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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EE202

Course Name: SYNCHRONOUS AND INDUCTION MACHINES (EE)

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks.

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|---|---|-------|
| 1 | Two alternators run on the same shaft (i.e, runs at same speed). One generates voltage at 50 Hz and the other at 40 Hz. Find the maximum possible speed. Also find another possible speed. | (5) |
| 2 | Draw the phasor diagram of cylindrical rotor alternator supplying leading current and develop an expression for induced emf E. | (5) |
| 3 | The excitation of an alternator is running on an infinite bus is steadily increased from a small value over a wide range keeping the power output constant. By drawing phasor diagram show the magnitude armature current decreases to a minimum value and then increases. | (5) |
| 4 | In rice/flour mills driven by squirrel cage induction motors, the hopper is loaded with the grains only after starting the motor. Similarly, the delivery valve of centrifugal pumps driven by squirrel cage induction motor is opened only after starting the motor. What is the reason behind this? Justify your answer with a relevant performance curve of squirrel cage induction motor. | (5) |
| 5 | No load and blocked rotor tests on induction motor are effectively open circuit and short circuit tests. Justify. | (5) |
| 6 | Name the induction motor used to drive lifts. What property of this makes it suitable to drive lifts? How this property is achieved. | (5) |
| 7 | Using equivalent circuit justify that induction machine becomes a generator when the machine is driven above synchronous speed. | (5) |
| 8 | Show the construction of one pole of a shaded pole induction motor and explain how it produces a sweeping flux when an alternating current flow through the winding. | (5) |

PART B

Answer any two full questions, each carries 10 marks.

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|----|---|------|
| 9 | The armature of 60Hz 11kV 450 rpm star connected alternator has 8 conductors per slot. The winding is short chorded by 3 slots to eliminate 5 th harmonics completely. Find the flux per pole to generate rated voltage on open circuit. | (10) |
| 10 | a) Prove that even harmonics will not be present in a full pitched winding. | (5) |
| | b) Give the procedure for experimental determination of synchronous impedance. | (5) |
| 11 | In an alternator a field current of I amp was required to drive rated current on short circuit and a field current of 2.5 times I was required to develop rated voltage on open circuit. Using emf method find the voltage regulation of the alternator when delivering rated current at 0.8 pf lag. Assume armature resistance | (10) |

= 20% of synchronous impedance. (You can assume any value for rated voltage and rated current. The final answer will be the same).

PART C

Answer any two full questions, each carries 10 marks.

- 12 Two 100 MW alternators operate in parallel. At no load both machines operate at 50Hz. The maximum load that can be shared without overloading either of the machines is 180 MW and this happens at 48 Hz. Find how will they share a total load of 160 MW. (10)
- 13 a) Draw the phasor diagram of a salient pole alternator working at lagging power factor and derive an expression for internal power factor angle ψ . (5)
- b) From rotor equivalent circuit of an induction motor derive the expression for torque in synchronous watts. (5)
- 14 While running at 1440 rpm a 3-ph. induction motor draws 50 kW from the mains. The stator iron and copper losses amount to 2 kW. Find the rotor copper loss, torque in synchronous watts as well as in Newton Metre. If there is a mechanical loss of 1.08 kW, find the overall efficiency of the motor. (10)

PART D

Answer any two full questions, each carries 10 marks.

- 15 A 400V 50Hz 7.5A 10HP delta connected induction motor was drawing 3A and 540W on no load test. In blocked rotor test rated current was driven with 100V and the power consumed was 450W. Draw the circle diagram and locate the maximum output point on the diagram. Find out slip efficiency and torque in synchronous watts at this point. (10)
- 16 a) Draw the schematic diagram of a star-delta starter. (5)
- b) Explain the working of synchronous induction motor. (5)
- 17 Show that the magnetic field produced by a single-phase armature can be modelled as double revolving field. By drawing torque speed characteristics prove that a single-phase induction motor is not self-starting. (10)
