Code No: R19ES1211 **R19** SET - 1

I B. Tech II Semester Regular Examinations, December - 2020
BASIC ELECTRICAL ENGINEERING
(Com. to ECE, EIE)

Time: 3 hours Max. Marks: 75

Answer any five Questions one Question from Each Unit
All Questions Carry Equal Marks

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1. a) Derive the torque equation of d.c. motor from the fundamentals. (8M)

   b) A long shunt compound d.c. generator delivers 25 kW to a load at 500V. The generator has shunt field, series field and armature resistance of 250 Ω, 0.03 Ω and 0.05 Ω respectively. Draw the schematic diagram of the generator. Calculate various branch currents and voltage generated in the armature winding. Assume 1V drop per brush. (7M)

Or

2. a) Describe Swinburne's test with the help of a neat diagram to find out the efficiency of a d.c. machine. What are the main advantages and disadvantages of this test? (10M)

   b) The shaft torque required to drive a d.c. generator is 18.7 Nm when it is running at 1250 r.p.m. If its efficiency is 87% under these conditions and the armature current is 17.3 A, determine the voltage at the terminals of the generator. (5M)

3. a) What are the losses that occur in a transformer and how can these losses be reduced? (8M)

   b) The equivalent impedance referred to the primary of a 2300/230 V, 500-kVA, single-phase transformer is (7M)
$$Z = 0.2 + j0.6\ \Omega$$
Calculate the percentage voltage regulation when the transformer delivers rated capacity at 0.8 power factor lagging at rated secondary voltage. Find the efficiency of the transformer at this condition given that core losses at rated voltage are 2 kW.

Or

4. a) Explain Sumpner's test for testing two single phase transformers? Also explain why this test is beneficial. (8M)

   b) A single-phase transformer has a voltage ratio of 6:1 and the h.v. winding is supplied at 540 V. The secondary winding provides a full load current of 30 A at a power factor of 0.8 lagging. Neglecting losses, find (i) the rating of the transformer, (ii) the power supplied to the load, (iii) the primary current (7M)

5. a) Describe the constructional details of salient pole alternator with neat sketches. (8M)

   b) Explain the principle of operation of synchronous motor, describe its equivalent circuit. (7M)

Or

6. a) Explain the synchronous impedance method for determining regulation of alternator. (8M)

   b) Why the speed of the synchronous motor is constant? Describe how the torque is produced in this motor. (7M)
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7. a) Describe with neat sketches the construction of a 3-phase wound induction motor. (8M)

   b) The power supplied to a three-phase induction motor is 40 kW and the stator losses are 2 kW. If the slip is 4 per cent determine (i) the rotor copper loss, (ii) the total mechanical power developed by the rotor, (iii) the output power of the motor if frictional and wind age losses are 1.48 kW, and (iv) the efficiency of the motor, neglecting rotor iron loss. (7M)

Or

8. a) A three-phase, 60-Hz induction motor runs at almost 1800 rpm at no load, and at 1710 rpm at full load. (8M)
   a) How many poles does the motor have?
   b) What is the per-unit slip at full load?
   c) What is the frequency of rotor voltages at full load?
   d) At full load, find the speed of (i) the rotor field with respect to the rotor, (ii) the rotor field with respect to the stator, and (iii) the rotor field with respect to the stator field

   b) Describe the torque speed characteristics of three phase induction motor with neat sketch. (7M)

9. a) Discuss why the single phase induction motors do not have a starting torque. (7M)

   b) Draw the circuit diagram of a capacitor-start capacitor-run single phase induction motor and explain its working. (8M)

Or

10. a) Describe the constructional details of shaded pole motor and explain its working. (10M)

    b) Explain the working principle of a.c. servo motors with neat sketches. (5M)

Code No: R19ES1211 **R19** SET - 2

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Time: 3 hours Max. Marks: 75

Answer any five Questions one Question from Each Unit
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1. a) Explain the necessity of starter in a d.c. motor and describe three point starter with a neat sketch. (8M)

   b) A short shunt compound d.c. generator delivers 25 kW to a load at 250V. The generator has shunt field, series field and armature resistance of 130 Ω, 0.1 Ω and 0.1 Ω respectively. Draw the schematic diagram of the generator. Calculate various branch currents and voltage generated in the armature winding. Assume 1V drop per brush. (7M)

Or

2. a) Draw and explain power flow diagrams of a d.c. generator and a d.c. motor. (8M)

   b) A 220 V d.c. shunt motor has armature and field resistance as 0.8 Ω and 200 Ω. During Swinburne's test, current drawn from the supply is found to be 2.5 A. Estimate the efficiency of the machine,(i) When it is running as a motor drawing a line current of 40 A from the 220 V supply.(ii) When it is running as a generator delivering a load current of 40 A at 220 V. (7M)

3. a) Define voltage regulation of a transformer, derive the approximate equation of voltage regulation. (8M)

   b) The no-load input power to a 50 kVA, 2300/230 V, single-phase transformer is 200 VA at 0.15 power factor at rated voltage. The voltage drops due to resistance and leakage reactance are 0.012 and 0.018 times rated voltage when the transformer is operated at rated load. Calculate the input power and power factor when the load is 30 kW at 0.8 power factor lagging at rated voltage. (7M)

Or

4. a) Why the primary of the transformer draws current from the mains when the secondary is not carrying any load (open circuit)? (5M)

   b) Determine the efficiency of a 15 kVA transformer for the following conditions: (10M)
   (i) full-load, unity power factor
   (ii) 0.8 full-load, unity power factor
   (iii) half full-load, 0.8 power factor.
   Assume that iron losses are 200 W and the full-load copper loss is300 W

5. a) Derive the e.m.f. equation for an alternator, explain the meaning of (i) distribution factor (ii) coil span factor. (8M)

   b) A three-phase, six-pole, wye-connected synchronous generator is rated at 550 V and has a synchronous reactance X_s= 2 Ω. When the generator supplies 50 kVA at rated voltage and a power factor of 0.95 lagging, find the armature current I_a and the excitation voltage E_f. Sketch the phasor diagram of V_t, I_a, and E_f. Also, determine the regulation corresponding to the operating conditions (7M)

Or
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6. a) What do you mean by synchronous reactance? Explain the term synchronous impedance of an alternator. (8M)

   b) Explain the principle of operation of synchronous motor. (7M)

7. a) Describe with neat sketches the construction of a 3-phase squirrel cage induction motor. (8M)

   b) A four-pole, three-phase induction motor is energized from a 60-Hz supply. It is running at a load condition for which the slip is 0.03. Determine: (i) The rotor speed in rpm. (ii) The rotor current frequency in Hz. (iii) The speed of the rotor rotating magnetic field with respect to the stator frame in rpm. (iv) The speed of the rotor rotating magnetic field with respect to the stator rotating magnetic field in rpm. (7M)

Or

8. a) What is meant by slip in induction motor? Why must slip be present for motor action? (8M)

   b) The power supplied to a three-phase induction motor is 32 kW and the stator losses are 1200 W. If the slip is 5 per cent, determine (i) the rotor copper loss, (ii) the total mechanical power developed by the rotor, (iii) the output power of the motor if friction and windage losses are 750 W, and (iv) the efficiency of the motor, neglecting rotor iron loss. (7M)

9. a) Explain the working of spilt-phase type single phase induction motor. (7M)

   b) Describe the working principle of two-phase a.c. servo motor and describe its characteristics. (8M)

Or

10. a) Describe the constructional details of shaded pole motor and explain its working. (10M)

    b) Enumerate applications of capacitor-start and capacitor-run single phase induction motor. (5M)

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Time: 3 hours Max. Marks: 75

Answer any five Questions one Question from Each Unit
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1. a) What are the different types of d.c. generators according to the ways in which fields are excited? Show the connection diagram of each type. (8M)

   b) A series motor having a series field resistance of 0.25 Ω and an armature resistance of 0.15 Ω, is connected to a 220V supply and at a particular load runs at 20 rev/s when drawing 20A from the supply. Calculate the e.m.f. generated at this load. Determine also the speed of the motor when the load is changed such that the current increases to 25A. Assume the flux increases by 25 per cent. (7M)

Or

2. a) What are the losses taking place in dc machine and how they vary with load current and derive the condition for maximum efficiency? (8M)

   b) A dc shunt machine has an armature winding resistance of 0.12 Ω and a shunt-field winding resistance of 50 Ω. The machine may be run on 250 V mains as either a generator or a motor. Find the ratio of the speed of the generator to the speed of the motor when the total line current is 80 A in both cases. (7M)

3. a) Explain the necessity for conducting OC and SC tests on a single phase transformer and how they are useful. (8M)

   b) A single phase transformer has 400 primary and 1000 secondary turns. The net cross-sectional area of the core is 60 cm^2. If the primary winding be connected to a 50 Hz supply at 500 V, Calculate (7M)
      (i) The peak value of the flux density in the core, and
      (ii) The voltage induced in the secondary winding.

Or

4. a) Describe the voltage regulation of a single phase transformer. Explain how it is determined. (8M)

   b) A 30KVA, 6000/230V, 50Hz single phase transformer has HV and LV winding resistances of 10.2Ω and 0.0016Ω respectively. The equivalent leakage reactance as referred to HV side is 34Ω. Find the voltage to be applied to the HV side in order to circulate the full load current with LV side short circuited. Also estimate the full load percentage regulation of the transformer at 0.8 lagging power factor. (7M)

5. a) Derive the expressions for (i) distribution factor (ii) coil span factor in an alternator. (8M)

   b) Explain the principle of operation of synchronous motor and describe characteristic features of this motor. (7M)

Or
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6. a) Describe phasor diagrams of cylindrical rotor synchronous motor for different power factors. (8M)

   b) A 600 V, 60 kVA, single-phase alternator has an effective armature resistance of 0.3 Ω. An exciting current of 5 A produces an e.m.f. of 400 V on open circuit and an armature current of 200 A on short circuit. Calculate:
   (i) the synchronous impedance and synchronous reactance.
   (ii) the full load regulation with 0.8 p.f. lagging. (7M)

7. a) Why starters are necessary for starting induction motors? Name different starting methods for 3-pahse induction motor. (8M)

   b) A 4-pole, 3-phase induction motor operates from a supply whose frequency is 60 Hz. Calculate : (7M)
   (i) The speed at which the magnetic field of the stator is rotating
   (ii) The speed of the rotor when the slip is 0.04
   (iii) The frequency of the rotor current when slip is 0.03
   (iv) The frequency of the rotor current at standstill.

Or

8. a) Draw the torque-speed characteristics of 3-phase induction and explain how do you obtain this characteristics. (8M)

   b) A 400 V, three-phase, 50 Hz, 2-pole, star-connected induction motor runs at 48.5 rev/s on full load. The rotor resistance and reactance perphase are 0.4 Ω and 4.0 Ω respectively. Calculate at full load (i) the rotor current, (ii) the rotor copper loss, and (iii) the starting current. (7M)

9. a) Explain the working of capacitor-start type single phase induction motor. (8M)

   b) Describe the constructional details of shaded pole single phase induction motor. (7M)

Or

10. a) Describe the working principle of two-phase a.c. servo motor and describe its characteristics. (8M)

    b) Describe the working principle of permanent-split capacitor motor. What are the advantages and disadvantages of this motor? (7M)

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Answer any five Questions one Question from Each Unit
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1\. a) What is the principle of operation of d.c. generator and derive its e.m.f. equation? (8M)

b) A six-pole lap-wound motor is connected to a 250V d.c. supply. The armature has 500 conductors and a resistance of 1 Ω. The flux per pole is 20 mWb. Calculate (i) the speed, (ii) torque developed when the armature current is 40A and what is speed at this load current? (7M)

Or

2\. a) Discuss with suitable diagrams different types of dc generators and their field of applications. (8M)

b) A 350 V shunt motor runs at its normal speed of 720 r.p.m when the armature current is 90 A. The resistance of the armature is 0.3 Ω. (i) Find the speed when the current is 45 A and a resistance of 0.4 Ω is connected in series with the armature, the shunt field remaining constant. (ii) Find the speed when the current is 45 A and the shunt field is reduced to 75% of its normal value by increasing resistance in the field circuit. (7M)

3\. a) What are the losses that occur in a transformer and how can these losses be reduced? (8M)

b) The secondary winding of a transformer has a terminal voltage of $v_s(t) = 282.8 \sin 377t$ V. The turns ratio of the transformer is 100:200 (k = 0.50). If the secondary current of the transformer is $i_s(t) = 7.07 \sin(377t - 36.87°)$ A, what is the primary current of this transformer? What are its voltage regulation and efficiency? The impedances of this transformer referred to the primary side are $R_{eq} = 0.20\ \Omega$, $R_C = 300\ \Omega$, $X_{eq} = 0.75\ \Omega$ and $X_M = 80\ \Omega$. (7M)

Or

4\. a) Explain the working principle of transformer and derive its e.m.f. equation. (8M)

b) A 3-kVA, 220:110-V, 60-Hz, single-phase transformer yields these test data: (7M)
Open-circuit test: 200 V, 1.4 A, 50 W
Short-circuit test: 4.5 V, 13.64 A, 30 W
Determine the efficiency when the transformer delivers a load of 2 kVA at 0.85 power factor lagging.

5\. a) Describe the working of synchronous motor and describe why this motor is not self-starting. (8M)

b) The air gap flux of a 12 pole, 3 phase alternator is 0.058 wb per pole and is distributed sinusoidally over the pole. The stator has 2slots per pole per phase and 8 conductors per slot. The winding is a double layer winding with a coil span of 135^0 electrical apart. Find the voltage generated per phase at no-load when the machine runs at 500 r.p.m. (7M)

Or
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6. a) Explain the concept of replacing the armature reaction in n alternator. (8M)

   b) What are the characteristic features of synchronous motor and describe its equivalent circuit. (7M)

7. a) Describe the working of (i) direct on-line starter (ii) auto-transformer starter. (8M)

   b) A three-phase, 50-Hz induction motor has a full load speed of 700 rpm and a no-load speed of740 rpm. (7M)
      a) How many poles does the machine have?
      b) Find the slip and the rotor frequency at full load.
      c) What is the speed of the rotor field at full load (i) with respect to the rotor? and (ii) with respect to the stator?

Or

8. a) Explain the working principle of three phase induction motor with neat sketches. (8M)

   b) The power supplied to a three-phase induction motor is 50 kW and the stator losses are 2 kW. If the slip is 4%, determine (i) the rotor copper loss, (ii) the total mechanical power developed by the rotor, (iii) the output power of the motor if friction and windage losses are 1 kW, and (iv) the efficiency of the motor, neglecting rotor iron losses. (7M)

9. a) Explain the construction and working principle of split-phase motor. (10M)

   b) Explain the working principle of a.c. servo motors with neat sketches. (5M)

Or

10. a) Discuss why single-phase induction motor do not produce starting torque. (6M)

    b) Describe the working principle of capacitor-start motor. What are the advantages and disadvantages of this motor? (9M)