Code No: RT22025 **R13** SET - 1

II B. Tech II Semester Regular/ Supplementary Examinations, April/May-2017
ELECTRICAL MACHINES - II
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1. a) Distinguish between step-up and step-down transformers? State clearly the quantities which remain unaltered or get stepped up or stepped down. (3M)
   b) Discuss the effect of circulating current at no-load, in two single phase transformers operating in parallel? (4M)
   c) State various conditions required for parallel operation of three phase transformers? (4M)
   d) Show that voltage generated in the rotor circuit of a three phase induction motor at any slip 'S' is equal to 'S' times the voltage generated at standstill? (4M)
   e) Explain why slip in a three phase induction motor is directly proportional to toque when operating at near synchronous speed (3M)
   f) What are the main dimensions of the induction motor? What are the design values of peripheral speed and width of ventilation ducts? (4M)

PART –B

2. a) Derive an expression for the e.m.f induced in a transformer winding. Show that e.m.f per turn in primary is equal to e.m.f per turn in secondary (8M)
   b) A 100 kVA, 2400/240 V, 50Hz single phase transformer has an exciting current of 0.64 A and a core loss of 700 W, when its high voltage side is energized at rated voltage and frequency. Calculate the two components of the exciting current. If the above transformer supplies a load current of 40 A at 0.75 p.f. lag on its l.v. side, then calculate the primary current and p.f. Ignore leakage impedance drops. (8M)

3. a) What parameters of the equivalent circuit of a transformer can be determined from open-circuit and short circuit tests? Explain. With the help of neat circuit diagrams? (8M)
   b) A 20KVA, 2300/230V, two winding transformer is to be used as an autotransformer, with constant source voltage of 2300V. At full load of unity power factor, calculate the power output, power transformed and conducted. If the efficiency of the two winding transformer at 0.6p.f.is 96%, find the auto transformer efficiency at the same power factor (8M)
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4. a) Draw the Phasor diagrams and winding connection of three-phase transformer for (8M)
   i) Group 1: Phase displacement of zero degrees
   ii) Group 3: Phase displacement of -30 degrees
   b) A 50 Hz Scott-connected transformer supplies an unbalanced 2-phase load at 200 V per phase. For the leading phase (A) the load has a resistance of 10 ohms and an inductance of 42.3 mH. For the other phase, the load consists of a resistor of 13.3 ohms and a capacitor of 318 micro-farads in series. Neglecting the magnetizing current and the internal impedance of the transformer, calculate line currents on the three-phase side. The main transformer primary/secondary turns ratio is 12/1. (8M)

5. a) Explain why an induction cannot develop torque when running at synchronous speed? Define the slip speed of an induction motor and deduce how the frequency of the rotor currents and magnitude of the rotor emf are related to slip? (8M)
   b) A 40 Hp three-phase induction motor has a full load slip of 4%. The stator losses amount to 4% of the input and the mechanical losses are 1% of the output. If the current in each phase of the rotor is 50 A., find the resistance per phase of the rotor and the efficiency of this machine? (8M)

6. a) Discuss briefly about the deep bar and double cage rotor of three-phase induction motor. (8M)
   b) A three phase squirrel cage induction motor has a short-circuit current of 5 times the full-load current. Its full-load slip is 5%. Calculate the starting torque as a percentage of full-load torque if the motor is started by (8M)
   i) DOL starter ii) Star Delta Starter.

7. Determine the main dimensions of the core, the number of turns and the cross section of the conductors for a 5 kVA,11000/400 V,50 Hz, single phase core type distribution transformer. The net conductor area in the window is 0.6 times the net cross section of iron in the core. Assume a square cross section for the core, a current density 1.4 A/m^2, a flux density of 1 Wb/m^2 and a window space factor 0.2.The height of the window is 3 times its width. (16M)

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2. Answer **ALL** the question in **Part-A**
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PART –A

1. a) Define all-day efficiency of a transformer? What is its significance? (3M)
   b) Explain how polarity test can be performed on a single phase two winding transformer? Explain how subtractive polarity is preferable to additive polarity? (4M)
   c) What are the advantages of single three phase transformer unit over a bank of single phase transformers? (4M)
   d) What are fixed and variable losses in a three phase induction motor? Give power flow diagram of induction motor? (4M)
   e) Sketch the torque –speed curve of a conventional three phase induction motor and how it will change when the rotor resistance is doubled keeping stator voltage and frequency are kept constant (3M)
   f) Which factor should be considered when estimating the length of air-gap of induction motor? Why the air gaps should be as small as possible? (4M)

PART -B

2. a) Derive an expression for computing per unit voltage regulation of a transformer both for lagging and leading power factors (8M)
   b) A 40 KVA single phase transformer has got maximum efficiency of 97 % at 80 % of full load at UPF. During the day, the load on the transformer is as follows. (8M)

No. of hours	Load	Power factor
9	6 KW	0.6 lag
8	25 KW	0.8 lag
7	30 KW	0.9 lag

Determine the All day efficiency of the transformer

3. a) Discuss the advantages and disadvantages of an auto transformer as compared to a two-winding transformer. (8M)
   b) With the instruments located on the high-voltage side and the low-voltage side short-circuited, the short-circuit test readings for the 50-kVA 2400:240-V transformer are 48 V, 20.8 A, and 617 W. An open-circuit test with the low-voltage side energized gives instrument readings on that side of 240 V, 5.41 A, and 186 W. Determine the efficiency and the voltage regulation at full load, 0.80 power factor lagging. (8M)
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4.	a)	Write a brief not on tap changing transformers	(8M)
	b)	A Scott connected transformer is fed from a 6000 V, 3-ϕ network and supplies 2-ϕ power at 500 V/Ph. Calculate the line current on 3-ϕ system, if the load on the 2-ϕ sides are 500 A at 0.8 pf lagging (teaser) and 400 A at 0.8 lagging (main).	(8M)
5.	a)	Discuss the points of similarities between a transformer and an induction machine. Hence explain why an induction machine is called a generalized transformer?	(8M)
	b)	A 3-phase, 50Hz induction motor has a full-load speed of 1440rpm. For this motor, calculate the following: i) Number of poles, ii) Full load slip and rotor frequency, iii) Speed of stator field with respect to A) stator structure and B) also rotor structure iv) Speed of rotor field with respect to A) rotor structure and B) stator field.	(8M)
6.	a)	Explain how the equivalent circuit parameters of a poly-phase induction motor can be determined from no-load and blocked-rotor tests and per phase stator winding d.c resistance	(8M)
	b)	The short circuit current of Squirrel cage induction motor on normal voltage is 3.5 times the full load current and the full load slip ids 4%. Determine the percentage tapping required to an autotransformer starter to start the motor against 1/3rd full load torque. Neglect magnetizing current	(8M)
7.		Determine the approximate diameter and length of stator core, the number of stator slots and the number of conductors for a 11 kW, 400 V,3 phase, 4 pole,1425 rpm., delta connected induction motor. Adopt a specific magnetic loading of 0.45 wb/m^3 and a specific electric loading of 23,000 A/m. Assume full load efficiency and power factor as 0.85 and 0.88 respectively. The ratio of core length to pole pitch is 1.The stator employs a double layer winding.	(16M)

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PART –A

1. a) In a transformer core flux depends on voltage whereas the leakage flux depends on currents. Explain? (3M)
   b) Explain why OC test and SC tests are conducted on lv and hv sides of the transformer respectively? (4M)
   c) Why tapings are on hv side in a tap changing transformer? (4M)
   d) Rotor leakage impedance at starting is different from its value at normal running condition? Justify? (4M)
   e) Explain the terms cogging and crawling related to three phase induction motors? (3M)
   f) Write short notes on crossover windings and disc windings? (4M)

PART –B

2. a) Describe the phasor diagram of the transformer under leading p.f. load (8M)
   b) In a transformer, the core loss is found to be 52 watts at 40 Hz and 90 Watts at 60 Hz; both losses being measured at the same peak flux density. Compute the hysteresis and eddy current losses at 50 Hz. (8M)

3. a) Following are the test results for the 4KVA, 200/400V, 50Hz, single phase transformer. (8M)
   O.C test : 200V, 0.8A, 70W
   S.C test : 17.5V, 9A, 50W.
   Calculate the parameters of equivalent circuit of a transformer.
   b) Describe the method by which the separation of core losses of a transformer is achieved (8M)

4. a) What is the difference between on load and no-load tap changers.Explain? (8M)
   b) A bank of three single phase transformers has its hv terminals connected to 3 wire 3 phase, 11kV system. Its lv terminals are connected to a 3 wire 3 phase load rated at 1500kVA, 2200V. Specify the voltage, current and kVA ratings of each transformer for both hv and lv windings for Y- Δ connection. (8M)

5. a) Describe the constructional features of the both squirrel cage and slip-ring induction motors. Discuss the merits of one over the other (8M)
   b) A 3-phase 400 V, 50 Hz induction motor takes a power input of 35kW at its full load speed of 980 rpm. The total stator losses are 1 kW and friction and windage losses are 1.5 kW. Calculate (i) slip, (ii) rotor ohmic losses, (iii) Shaft power, (iv) shaft torque and (v) efficiency (8M)
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6. a) Derive the general expression for the torque developed in the three-phase induction motor? (8M)

   b) A 3 phase 4-pole 400 V, 50 Hz induction motor develops 15 bhp at 1425 rpm with a power factor of 0.8.The mechanical losses amount to 0.75 hp. Determine for this load i) Slip
   (ii) rotor losses
   (iii) gross torque developed in synchronous watt
   (iv) line current. Take the stator losses equal to 1200 W. (8M)

7. Determine the main dimensions of the core, the number of turns and the cross section of the conductors for a 5 kVA, 11000/400 V, 50 Hz, single phase core type distribution transformer. The net conductor area in the window is 0.6 times the net cross section of iron in the core. Assume a square cross section for the core, a current density 1.4 A/m^2, a flux density of 1 Wb/m^2 and a window space factor 0.2.The height of the window is 3 times its width. (16M)

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2. Answer **ALL** the question in **Part-A**
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PART –A

1. a) What current flows in the transformer primary when it's secondary is open? What is its function? Give its order of magnitude? (3M)
   b) What parameters of the transformer can be determined from open circuit and short circuit tests? (4M)
   c) Why tertiary winding is used in transformers? (4M)
   d) List the differences between Squirrel cage and slip ring induction motors? (4M)
   e) Explain the principle of induction generator? (3M)
   f) Write a comparative note on choice of flux density in power transformers? (4M)

PART -B

2. a) Draw the exact equivalent circuit of a transformer and describe briefly the various parameters involved in it (8M)
   b) A 20 kVA, 2000/200V, 50 Hz transformer has maximum efficiency at 90 % of the full load. Its per unit resistance and impedance are 0.010 and 0.05 respectively. Determine its efficiency and voltage regulation at half of the full load and 3/4th of full load and 0.8 pf lagging and leading. (8M)

3. a) Discuss how parallel operation of two single phase transformers is effected by unequal voltage ratios and un equal per unit leakage impedances but same x_e/r_e ratio. (8M)
   b) A 400/100 V, 5 kVA single-phase two winding transformer is to be used as an auto transformer to supply 400 V from 500 V voltage source. When tested as a two winding transformer at rated load and 0.8 pf lagging, its efficiency was found to be 94%.Find its efficiency as an auto transformer at rated load and 0.85 pf lag. (8M)

4. a) Describe four possible ways of connections of 3 phase transformers with relevant relations amongst voltages and currents on both hv and lv sides. (8M)
   b) An ideal 3-Phase step down transformer connected in star/delta delivers power to a balanced 3-Phase load of 100 kVA at 0.8 pf. The input line voltage is 10 kV and the turn's ratio of transformer (phase to phase) is 10. Determine the line voltage line currents, phase voltages, phase currents on both primary & secondary sides. (8M)
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Code No: RT22025 **R13** SET - 4

5. a) Draw and explain the Phasor diagram of a three-phase induction motor? (8M)
   b) A 20hp 400V, 50 Hz three-phase induction motor runs at 970 rpm at full load. The mechanical losses are 600 W. If the stator losses are 750 W find rotor copper losses and efficiency of the motor at full load. (8M)

6. a) Explain the phenomena of cogging and crawling in three phase induction motor (8M)
   b) Explain the torque-speed characteristics of three phase induction motors in motoring, generating and braking modes (8M)

7. Determine the approximate diameter and length of stator core, the number of stator slots and the number of conductors for a 11 kW, 400 V,3 phase, 4 pole,1425 rpm., delta connected induction motor. Adopt a specific magnetic loading of 0.45 wb/m^3 and a specific electric loading of 23,000 A/m. Assume full load efficiency and power factor as 0.85 and 0.88 respectively. The ratio of core length to pole pitch is 1.The stator employs a double layer winding. (16M)