system different from closed loop control system? Explain taking a suitable example for each case.
 - (b) What are the various methods of speed control techniques used in D.C. motors? Explain any two methods in detail.
 - (c) How can synchronous machines be used to improve power factor of a system? Explain.
 - (d) Discuss the importance of 'Flow-charting' in case of algorithm development? How are they helpful in computer programming?
 - (e) How does a capacitor start induction motor differ from a capacitor start and run induction motor? Discuss their operation.
 - (f) What is the role of back e.m.f. in case of D.C. motors? How does it adjust the input to the motor with the change in load at the shaft terminal?
 - (g) How does the three point starter differ from that of a four point starter in case of D.C. machines? Discuss with a diagram.
 - (h) Discuss the various factors on which the efficiency of a D.C. machine depends.
 - (i) What are eddy current and hysteresis loss in case of Transformers? How can they be minimized?
 - (j) An induction motor can be realized as a transformer with its secondary short-circuited. Explain with the help of a circuit diagram.
- **3.** Attempt any five (5):

 $5 \times 8 = 40$

- (a) Develop an algorithm to read n numbers, sort them in descending order and display the sum of all the n numbers.
- (b) Define modulation in communication systems. What are amplitude modulation, frequency modulation and delta modulation? What are the limitations of delta modulation and how can they be overcome?
- (c) What is Automatic Load Frequency Control (ALFC)? Discuss with a proper diagram.
- (d) How is Machine Language different from High level language? Discuss the advantages and disadvantages of both the languages.
- (e) Draw the equivalent circuit diagram of a single phase transformer when its secondary side is loaded Draw the phasor diagram and explain how power transfer takes place under such a condition.

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- (f) What is critical disruptive voltage in relation to corona? What are the advantages and disadvantages of corona effect?
- (g) Draw the load curve of a power system and define base load, peak load, average load and load factor with reference to the load curve.
- 4. Answer any four:

4 x 10 = 40

- (a) Write a computer program (in any high level language known to you) to read an array of N (N<=100) integers and then find and print the following results:
 - i. Number of odd and even integers
 - ii. Sum of the odd integers
 - iii. Sum of the even integers
 - iv. Sum of the squares of the integers
 - v. Sum of the squares of the even integers
- (b) Explain with the help of appropriate circuit diagram how three phase induction motors are started using
 - i. Star delta method of starting
 - ii. Direct on-line starting or Autotransformer starting.
- (c) Discuss the various methods of arc extinction in power system protection.
- (d) A D.C. shunt machine has an armature resistance of 0.10 Ω and a field winding resistance of 100 Ω . While operated at a voltage of 220 V mains, calculate the speed of the machine while running as a generator to the speed as a motor if the line current in each case is 50 A.
- (e) What is the difference between air circuit breaker and oil circuit breaker? Why are SF₆ circuit breaker preferred over other circuit breakers? Discuss briefly the operating principle of SF₆ circuit breakers.
- 5. Answer any two (2):

2 x 20 = 40

(a) The closed loop transfer function of a system is given by :

$$\frac{C(S)}{R(S)} = \frac{K}{S(S^2 + 3S + 1)(S + 1) + K}$$

Using Routh–Hurwitz stability criterion determine the range of K for which the system will be stable.

- (b) Two shunt generators are operating in parallel and deliver a total current of 250 A. One of the generators is rated 50 kW and the other 100 kW. The voltage rating of both machines is 500 V, and has a regulation of 6 percent and 4 percent respectively. Assuming linear characteristics, determine the current delivered by each machine and the terminal voltage.
- (c) Incremental Fuel costs in rupees per MWh for a plant consisting of two units are:

$$IC_1 = 0.20 P_{G1} + 40$$

 $IC_2 = 0.40 P_{G2} + 30$

Find the optimum load shared by the load if the total load is 100 MW and the generation limits are as follows:

 $\begin{array}{l} 30 \mbox{ MW} \leq P_{G1} \leq 175 \mbox{ MW} \\ 20 \mbox{ MW} \leq \!\!P_{G2} \! \leq 125 \mbox{ MW} \end{array}$

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6. Answer any four (4):

4 x 10 = 40

2 x 20 =40

(a) In a 25 kVA, 2000/200 V transformer, the iron loss and the copper losses are 350 W and 400 W respectively. Calculate the efficiency at full load and 0.8 p.f. lagging. Also determine the maximum efficiency and corresponding load.

- (b) A 4- pole, 400 V, 3-phase, 50 Hz squirrel cage induction motor runs at 1450 r.p.m. at 0.85 p.f. lagging developing 11 kW power. The stator losses are 1100 W and mechanical losses are 400 W. Determine the (i) slip
 (ii) Rotor copper loss
 (iii) Rotor Frequency
 (iv) Line Current
 (v) Efficiency.
- (c) What are Boolean expressions and what are logic gates? How Boolean expressions are realized using logic gates. Explain taking an example. Why are NAND and NOR gates called universal gates? Explain with suitable example.
- (d) Differentiate between an ideal and non-ideal OP-AMP. How are OP-AMPS used as summers, differentiators and integrators? Explain with necessary equations and circuit diagrams.
- (e) What do you understand by armature reaction in case of alternators or synchronous generators? What is the effect of armature reaction when an alternator works at
 - (i) Unity power factor, (ii) zero power factor at lagging load and
 - (iii) Power factor of zero and leading load.

7. Answer any two(2):

(a) For a system with the transfer function $G(s)H(s) = \frac{K}{s(s+3)(s+5)}$, (K > 0), sketch the root locus and determine the break-away points.

(b) A 4 kVA, 200 V/400 V , 50 Hz single phase transformer gives the following test results: OC test (on primary side): 200 V, 0.8 A, 50 W

SC test (on secondary side): 17.5 V, 9 A, 50 W

Calculate the full load efficiency and secondary terminal voltage when supplying full-load secondary current at 0.8 p.f. lagging.

- (c) (I) A power generating station has a maximum demand of 25 MW, a load factor of 60% and plant capacity factor of 50% and a plant use factor of 72%. Find
 - i. the daily energy produced
 - ii. the reserve capacity of the plant
 - iii. the maximum energy that could be produced daily if the plant, while running as per schedule were fully loaded.
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 - (II) Three consumers of electricity have different load requirements at different times. Consumer 1 has a maximum demand of 5 kW at 6 p.m. and a demand of 3 kW at 7 p.m. and a daily load factor of 20 %. Consumer 2 has a maximum demand of 5 kW at 11 a.m. and a demand of 2 kW at 7 p.m. and an average load of 1200 W. Consumer 3 has an average load of 1 kW and maximum demand is 3 kW at 7 p.m. Determine
 - i. the diversity factor
 - ii. the load factor and average load of each consumer and
 - iii. the average load and load factor of the combined load

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