

B.E. MECHANICAL ENGINEERING 1<sup>ST</sup> YEAR 2<sup>ND</sup> SEMESTER EXAM 2017

## ELECTRICAL MACHINES

Full Marks 100

Time : Three hours

## Part - I

Use a separate Answer-Script for each part (Each part of 50 marks)

| No. of questions | Answer any <u>three</u> questions (16×3).<br>02 (two) marks for neat and well organized answers and answer script.  | Marks |
|------------------|---|-------|
| 1. a)            | What do you mean by phase sequence of a poly phase system? Show that there are only two possible phase sequences for a three phase system.  | 6     |
| b)               | A three phase star connected 3.3kV synchronous generator supplies power to a 2MW delta connected induction motor. The power factor and efficiency of the induction motor are 0.86 and 0.83 respectively. Find (i) motor input power (ii) phase and line current of the synchronous generator (iii) phase and line current of the induction motor.   | 10    |
| 2. a)            | Classify transformers based on core structures. Mention the advantages and disadvantages of the respective core structures.   | 7     |
| b)               | Derive and draw the equivalent circuit of a practical single phase transformer.   | 9     |
| 3. (a)           | Derive the condition for maximum efficiency of a power transformer. Explain the effect of power factor on this condition.   | 7     |
| (b)              | A 50kVA, 2.2kV/220V, 50Hz single phase transformer has following resistance and leakage reactances: HV side $R=2 \Omega$ , $X=10 \Omega$ , on LV side $R=0.02 \Omega$ , $X=0.1 \Omega$ . The transformer is operated at 80% load with load power factor of 0.9 with HV side connected to rated voltage. Find (i) efficiency of the transformer (ii) input current (iii) output voltage. Neglect core loss and magnetizing component of current. | 9     |
| 4. (a)           | Why the no load current of an induction machine is higher compared to a transformer of equivalent rating?   | 4     |
| (b)              | What type of starter is used for slip-ring induction motor? Explain its working principle.  | 5     |
| (c)              | How is rotating magnetic field produced by the stator of a three phase induction machine?   | 7     |
| 5. (a)           | Derive and plot the torque speed curve of three phase induction machine. Show the stable range of motoring operation.   | 8     |
| (b)              | How would you determine the equivalent circuit parameters of an induction machine?  | 8     |

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Form A: Paper-setting Blank

Ref. No. Ex /ME/EE/T/122/2017

B Mechanical 1<sup>st</sup> year 2<sup>nd</sup> sem EXAMINATION, 20 17(1<sup>st</sup>/2<sup>nd</sup>-Semester/Regular/Repeat/Supplementary/Spl. Supplementary/Old/Annual/Bi-Annual)SUBJECT Electrical Machines  
(Name in full)

PAPER

Time : Two hours/Three hours/Four hours/Six hours

Full Marks 30/ 100  
(15/50 marks for each part)

Use a separate Answer-Script for each part

| No. of questions | PART II   | Marks  |
|------------------|---|--------|
|                  | <u>Answer any three questions (16 × 3)+ 2 marks for well organized answer</u>   |        |
| 1. a)            | With neat diagram explain the working principle of a DC motor and hence deduce the torque equation $T=K_2\Phi I_a$ . Explain the importance of back-emf in case of DC motor.  | 8      |
| b)               | The armature resistance of a shunt motor is 0.09ohms. When connected to a 230 Volt supply a Counter-emf of 222.8 volts is developed. Find (a) the armature current; (b) the armature current when the armature is not rotating; (c) counter-emf when the armature current is 100 amp.   | 8      |
| 2. a)            | With the help of Torque vs Armature Current characteristics classify DC motor. Explain voltage build-up process in case DC generator.   | 8      |
| b)               | A direct current shunt machine generates 250V on open circuit at 1000 RPM. Armature resistance, including brushes 0.5 ohms; field resistance 250 ohms; input to machine running as motor at no-load, 4 A at 250 V. Calculate the speed and efficiency of the machines as a motor taking 40 A at 250 V. Armature reaction weakens the field by 4%. | 8      |
| 3. a)            | Explain following term with neat diagram<br>i) Critical resistance in case of DC generator<br>ii) External Characteristic of a DC generator   | 8      |
| b)               | What are advantages of stationary armature in case of synchronous generator? Why damper winding are used on pole shoe for alternator? Define pitch factor and distribution factor.  | 8      |
| 4. a)            | Write the working principle and method of starting of synchronous motor.  | 8      |
| b)               | Draw the phasor diagram of synchronous motor in case of changing excitation of constant load. When a synchronous will be treated as synchronous condenser?  | 8      |
| 5.               | Write with detailed diagram about any two from the following<br>a) Armature Reaction and commutation in case of DC machine<br>b) 4-point starter with neat diagram for a DC machine<br>c) Parallel operation of alternator and hence synchronization procedure.   | 8<br>8 |