**B.Tech. SEM -V Electrical 2014 Course (CBCS) : SUMMER - 2019**
**SUBJECT: ELECTRICAL MACHINE DESIGN**

Day: Monday
Date: 13/05/2019

S-2019-2664

Time: 10.00 AM TO 01.00 PM
Max Marks. 60

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**N.B. :**

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Assume suitable data, if **NECESSARY**.
4) Use of non-programmable calculator is **ALLOWED**.

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**Q.1** a) Derive output equation of d. c. machine. **(05)**

b) What are different types of duties of electrical machines? With the help of graph explain the continuous duty with intermittent periodic duty. **(05)**

**OR**

**Q.1** a) What are different methods of cooling of three phase induction motor? How induction motors are classified based on cooling? **(05)**

b) A three phase slipring induction motor has a final steady temperature rise of $40^0C$ when running at its rated output. Calculate its half hour rating for the same temperature rise if the copper loss at rated output is 1.25 times its constant loss. The heating time constant is 90 minutes. **(05)**

**Q.2** a) What types of forces developed in transformer winding under short circuit condition? With a neat diagram explain any one in detail. **(05)**

b) Step by step write down the procedure to calculate the magnetizing component of no load current of three phase transformer. **(05)**

**OR**

**Q.2** a) How total reactance referred to primary side is calculated of three phase distribution transformer. **(05)**

b) Calculate the percentages regulation at full load 0.8 pf lag for a 300 kVA, 6600/440V, delta star, 3 phase, 50Hz core type transformer having cylindrical coils of equal length with the following data. Height, of coils = 4.7 cm, thickness of HV coil = 1.6 cm, thickness of LV coil = 2.5 cm, insulation between LV and HV coils = 1.4 cm. Mean diameter of the coils = 27 cm, volt/turns = 7.9 V, full load copper loss = 3.75 kW. **(05)**

**Q.3** a) Derive the expression for endring current of three phase induction motor. **(05)**

b) Determine the main dimensions of the stator of 10 H.P. , 415V, 50Hz, delta connected three phase, 4 pole, squirrel cage induction motor. The motor has an efficiency of 0.88, power factor of 0.865 lag and winding factor of 0.955. Assume specific magnetic and electrical loading of 0.45 $Wb/m^2$ and 23000A/m. Frame size of 0.16 m is to be used for stator core. Assume slot/pole/phase of 3 and current density of 4.1 $A/mm^2$. **(05)**

**OR**

**Q.3** a) Step by step write down the procedure to calculate the magnetizing component of no load current of three phase induction motor. **(05)**

b) Write detail procedure to design rotor of 3-phase induction motor. **(05)**

**P.T.O.**

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| Q.4 | | Describe the design of starting winding for capacitor start motor. | (10) |

**OR**

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| Q.4 | | Discuss the operating characteristics of single phase induction motor. | (10) |
| Q.5 | | Determine for a 250 kVA, 1100 V, 12 pole, 500 rpm, 3 phase alternator, suitable values for<br>**i)** the diameter at air gap **ii)** the core length<br>**iii)** the number of stator conductors **iv)** the number of stator slot<br>Assume a star connected stator winding, a specific magnetic loading 0.6 $wb/m^2$ and a specific electric loading of 30,000A/m. Assumer ratio of length: pole pitch = 1.5. | (10) |

**OR**

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| Q.5 | a) | Calculate the following design data for 37 kW, 220V, 4 –pole, 900 rpm d.c. shunt motor:<br>**i)** length and diameter of core<br>**ii)** Number of armature conductors<br>**iii)** Armature and line currents<br>**iv)** Armature mmf per pole<br>**v)** Field mmf per pole<br>Assumer specific magnetic loading = 0.7 $wb/m^2$, specific electric loading 26000 ampere conductor per motors, ratio pole are to pole pitch = 0.7, length of machine = pole arc, internal drop in armature circuit = 10V, field current = 2.5 A, field mmf = 1.25 × armature mmf, mmf required for airgap = 0.5 x armature mmf, gap contraction factor = 1.15, full load efficiency = 89 percent. | (07) |
| | b) | What are the guiding factors for choice of number of poles of d. c. machine ? | (03) |
| Q.6 | | What are the modern electrical machine design challenges? Describe how FEA technique overcomes the requirements of all types of electrical machines. | (10) |

**OR**

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| Q.6 | | Describe the transient finite element analysis of induction motors using Maxwell 2D and 3 D. | (10) |

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