3 Hours   **Total marks : 80**

Instructions:

1. QuestrionNo.1 is compulsory.
2. Answer any **three** from the remaining **five** questions
3. **Figures** to the **right** indicate full **marks**.

1   Solve **any four**:-   **(20)**

a) Convert $\overline{A} = 3\overline{a_X} + 4\overline{a_y} + 5\overline{a_z}$ at the point(3,4,5) in spherical coordinates.
b) State and explain Biot-savart law .
c) Explain Coulomb's Law.
d) Find the force on current carrying wire in a magnetic field.
e) What do you mean by irrotational and solenoidal fields?

2

a)   An aluminium conductor is 30 m long and has circular cross section with a diameter of 20.32mm. If there is a d.c. voltage of 1.2V between two ends, find (i) (J) (ii) Current (iii) Power dissipated, conductivity of Al=3.82 × 10^{-7} mho/m.   **(10)**

b) Find the force on a 100μC charge at (0,0,3)m if four like charges of 20 μC are located on the x and y axis at ±4m.   **(10)**

3

a)   Derive an electric field intensity due to infinite sheet charge.   **(10)**
b)   Given that $\overline{D}=30\, e^{-\frac{r}{b}} a_{\bar{r}} - 2(z/b)\, a_{\bar{z}}$ (c/m²) in cylindrical coordinates, find the outward flux crossing the rights circular cylinder described by r=2b,z=0 and z=5b(m).   **(10)**

4

a) The region x<0 contains dielectric medium for which ε$_{r1}$=4,while the region x > 0 is characterized by ε$_{r2}$=2 if $\overline{E_1} = 50\overline{a_x} - 30\overline{a_y} + 60\overline{a_z}$ (KV/m) find i) E_{n1} ii)ϴ$_1$ iii) E_{t1} iv) E_2 v) ϴ$_2$ **(10)**

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b) V=0volts for r=0.1m and V=100Volts for r=2m in spherical co-ordinates Assuming free space between the concentric spherical shells. find $\overline{E}$ and $\overline{D}$.   **(10)**

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5

a) Derive magnetic field intensity on the axis of a circular loop. **(10)**

b) Given $\bar{E} = E_0 z^2 e^{-t}\overline{a_x}$ in free space .Determine if there exists a magnetic field such that both Faraday's law and ampere's circuital law are satisfied simultaneously. **(10)**

6

a) Derive the wave equation for electric field and magnetic field in free space **(10)**

b) A 10GHz plane wave travelling in free space has an amplitude $E_X=10$ V/m . find v,λ,β,η and amplitude and direction of H. **(10)**

(3 Hours) [Total marks : 80]

Note: 1) Question No.1 is compulsory.

2) Attempt any three questions out of remaining five question.

3) Assume suitable data if required.

1. Solve any four each carry equal marks. 20

    a. Explain connection and phasor diagram of DY 11 transformers.

    b. Explain the operating principle of three phase induction motor.

    c. Explain capacitor start capacitor run single phase I.M.

    d .Explain need of parallel operations of transformers and write necessary condition for parallel operation.

    e. Draw and explain torque slip characteristics of 3 phase I.M.

2). a Explain the oscillating neutral phenomenon in 3 phase transformer . 10

   b. Two three phase transformers rated at 500 KVA and 450 KVA respectively and connected in parallel to supply a load of 1000 KVA at 0.8 PF lagging.The per phase leakage resistance and reactance of the first transformer is 2.5% and 6% respectively and of second transformer 1.6% and 7% respectively.Calculate the KVA load and PF at which each transformer operates. 10

3.a Explain with a neat diagram cogging and crawling phenomenon in 3 phase I.M. 10

  b. A three phase I.M. having 6 pole star connected stator winding runs on 240v 50 H_2 supply. The rotor resistance and standstill reactance are 0.12 and 0.85 per phase. The ratio of stator of rotor turns is 1.8 and F.L. slip is 4% . Calculate the developed torque at F.L. , maximum torque and the speed at maximum torque.

10

4. a. Explain the need of starter for 3 phase I.M. and explain auto-transformer starter in detail. 10

b. A 15KW , 400V , 4pole , 50Hz 3 phase star connected I.M. give the following test result

	Line current(A)	Power i/p (w)	Line voltage(v)
N.L. test	9	1310	400
Blocked rotor test	50	7100	200

Assume stator and rotor ohmic losses are equal at standstill. Draw circle diagram and find line current , power factor , slip , torque and efficiency at F.L. 10

5. a . Draw equivalent circuit diagram of single phase I.M. based on double field revolving theory and explain the double field revolving theory. 10

b. Explain shaded pole 1 phase I.M. in detail. 10

6. Write short note on any two 20

    a. Scott connection of two 3 phase transformers.

    b. Induction generator.

    c. Power flow in 3 phase I.M.

(3 Hours)   **[Total Marks: 80]**

N.B.:- (1) Question No.**1** is compulsory.
(2) **Attempt** any **Three** questions out of remaining **five** questions.
(3) Assume suitable data if necessary and justify the same.

Q 1.   Answer any following questions.
A) Explain time grading and current grading used in protection system. **05**
B) Explain rated characteristics of contactors **05**
C) Draw single line diagram and show all substation devices. **05**
D) Why isolators, contactors and circuit breaker are used in power system. **05**

Q 2 a) Explain construction, working, torque equation and characteristics of following **10**
Distance relay.
    I)   Reactance Relay   II) Mho Relay

Q 2 b) How transformer can be protected against incipient fault. **10**

Q 3 a) Explain the constructional details of HRC fuse with its characteristics. Write **10**
advantages over other type

Q 3 b) Explain construction and working principle of vacuum circuit breaker with its **10**
advantages and disadvantages

Q 4 a) Explain REF protection for alternator. How 100% winding is protected in an **10**
alternator.

Q 4 b) Explain with neat sketch construction and working of Air circuit breaker. Write **10**
advantages and disadvantages

Q 5 a) Explain single phasing in induction motor. How motor is protected from single **10**
Phasing?

Q 5 b) Draw and explain Merz-Price protection scheme for star-delta transformer. **10**

Q6) a) Explain high resistance and low resistance method of arc quenching. **10**

Q6) b) Explain working principle of induction type of relays. Explain IDMT characteristics **10**

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(3 Hours)   **[Total Marks: 80]**

N.B.:   (1) Question No. **1** is **compulsory.**
       (2) Answer any **three** from the remaining **five** questions.
       (3) **Assume** suitable **data** if necessary and justify the same.
       (4) **Figures** to the **right** indicate the marks.

1. (a) State and explain the application of controlled rectifier and Inverter. **[5]**
   (b) Once SCR is triggered gate loses its control. Why? **[5]**

   (c) Explain the principal of operation of power IGBT. **[5]**
   (d) Write short note on protection of SCR. **[5]**

2. (a) Define and explain any two-commutation circuit along with the difference between them. **[10]**

   (b) Explain the constructional detail of MOSFET with equivalent circuit and discuss its characteristics. **[10]**

3. (a) Draw a neat circuit and explain the working of full wave fully controlled 3-phase bridge circuit with resistive load. Draw the corresponding input and output voltage waveforms. Also obtain the expression for output voltage. **[10]**

   (b) Explain 1-phase semi controlled rectifier with RL load with and without freewheeling diode. **[10]**

4. (a) Explain with circuit diagram and waveforms 3 phase bridge inverter for 180° conduction mode. **[10]**

   (b) Discuss the different method of Harmonic reduction. **[10]**

5. (a) Explain with a neat circuit diagram and relevant waveforms the working of BUCK-BOOST regulator and derive the expression for output voltage filter capacitance and filter inductance. **[10]**

   (b) A BUCK- Converter has an input voltage of Edc=14V. The required average output voltage is Eo=6V and the peak to peak output ripple voltage is 15mV. The switching frequency is 30kHz. If the peak to peak ripple current of inductor is limited to 0.6 A. Determine: (a) the duty cycle $\propto$, (b) the filter inductance L, and (c) the filter capacitor C. **[10]**

6. (a) Explain in detail with circuit diagram and waveforms, single phase step up cycloconverter. **[10]**

   (b) Explain single phase bidirectional AC voltage controller with R-L load. **[10]**