42 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE, BAM	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the losses, which occur when magnetic materials are subjected to an alternating flux. How can we reduce these losses practically? [5+3]

   b) What do you mean by armature reaction in a synchronous generator? How the resistive inductive, and capacitive load affects the nature of armature reaction. [8]

2. a) Explain, how can we make equivalent circuits referred to primary side and referred to secondary side. What happens, when a power transformer is connected to a d.c. supply of the same voltage ratings? [6+2]

   b) A 10 KVA, 200/400 V, 50 Hz single-phase transformer gave the following test results:

   O.C. test : 200V, 1.3A, 120W, ... on L.V. side.
   S.C. test : 22V, 30 A, 200 W, ... on H.V. side.
   Calculate: $I\mu$, Iw, Ro, Xo, Ro_2 Xo_2 and Zo_2. [8]

3. a) Explain the functions of commutator and carbon brushes in d.c generator with neat sketch. [8]

   b) A 230V, shunt motor takes 5A at no load. The resistance of the armature and field circuit are 0.25 Ω and 115 Ω respectively. If the motor is loaded so as to carry 40 A, determine (i) Iron and friction losses (ii) efficiency [8]

4. a) Explain the operating principle of three phase induction motor with neat sketches. Why rotor speed is always less than synchronous speed. Justify. [6+2]

   b) An alternator on open circuit generates 360V at 60 Hz, when the field current is 3.6 A. Neglecting saturation, determine the open circuit emf. When the frequency is 40 Hz and the field current is 2.4 A. [8]

5. a) Explain the operating principle and characteristics of split phase induction motor with neat sketches. [8]

   b) Explain construction, operation and characteristics of universal motor. Why is it called so? Give reason. [8]

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX ,BCT, BME, BIE, BAM	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) A steel ring of 12 cm mean radius and of circular cross-section 1 cm in radius has an air gap of 2 mm length. It is wound uniformly with 550 turns of wire carrying 3A of current. The air gap takes 60% of total magnetomotive force. Find the total reluctance. [5]

   b) Explain hysteresis and eddy current losses in electrical machines. Prove that hysteresis loss in a magnetic material is equal to the area of hysteresis loop. [5]

   c) Explain the following: [2×3]

   (i) Faraday's laws of electromagnetic induction
   (ii) Fleming's right and left hand rules

2. a) Derive expression giving amount of copper saving in an auto-transformer. [4]

   b) Discuss how to conduct open-circuit and short-circuit tests on a single phase transformer. From the test results how the efficiency and voltage regulation of the transformer is determined? [6]

   c) An ideal 3-phase delta/star step-down transformer delivers power to a balanced 3-phase load of 120 kVA at 0.8 power factor. The input line voltage is 11 kV and the turns ratio of the transformer, phase to phase is 10. Determine the line voltage, line currents, phase voltages and phase currents on both the primary and secondary sides. [6]

3. a) In a 220 V compound generator, the armature, series and shunt windings have resistances of 0.3Ω, 0.2Ω and 60 Ω respectively. The load consists of 80 lamps, each rated at 60 W and 220 V. find the total emf and armature current when the machine is connected for i) long shunt and ii) short shunt. [6]

   b) What do you mean by back emf in DC motors? Explain the significance of back emf. [4]

   c) Explain the speed-current, torque-current and speed-torque characteristics of a DC shunt motor. [6]

4. a) Explain the torque-slip characteristics of a three phase induction motor. Starting with the expression for torque as a function of slip, show that the value of maximum torque is independent of rotor resistance. [6]

   b) The power input to the rotor of a 440 V, 50 Hz, 3-phase, 6-pole, induction motor is 50 kW. The rotor emf makes 120 cycles per minute. Friction and windage losses are 2 kW. Calculate (i) slip (ii) rotor speed (iii) rotor copper losses (iv) mechanical power developed (v) output power (vi) output torque [6]

5. a) Explain about constructional details and working principle of three phase synchronous generator. [8]

   b) Describe briefly the effect of varying excitation upon the armature current and power factor of a 3-phase synchronous motor when input power to the motor is maintained constant. [6]

   c) Using double revolving field theory, explain the working of a single phase induction motor. [6]

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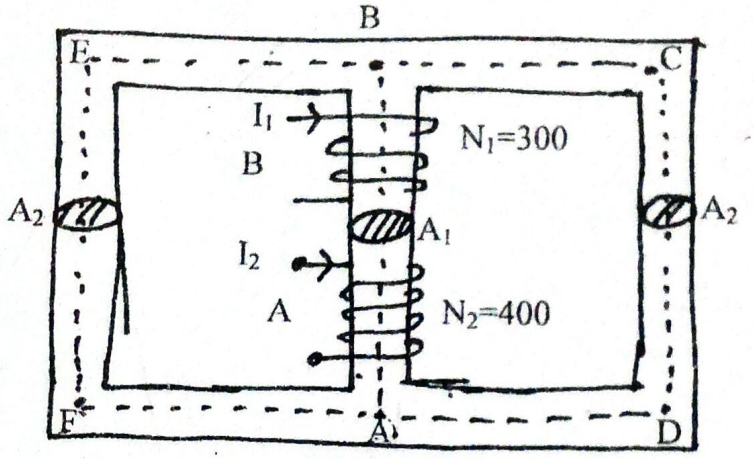
43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT,BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) For magnetic circuit shown in figure below, find out the current to be passed through coil B so that magnetic flux in CD section is 2 mWb. Given $\mu_r = 1000$ [8]



Given:

$I_2 = 3$ Amp, $A_1 = 6\ cm^2$, $A2 = 3\ cm^2$

$AB = CD = EF = 20$ cm

$BC = AD = BE = AF = 20$ cm

b) Copper loss is assumed to be negligible in no load test and iron loss is assumed negligible in short circuit test. Explain why it is so. [8]

2. a) The following test result were obtained on 20 KVA, 2200/220 V, 50 HZ single phase transformer [8]

Open circuit test: 220 V, 1.1 A, 125 W
Short circuit test: 52.7 V, 8.4 A, 287 W

i) Calculate the equivalent circuit parameters referred primary sides and draw the equivalent circuits
ii) Calculate maximum efficiency at full load
iii) Calculate the efficiency at half full load with 0.8 power factor lagging

b) How current transformer is different from conventional transformer. Explain how CT is used to measure high currents. Also explain, what happens if the secondary of CT is open when there is high current flowing in primary side. [8]

3. a) Using circuit diagram and graphical representation, explain the characteristics of DC series generator and DC shunt generator. Also mention their applications. [8]

   b) A 220 V, DC series motor draws 100 A current and runs at 1200 RPM. What is value of armature resistance required to run the motor at 800 RMP keeping load torque constant. Given armature resistance = 0.2 ohm, field winding = 0.05 ohm [4+4]

4. a) Explain the torque-slip characteristics of an induction motor. Show the condition for which the maximum torque develops in the induction motor. [5+3]

   b) A 6-pole, 50 Hz, three-phase induction motor has rotor resistance of 0.4 Ω/phase, maximum torque is 200 Nm at 850 rpm. Find (i) torque at 4% slip, and (ii) additional rotor resistance to get $(2/3)^{rd}$ of maximum torque at starting. [8]

5. a) Explain effect of excitation on pf of synchronous motor with necessary diagrams. [8]

   b) Explain double field revolving theory refer to single phase induction motor and prove that a single phase induction motor is not self starting. [8]

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define coercitivity and retaintivity with the help of BH curve. [6]

   b) A magnetic circuit consists of a circular iron core having mean length of 10 cm and cross sectional area of 100 square mm. The air gap is 2 mm and the core has 600 turns of winding. Calculate the magnitude of current to be passed through the winding to produce air gap flux of 1 tesla (permeability of iron = 4000) [10]

2. a) Explain working principle of an auto-transformer. Derive an expression for Cu saving in an auto-transformer. [8]

   b) A 4-kVA, 200/400V single phase transformer has following test results: [8]

   O.C Test: 200V 0.8A 70W

   S.C Test: 20V 10A 60W

   Obtain equivalent circuit parameters of the transformer refer to L.V side.

3. a) Make a detail comparison of dc shunt generator and dc series generator with their diagrams, equations and characteristics curve. [8]

   b) A dc shunt motor is supplied by a source of 200 V. It draws a current of 20 A and runs at speed of 1500 rpm. The armature and field winding resistance are 0.08 Ω and 110 Ω respectively. A resistance of 0.02 Ω is added in series with armature and load torque is increased by 30%, calculate new speed. [8]

4. a) How does induction motor and synchronous motor adjust the current according to the change in load? Explain briefly using mathematical expression. [4+4]

   b) A 4 pole, 50 Hz, 3-phase slip ring induction motor has star connected stator and rotor windings. The rotor winding has impedance of (1+j4)Ω per phase at stand still. The stator to rotor turn ratio is 2. Given that emf induced in rotor circuitis 400 V between two slip rings at stand still. Calculate starting current and running current at 1400 rpm. [8]

5. a) A 1200 KVA, 6000 V, 3 phase star connected stator of a synchronous generator has a armature resistance of 0.4 ohms/phase and synchronous reactance of 6 ohm/phase. The generator delivers full load current at pf 0.8 lagging at normal rated voltage. Calculate the terminal voltage for the same excitation and load current at 0.8 pf leading. [8]

   b) Why single phase induction motors are not self-starting? Explain any two starting methods for single phase induction motor. [8]

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the operating principle of an ideal transformer and derive the emf equation.

   b) A ring of 30 cm mean diameter is made up of round iron rod 2.5 cm in diameter. A saw cut of 1 mm is made on the ring. It is uniformly wound with 500 turns of wire. Calculate the current required by the exciting coil to produce a total flux of 4m Wb. Assume a relative permeability of iron at this flux density as 800.

2. a) Explain the operation principle of dc generator. What are main functions of carbon brush in dc generator?

   b) A 20 kVA, 250V/2500V, 50Hz single phase transformer gave the following test results:

   No-load test (on L.V. side): 250V, 1.4A, 105 watts

   Short circuit test (on H.V.side): 120V, 8 A, 320 watts

   Calculate the equivalent circuit parameters referred to primary side and draw the equivalent circuit.

3. a) Sketch and explain the torque slip characteristics of a 3-phase induction motor indicating the starting torque, maximum torque and the operating region. How does rotor resistance affect the torque slip characteristics?

   b) A 200V DC shunt motor drives a centrifugal pump where constant torque is required. The motor draws a current of 50 A when running at 1000rpm. What value of resistance must be inserted in the armature circuit to reduce the speed to 800rpm at constant torque? Given that armature winding resistance, R_a = 0.1 Ω and field winding resistance, R_f = 100 Ω

4. a) With the help of phasor diagrams, explain the effect of excitation in a 3-phase synchronous motor.

   b) A 4-pole, 50 Hz, 3 phase induction motor develops a starting torque of 50 N-m. The rotor winding has an impedance of (0.8+j2) Ω per phase at stand still. At what speed the motor will develop maximum torque and calculate magnitude of the maximum torque.

5. a) What do you understand by double field revolving theory? Explain it with the help of a neat diagram.

   b) A 500 KVA, 50 Hz, 6600V/400V, 1- phase transformer have primary and secondary winding resistances are 0.4 Ω and 0.001 Ω respectively. If the iron loss is 3.0 KW, Calculate the efficiency at (a) full load (b) half full load.

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

(19)

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. a) An iron ring has a mean length of 2m and cross-sectional area of 0.01 m^2. It has a radial air gap of 4 mm. The ring is wound with 250 turns. What dc current would be needed in the coil to produce a flux of 0.8 Weber in the air gap? Assume that $\mu r = 400$.

   b) Explain the operation of transformer with no-load and load. Prove that the magnetic field in a transformer core remains constant at any load.

2. a) A 20 kVA, 250/2500V, 50 Hz, single phase transformer has R_o = 595.2 Ω, X_o = 187.26 Ω, R_{01} = 0.05 Ω and X_{01} = 0.14 Ω. Calculate (i) iron loss of the transformer (ii) efficiency of the transformer at half load with 0.8 pf lagging.

   b) A short shunt compound generator delivers a load current of 30 A at 220 V and has armature, series and shunt field resistances of 0.05 Ω, 0.03 Ω and 200 Ω respectively. Calculate the induced emf and the armature current. Allow 1 V per brush contact drop.

3. a) A 200 V DC series motor draws full-load line current of 38 A at the rated speed of 600 rpm. The motor has armature resistance of 0.4 Ω and the series field resistance is 0.2 Ω find:

      i) The speed of the motor when the load current drops to 19 A
      ii) The speed on removal of load when the motor takes only 1 A from supply

   b) Explain torque-slip characteristics of 3 phase induction. Deduce the condition for which maximum torque. Discuss the effect of variation of rotor resistance on this maximum torque.

4. a) Explain why a 3 phase synchronous motor is not self starting. Explain a method of starting a 3 phase synchronous motor.

   b) Draw equivalent circuit of 3 phase induction motor at stand still and running conditions. Derive the expression for starting torque and running torque.

5. a) Explain the operating principle of servo motor.

   b) The no-load test and short circuit test on a 220V/2200 volt single phase transformer gave following results.

      No load test (on L.V side): 220V 1.2 Amp 100 watts
      Short circuit test (on HV side): 110V 8Amp 300 watts
      Calculate equivalent circuit parameters refer to primary side and draw the equivalent circuit.

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

20 **2071 Bhadra**

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What are different types of losses in transformer? Derive the expression of efficiency of transformer. [8]

   b) An iron ring of mean diameter 100cm and cross sectional area $10cm^2$ is wound with 1000 turns and has $\mu_r = 2000$. Compute (i) reluctance (ii) flux produced when the current through the coil is 1A (iii) Flux in the ring if a saw cut of 1mm length is made, the current through the coil remaining the same. [8]

2. a) A 25 KVA, single phase, 11 KV / 400V transformer has impedance of primary and secondary $0.4 + j2\Omega$ and $0.02 + j1\Omega$ respectively. Determine the load terminal voltage and primary current at half load. [8]

   b) Describe the construction and working principle of a dc generator with neat diagram. Also derive the emf equation of a dc generator. [8]

3. a) Describe different methods of controlling the speed of shunt DC motor. [8]

   b) Explain with necessary vector diagram how rotating magnetic field is produced in a three phase induction motor. Also explain how this rotating magnetic field helps the motor to rotate. [8]

4. a) Explain torque slip characteristics of 3-phase induction motor. Why the induction motor operates only in linear portion of torque-slip characteristics. [8]

   b) A 3.3 KV, 3-phase star connected synchronous motor has impedance of $0.2 + j2.2\Omega$/phase of the armature winding. The motor is operated at 0.5 pf leading with line current of 100 A. Determine the back emf per phase and also draw phasor diagram. [8]

5. Give reasons for the following statements. [4×4]

   a) Single phase induction motors are not self starting
   b) Servo motor has longer length and smaller diameter compared to other normal motor
   c) DC series motor can also be operated from ac supply
   d) Hysteresis and eddy current losses depends on the frequency of supply system

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41 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

(20)

2071 Magh

Exam.	[illegible] Back (2066 & [illegible] Batch)		
Level	BE	**Full Marks**	80
Programme	BEX, BCT, BME, BIE	**Pass Marks**	32
Year / Part	II / II	**Time**	3 hrs.

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) A rectangular iron core is shown in figure 1. It has a mean length of magnetic path of [illegible] cm, cross-section of (2 cm × 2 cm), relative permeability of 1400 and an air-gap of 5 mm cut in the core. The three coils carried by the core have number of turns, $N_a = 335$, $N_b = 600$ and $N_c = 600$; and the respective currents are 1.6 A, 4 A and 3 A. The directions of the currents are as shown in the figure. Find the flux in the air-gap. [6]

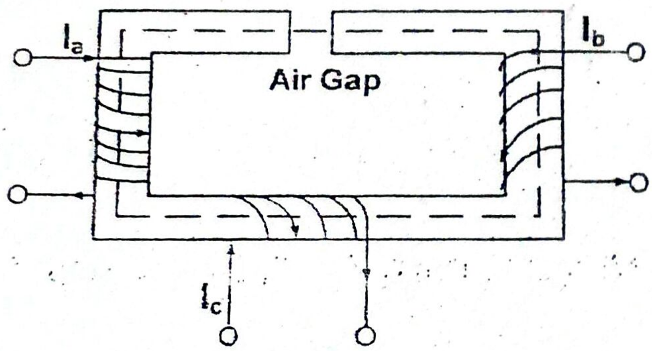

Figure 1

b) State Faraday's Laws of electromagnetic induction. Distinguish between statically induced emf and dynamically induced emf. [6]

2. a) Explain the working of an ideal transformer under (i) no-load and (ii) loaded conditions and derive expressions for voltage and current ratios relating to transformer turns ratio. [4+4]

b) The following test results were obtained for open circuit and short circuit tests on a 8 kVA, 400/120 V, 50 Hz transformer: [8]

Open-circuit Test (LV Side) : 120 V, 4 A, 75 W
Short-circuit Test (HV Side) : 9.5 V, 20 A, 110 W

Calculate the equivalent circuit parameters referred to high voltage side. Also calculate the efficiency at half full load and 0.8 power factor lagging load.

3. a) Explain the working principle of dc generator with neat diagram. [3+3]

b) A short shunt compound generator supplies a load current of 100 A at 250 V. The generator has the following winding resistances: shunt field 130 Ω, armature 0.1 Ω and the series field 0.1 Ω. Find the emf generated and the armature current, if the brush drop is 1 V per brush. [6]

4. a) What is back emf? How does back emf play an important role in DC motor? [2+4]

   b) A dc shunt motor runs at 600 RPM taking 60 A from a 230 V supply. Armature resistance is 0.2 Ω and field resistance is 115 Ω. Find the speed when the current through the armature is 30 A. [6]

5. a) Explain the torque-slip characteristics of an induction motor. Show the condition for which the maximum torque develops in the induction motor. [3+3]

   b) A 3-phase delta connected 440 volts, 50 Hz, 4-pole induction motor has a rotor stand-still emf per phase of 130 volts. If the motor is running at 1,440 RPM, calculate for this speed : (i) the slip, (ii) the frequency of rotor induced emf, (iii) the value of the rotor induced emf per phase, and (iv) stator to rotor turn ratio. [4]

6. a) What do you mean by V-curve and inverted V-curve for a synchronous motor? Explain with a neat diagram. [6]

   b) What are the advantages of rotating magnetic system and stationary armature system in ac machine? [4]

   c) Write short notes on the following: [2×4]

   i) Universal motor
   ii) AC servo motor

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33 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) The flux in transformer remains practically constant from no load to full load. Justify the statement. [4]

   b) Derive an expression for Cu saving in an auto-transformer. [4]

   c) A 230 V / 2300 V single-phase transformer is excited by 230 V ac voltage. The equivalent resistance and reactance referred to primary side are 0.1 Ω and 0.4 Ω respectively. Given that R_0 = 500 Ω and X_0 = 200 Ω. The load impedance is (400 + j600) Ω. Calculate: (i) Primary current and input power factor (ii) Secondary terminal voltage. [8]

2. a) Derive an emf equation for a dc generator. [4]

   b) DC shunt generator shall be started keeping its output terminal open. Justify the statement. [4]

   c) A 4 pole, 250 V long shunt dc compound generator supplies a load of 10 KW at the rated voltage. The armature, series and shunt field resistances are 0.1 Ω, 0.15 Ω and 250 Ω respectively. The armature is lap wound with 300 conductors. If the flux per pole is 50 mWb, calculate the speed of the generator. [8]

3. a) With the help of a neat sketch, explain the working principle of three terminal DC motor starter. [5]

   b) A dc series motor of resistance 1 Ω between terminals runs at 1,000 RPM at 250 V with a current of 20 A. Find the speed at which it will run when connected in series with a 6 Ω resistance and taking the same current at the same supply voltage. [5]

   c) A circular iron core has a cross-sectional area of 5 sq.cm. and mean length of 25 cm including an air gap of 4 mm. The core is wound with 500 turns of winding. Calculate the inductance of the coil. If a dc current of 10 Ampere passed through the coil, calculate magnetic flux in the core. Given that relative permeability of the core is 2000. [6]

4. a) What will be the condition for maximum torque and explain torque slip characteristics of 3-phase induction motor. [8]

   b) A 3-phase, 50 Hz induction motor has starting torque which is 1.25 times full load torque and a maximum torque which is 2.5 times the full load torque. Neglecting stator resistance and rotational losses and assuming constant rotor resistance. Find [8]

   i) slip at maximum torque
   ii) the slip at full load
   iii) the current at starting in per unit full load current

5. a) With the help of phasor diagrams, explain the effect of excitation in a 3-phase synchronous motor. [8]

   b) A 1200 KVA, 6600 V, 3-phase star connected stator of a synchronous generator has a armature resistance of 0.4 Ω/phase and synchronous reactance of 6 Ω/phase. The generator delivers full load current at pf of 0.8 lagging at normal rated voltage. Calculate the terminal voltage for the same excitation and load current at 0.8 pf leading. [8]

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INSTITUTE OF ENGINEERING
Examination Control Division
2070 Magh

Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the working of an ideal transformer under (i) no-load and (ii) loaded conditions and derive expressions for voltage and current ratios relating to transformer ratio. [8]

   b) The following test results were obtained on a 20 kVA, 2200/220 V, 50 Hz single phase transformer: [8]

   Open-circuit Test (LV Side): 220 V, 1.1 A, 125 W
   Short-circuit Test (HV Side): 52.7 V, 8.4 A, 287 W
   Calculate the equivalent circuit reffered to L.V side and draw the equivalent circuit.

2. a) Explain torque-armature current and speed-torque characteristics of DC shunt and DC series motor. [8]

   b) A 220V dc shunt motor draws a current of 40A at full load and runs with speed of 1400rpm. Calculate the value of resistance required to be inserted in the armture circuit so that speed drops to 1200rmp at constant load. Given that R_a=0.02ohm and R_f=100ohms. [8]

3. a) Explain why synchronous motor is not self starting? Explain the starting method using damper winding. [8]

   b) A 4-pole dc shunt generator has wave wound armature. The armature and field winding resistance are 0.2 ohm and 60 ohms respectively. The brush contact drop is 1V per brush. The generator is delivering a power of 3 kW at 120V. Calculate: [8]

   i) Total armature current coming out from the brush
   ii) Current in each armature conductor
   iii) Generated EMF (E)

4. a) Explain the torque-slip characteristics of 3 phase induction motor. Show the condition for which the maximum torque develops in the induction motor. Discuss the effect of variation of rotor resistance on this maximum torque. [8]

   b) A 8-pole, 50 Hz, 3 phase induction motor develops a starting torque of 50 N-. The rotor winding has an impedance of (0.8+j2) Ω per phase. At what speed the motor will develop maximum torque and calculate the magnitude of maximum torque. [8]

5. a) What do you understand by double field revolving theory? Explain it with the help of a neat diagram. [8]

   b) A ring of 30 cm mean diameter is made up of round iron rod 2.5 cm in diameter. At one end, a saw cut of 1 mm wide is made through it. It is uniformly wound with 500 turns of wire. Calculate the current required by the exciting coil to produce a total flux of 4 mWb. Take relative permeability of iron as 800. Neglect leakage and fringing. [8]

33 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine ***(EE554)***

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the no-load and loaded operation of an Ideal transformer. Prove that the net magnetic flux in the core remains constant at any load.

   b) A magnetic circuit consists of a circular iron core having mean length of 10cm and cross-sectional area of 100mm^2. The air gap is 2mm and the core has 600 turns of winding. Calculate the magnitude of current to be passed through the winding to produce air gap flux of 1 Telsa. Given $\mu_r = 4000$.

2. a) Explain the working principle of a d.c. motor and derive the equation of Torque developed by the armature of the d.c. motor.

   b) A dc series motor with armature resistance of 0.06Ω, and field winding resistance of 0.04Ω is supplied by a 220V source. If the motor draws 25A when running at 1200rpm, calculate the current drawn by motor when running at 800 rpm.

3. a) Explain the Armature control method and field control method of speed control of DC shunt motor.

   b) A 4 pole dc shunt generator has armature and field winding resistance are of 0.2Ω and 60Ω respectively. The brush contact drop is 1V per brush. The generator is delivering a power of 3KW at 120V. Calculate:

      i) Total armature current coming out from the brush

      ii) Current in each armature conductor

      iii) Generated EMF(E)

4. a) Explain the armature reaction in a synchronous generator for resistive, inductive and capacitive loading with necessary diagram.

   b) A-3phase, slip-ring, induction motor with star-connected rotor has an induced e.m.f. of 120 volts between slip-rings at standstill with normal voltage applied to the stator. The rotor winding has resistance per phase of 0.3 Ohm and standstill leakage reactance per phase of 1.5 Ohm. Calculate the current/phase when running short-circuited with 4% slip.

5. a) Explain the nature magnetic field created by signal phase induction motor with the help of double field revolving theory and explain why single phase induction motor is self starting.

   b) Write about the working principle of a signal stack stepper motor with neat diagram.

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33 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Poush

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine *(EE554)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Define retaintivity and coercivity of core using hysteresis loop of a magnetic material used in electrical machine. Prove that energy spent per cycle per unit volume is proportional to the area of loop.

   b) An iron ring has a mean length of 2.5 m and A = 0.04 m^2. It has a radial air gap of 5 mm. the ring is wound with 200 turn, what dc current would be needed in the coil to produce a flux of 0.82 Wb in the air gap. Assume that $\mu_r = 5000$.

2. a) What are different types of losses in DC generator? Derive the expression for the efficiency of DC generator.

   b) A 220 v, DC series motor draws 100 A current and runs at 1200 rpm. What is the value of armature resistance required to run the motor at 800 rpm. Given: Armature resistance = 0.2 Ω, field winding resistance = 0.05 Ω.

3. a) A dc shunt motor drains a current of 120 A from 480 V dc source, the armature winding and field winding resistance are 0.5 Ω and 222 Ω respectively. The motor has 6 poles and the armature winding has 740 conductors. The flux per pole is 0.08 Wb. Calculate: (i) Armature current (ii) Speed (iii) Torque developed by armature.

   b) What is back emf in dc motor? How back emf helps to developed required torque according load applied on the shaft.

4. a) Show that the synchronous motor can be operated in both leading as well as lagging pf mode.

   b) A 6 pole, 50 Hz, 3-ph, slip ring induction motor has star connected stator and rotor windings. The rotor windings has impedance of 0.8 + j4 Ω/ phase at standstill. The induced emf between slip rings at standstill is 400 V. The stator to rotor turn ratio is 4. The motor runs at 960 rpm at no load. Calculate current drawn by motor at standstill and no load.

5. a) Explain double revolving field theory. Explain any two methods which are used for starting single phase induction motor.

   b) Explain the operating principle of dc servo motor and its applications.

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33 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

32 2068 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Five questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. State whether the following statements are true or false and justify them. [(1+3)×4]
   a) Secondary of CT should not be kept open while the primary winding is energized. T
   b) DC series motor should always be started at no load. F
   c) Rotor core loss is often neglected in 3 phase induction motor.
   d) Construction of auxiliary winding of 1 phase induction motor is different from that of the main winding. F

2. a) Describe different types of losses on the transformer. Also derive the expression for the maximum efficiency of the transformer. [8]

   b) A 10 kVA, 200/400V, 50HZ, 1-phase, transformer gave the following test results: [8]

   OC test (HV open): 200V 1.3A 120W
   SC test (LV, sort): 22V 30A 200W

   Determine shunt and series branch parameters referred to Low Voltage Side and hence draw equivalent circuit diagram also.

3. a) Explain working principle of DC generator in detail and hence derive the expression of emf equation also. [8]

   b) A 200V, dc shunt motor drives a centrifugal pump where torque is proportional to the square of speed. The motor draw a current of 50A when running at 1000 rpm. What value of resistance must be inserted in the armature circuit to reduce the speed to 800 rpm. Given: Armature resistance (R_a) = 0.1Ω and field winding resistance (R_f) = 100Ω. [8]

4. a) What do you mean by excitation control in synchronous motor? How synchronous motor can be operated in leading and lagging pf mode? [8]

   b) A 8-pole, 50Hz, 3-ph induction motor develops a starting torque of 50N-m. The rotor winding has an impedance of (0.8 + j4)Ω per phase. At what speed the motor will develop maximum torque and calculate the magnitude of maximum torque [8]

5. a) Why single phase induction motor are not self starting? Explain any two starting methods for single phase induction motor. [8]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

38 2068 Magh

Exam.			
Level		Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: Electrical Machine

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Five questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the working principle of a single phase induction motor. What is the effect of air gap in the magnetic circuit? [5+3]

   b) A cast steel ring has a circular cross section of 3cm in diameter and mean circumference of 80cm. A 1mm air-gap is cut in the ring which is wound with a coil of 600 turns. Estimate the current required to establish a flux of 0.75 mWb in the air-gap. [8]

   Magnetization data:

H (AT/m)	200	400	600	800	1000	1200	1400	1600
B(T)	0.1	0.32	0.6	0.9	1.08	1.18	1.27	1.32

2. a) Explain the transformer on load and no load with the phasor diagram of resistive and capacitive load. [8]

   b) Test data on a 1-Ø, 250/500V, 50Hz transformer are: [8]

   O.C. Test: 250V, 1A, 80W (carried on L.V. Side)
   S.C. Test: 20V, 12A, 100W (carried on H.V. side)

   Then draw the equivalent circuit referred to primary side and find out the output power to obtain maximum efficiency at 0.9 lag p.f.

3. a) A 500-KVA, 3-Ø, 50Hz transformer has a voltage ratio (line voltage) of 33/11KV and is delta/star connected. The resistances per phase are: High voltage 35Ω, low voltage 0.876Ω and the iron loss is 3050W. Calculate the value of efficiency at full-load and one-half of full-load respectively at 0.8 p.f. [8]

   b) Why the dc motor draws large current at starting? Justify it clearly and also describe the working of 3-point dc motor starter. [3+5]

4. a) A short shunt compound generator delivers a current of 80A to the load at 220V. The shunt field, series and armature winding resistances are 100Ω, 0.05Ω and 0.1Ω respectively. Calculate the emf generated by the armature. [8]

   b) Draw and explain torque-slip characteristics of 3-Ø induction motor, showing clearly the starting torque, maximum torque and normal operating region. [8]

5. a) A 208V, 60 Hz, 4 pole, 3-Ø induction motor has a full-speed of 1755 rpm. [8]

   Calculate: (i) asynchronous speed, (ii) the slip and (iii) rotor frequency.

   b) Write down the criteria for synchronizing two 3-Ø alternators with the detail explanation. [8]

6. Write short notes on: [4x4]

   a) Capacitor starting of 1-Ø induction motor
   b) Armature reaction in dc machine
   c) Eddy current loss
   d) Starting methods of synchronous motor