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BIEE-012

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

00475

December, 2014

BIEE-012 : ELECTRO-MECHANICAL ENERGY CONVERSION – II

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***seven*** *questions out of ten questions. All questions carry equal marks. Assume data wherever required. Use of scientific calculator is allowed.*

1. Explain the phenomena of armature reaction when an alternator is delivering a load current at (a) Purely lagging power factor (b) Unity power factor (c) Purely leading power factor. *10*

2. A 6600 V, 1200 kVA, 3-phase alternator is delivering full load at 0·8 power factor lagging. Its reactance is 25% and resistance, negligible. By changing the excitation, the e.m.f. is increased by 30% at this load. Calculate the new values of current and power factor. The machine is connected to infinite bus bars. *10*

3. (a) A 3-phase, 400 V, 100 kVA, star-connected synchronous machine is used as a motor. The stray losses of the machine, assumed to be constant, is 4000 W. The synchronous impedance per phase of the machine is (0·13 + j 1·3 n). Calculate the power factor and efficiency when the excitation is so adjusted as to take a line current equal to its rated value keeping the power delivered constant at 75 kW. Determine the excitation e.m.f.'s both at under and over excitation and the respective load angles. Give the phasor diagrams. What will be the input current at normal excitation ? *8*

(b) For the motor in part (a), calculate the load angle for obtaining the maximum power output and the value of the possible maximum output when under excited. *2*

4. A salient-pole synchronous motor has X_d = 0·85 pu and X_q = 0·55 pu. It is connected to bus bars of 1·0 pu voltage, while its excitation is adjusted to 1·2 pu. Calculate the maximum power output that the motor can supply without loss of synchronism. Compute the minimum pu excitation that is necessary for the machine to stay in synchronism while supplying the full load torque. *10*

5. With regard to synchronous motor V-curves, explain the following :

(a) There is a bend in the compounding curve obtained by joining the minimum and maximum excitation points.

(b) Unity p.j. compounding curve has also a bend in it. *5+5*

6. A 50 Hz, 440 V, 3ϕ, 4-pole induction motor develops half the rated torque at 1490 rpm. With tha applied voltage magnitude remaining at the rated value, what should be its frequency if the motor has to develop the same torque at 1600 rpm ? Neglect stator and rotor winding resistances, leakage reactances and iron losses. *10*

7. (a) Describe the principle of operation of a 3-ϕ induction motor. Explain why the rotor is forced to rotate in the direction of rotating magnetic field.

(b) Discuss the differences between 3-phase induction motor and transformers. *5+5*

8. (a) Why is an induction generator not a self-excited generator ? How does an isolated induction generator work ?

(b) Explain the voltage build-up of an isolated induction generator. *5+5*

9. Draw the circuit diagram of a capacitor-start capacitor-run single-phase induction motor and explain its working. Where is this type of motor commonly used ? *10*

10. A universal series motor has a resistance of 30 Ω and an inductance of 0·5 H. When connected to a 250 V dc supply and loaded to take 0·8 A it runs at 2000 rpm. Determine the speed, torque and power factor, when connected to a 250 V, 50 Hz ac supply and loaded to take the same current. *10*
