TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

Exam.			
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy (*EE 702*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the present area's of utilization of electrical energy in the context of Nepal. How consumption of electrical energy in these area's can be increased or improved for the development of our country? [8]

   b) A 40 kW, 3-phase, 400 V resistance oven is to employ nickel-chrome strip 0.0025 cm thick for the three phase star connected heating elements. If the wire temperature is to be 1, 100°c and that of charge is to be 700°c, estimate a suitable width for the strip. Assume radiating efficiency as 0.6 and emissivity as 0.9. The specific resistance of the nichrome-alloy is 1.03×10^{-6} Ω-m. [8]

2. a) For the selection of various types of motor, what are the classes duties to be performed by the motor on the basis of load variations? List out some examples of the driver/machine applicable to various classes of duties. [8]

   b) A 220 V, 20 kW dc shut motor running at its rated speed of 1200 rpm is to be braked by reverse current braking. The armature resistance is 0.1 Ω and the rated efficiency of the motor is 88%. Calculate:

      i) The resistance to be connected in series with the armature to limit the initial braking current to twice the rated current.
      ii) The initial braking torque.
      iii) The torque when motor falls to 400 rpm. [8]

3. a) Draw the torque speed-characteristics of induction motor with constant V/f control for speed variation from very low up to the base speed. Describe an open loop control scheme for induction motor with constant V/f control. [8]

   b) A 3 phase fully controlled Thyristor Bridge with 400 V, 3 phase, 50 Hz supply is feeding a separately excited DC motor. Armature resistance is 0.2 Ω, armature rated current is 100 A and back emf constant is 0.25 V/rpm. Determine no-load speed if no-load armature current is 5 A and firing angle is 45°. Also determine firing angle to obtain a speed of 1500 rpm at rated current. [8]

4. a) What are the advantages of electric traction system? Explain about the traction system fed from separate distribution line. [4+4]

   b) A train is required to run between two stations 2 Km apart at an average speed of 40 km/hr. The run is to be made to a simplified quadrilateral speed time curve. If the maximum speed is to be limited to 60 km/hr, acceleration to 2 km/hr/sec, Coasting retardation to 0.15 km/hr/sec and braking retardation to 3 km/hr/sec. Determine the duration of acceleration, coasting and braking periods. [8]

5. a) Define Tariff. Explain different types of tariff used in Industry billing by Nepal Electricity Authority. [1+3]
   b) Explain demand side management techniques used for controlling peak demand. [4]
   c) A 340 kW, 50 Hz, 3- phase star connected induction motor has full load efficiency of 85% and p.f of 0.8 lagging. It is desired to improve the power factor to 0.96 lagging by using bank of three capacitors. Calculate:

      i) The kVAR rating of the capacitor bank.
      ii) The capacitance of each limbs of the condenser bank connected in delta.
      iii) The capacitance of each capacitor, if each one of the limb of the delta-connected condenser bank is formed by using 6 similar 3300 V capacitors. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy (*EE 702*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Elaborate the role of electrical energy in the sustainable development of the country. Describe on the basis of the utilization of the electrical energy. [8]

   b) With example, write about the characteristics of heating element? A 25 kW, 240 V, 50 Hz, single phase resistance heater is to have nichrome wire as a heating element. If the wire temperature is to be 1400°C and that of the charge is 500°C. Estimate the diameter and length of the wire. The resistivity of nichrome is 42.5 μΩ-m. Assume the radiating efficiency and the emissivity of the element as 0.9 and 0.85 respectively. [3+5]

2. a) Explain the block diagram of an electric drive. Why describe motors and shunt motors are started on load and no-load respectively. [8]

   b) A horizontal conveyer belt moving at uniform speed of 2.2 m/s transport material at the rate of 200 tones/hour. Belt is 100 m long and driven by a motor at 1500 rpm.

      i) Determine load inertia referred to motor shaft.
      ii) Calculate torque that motor should develop to accelerate the belt from standstill to fill speed in 8 second. Moment of inertia of motor is 0.1 kg-m^2. [4+4]

3. a) What is Slip Power Recovery Scheme? Describe in detail about Slip Power Recovery Scheme using Static Kramer drive. Can supersynchronous speed be achieved through it? Explain. [8]

   b) A single phase, 220 V, 50 Hz supply feeds a separately excited dc motor through two single phase semi-converters, one for the field and another for armature. The firing angle for the field semi- converter is zero. The field resistance is 250 Ω and armature resistance is 0.2 Ω. The load torque is 50 N-m at 1000 rpm. The voltage constant is 0.8 V/A-rad/s and the torque constant is 0.8 N/A^2. Assuming the armature and field currents to be continuous and neglecting losses, Determine: [8]
      i) Field current.
      ii) Firing angle of the converter in the armature circuit.
      iii) Power factor of the converter of armature.

4. a) What do you mean by electric traction? Discuss compare various arrangement of current collection used in electric traction. [8]

   b) An electric train is to have acceleration and breaking retardation of 0.8 km/h/s and 3.2 km/h/s respectively. If the ratio of maximum to average speed is 1.3 and time for stops 26 seconds, find the schedule speed for a run of 1.5 km. Assume simplified trapezoidal speed- time curve. [8]

5. a) What are the factors affecting to determine the tariff? Explain about the two-part and time of day tariff. [2+2]

   b) Write some effective techniques implemented by Nepal Government for Demand Side Management. [4]

c) A consumer requires on induction motor of 35 kW. He is offered two motors of the following specifications.
Motor A: Efficiency = 85%; power factor 0.9
Motor B: Efficiency = 90%; power factor 0.8
The consumer is being charged on a two-part tariff of Rs. 250 per kVA of the maximum demand plus Rs. 8 per unit. The power factor of the motor B is to be raised to 0.85 by installing condensers. The motor costs Rs. 1500 less than motor A.
The cost of condenser is Rs. 400 per kVAR. Determine which motor is more economical. Assume rate of interest and depreciation as 10% and working hours of motors as 3000 hours in a year. [8

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TRIBHUVAN UNIVERSITY
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Examination Control Division
2079 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy *(EE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What do you mean by electrical energy? Explain the different class of electrical consumers and their demand. [8]
2. A laminated wooden board 30 cm × 25 cm thick is to be heated from 20°C to 170°C in 10 min by dielectric heating using 30 MHz supply source. Specific heat of wood is 0.35 calorie per gram per °C and density 0.55 gm/cc, relative permittivity = 5, pf = 0.05. Determine the voltage across the work piece and current during heating. Assume loss of energy by conduction, convection and radiation is 15%. [5]
3. What are the requirements of good heating elements? Explain. [3]
4. What are the different classes of motor duty? Explain with waveform and area of applications. [8]
5. A drive has following parameters:

   $J = 10$ kg-m^2, $T = 100\text{-}0.1N$, N-m, Passive load torque $T1 = 0.05N$, N-m, where N is the speed in rpm.
   Initially the drive is operating in steady-state. Now it is to be reversed. For this motor characteristic is changed to $T = -100 - 0.1N$, N-m. Calculate the time of reversal. [8]
6. Discuss the four quadrant operation of a hoisting mechanism assuming constant load torque. [8]
7. A DC chopper fed from 400V supply runs a separately excited motor. The armature resistance Ra = 0.1 Ω. The motor voltage constant is 4 Vsec/radian, the average armature current Ia = 150 A. the armature current is continuous and has negligible ripple. Determine

   a) The input power
   b) The motor speed and
   c) The developed torque for a duty cycle of 60%

   Neglect the losses in chopper
   If the duty cycle of chopper varies between 10% and 90%, find maximum and minimum speed. [8]
8. Justify the statements

   a) Power drawn from supply mains varies as the square root of the load torque in case of dc series motors.
   b) Shunt motor is not suitable for traction purposes. [8]

9. The schedule speed with a 200 tone train on an electric railway with stations 777 metres apart is 27.2 km per hour and the maximum speed is 20 percent higher than the average running speed. The braking rate is 3.22 km p.h.p.s. and the duration of stop is 20 seconds. Find the acceleration required. Assume a simplified speed-time curve with free running at the maximum speed. [8]

10. What are the causes and disadvantages of low power factor? Mention the methods of power factor enhancement. [8]

11. A factory works for 16 hours a day for 300 days in a year. The following two systems of tariff are available:

    - High voltage supply at Rs. 1 per unit plus Rs. 50 per month per kVA of maximum demand.
    - Low voltage supply at Rs. 60 per month per kVA of maximum demand plus Rs. 1.1 per unit.

    The factory has an average load of 250 kW at 0.8 power factor and a maximum demand of 300 kW at the same power factor. The high voltage equipment costs Rs. 500 per kVA and losses can be taken as 5% Interest and depreciation charges are 12%. Calculate the difference in the annual cost between the two systems. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV /I	Time	3 hrs.

Subject: - Utilization of Electrical Energy *(EE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the common uses of electrical energy on basis of consumers and their demand. [8]

   b) A single phase electric furnace rated at 20kW and 220V is to be designed using Nichrome wire as resistance element. Determine its length and diameter if the wire temperature is not to exceed 1170°C and the temperature of the charge is to be 500°C. Take k = 0.57, e = 0.95 and $\rho = 10\mu\Omega$-cm.

2. a) Describe the open loop control and close loop control of electric drive. [8]

   b) A horizontal conveyer belt moving at uniform velocity of 1m/s, transports load of 500kg and the belt is driven by motor of inertia of 0.8kg-m^2 at 1000 rpm. [6]

   (i) Determine equivalent rotational inertia at the motor shaft
   (ii) Calculate the equivalent torque at the motor shaft to stop the belt at a uniform rate in 10s. [6]

   c) What do you understand by constant torque drive and constant power drive? Give typical example for each. [4]

3. a) A single phase 220V, 50Hz supply feeds a separately excited dc motor through two single phase semiconverters, one for field and another for armature. The firing angle of the field semiconverter is zero, the field resistance is 250Ω and armature resistance is 0.2Ω. The load torque is 150N-m at 1500 rpm. The voltage constant is 0.8 V/A-rad/s and torque constant is 0.8 Nm/A^2. Assuming armature and field current to be continuous and neglecting losses. Determine:

   (i) Field current
   (ii) Firing of the converter in the armature circuit
   (iii)Power factor of the converter of the armature circuit. [8]

   b) Draw the torque speed-characteristics of an induction motor with constant V/f control for speed variation from very low up to the base speed. Describe an open loop control scheme for induction motor with constant V/f control.

4. a) A 150 tonne electric train has a rotational inertia of 10%. This train while running between two stations which are 4km apart has an average speed of 60km/h. The acceleration and retardation during braking are respectively 1.5km/h/s and 2km/h/s. The percentage gradient between these two stations is 1.5% and the train move up the incline. The track resistance is 40N/t. If the combined efficiency of the electric train is 65%, determine (i) Total energy output at the driving axles (ii) Total energy consumption (iii) specific energy consumption. Assume that journey estimation is being made in simplified trapezoidal speed time curve. [8]

b) What is the tractive effort of a train and what are its functions? Derive an expression for the tractive effort developed by a train unit. [8]

5. a) What are the different demand side management (DSM) techniques? Write how DSM benefits utilities as well as consumers? [8]

b) A 850kW, 50Hz, 3 phase load has a power factor of 0.8 lagging. It is desired to improve the P.F. to 0.95 lagging by using delta connected bank of 2200V capacitors. Find:

(i) Capacitance of reach of each capacitor
(ii) kVA rating of capacitor bank and transformer
(iii)ratio of capacitance of 2200V capacitors to the capacitance of 400V capacitors for the same P.F. improvement. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy *(EE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What are the advantages of electrical energy over other forms of energy? Also write how electrical energy needs to be utilized in order to achieve development in our country? [8]

   b) What are the advantages of electric heating? Discuss the methods of temperature control of resistance ovens. [8]

2. a) A motor drives two loads, one has a rotational motion. It is coupled to a motor through a reduction gear with a=0.1 and efficiency of 92%. The load has moment of inertia of 10 kgm^2 and torque of 12N-m. The other load has a translational motion and consists of thousand kilograms to be lifted up at a uniform speed of 1.5 m/s. Coupling between this load and motor has an efficiency of 80%. Motor has inertia of 0.2 kgm^2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred to the motor shaft and power developed by the motor. [6]

   b) What are the various components of friction torque? Show how the friction torque components vary with speed with the help of speed-torque graph. [6]

   c) Explain the classes of motor duty with respect to continuous duty, short time duty and intermittent duty. [4]

3. a) A 220V dc shunt motor takes 22A at rated voltage and runs at 1000 rpm. Its field resistance is 100 ohm and armature circuit resistance is 0.1 ohm. Compare the value of additional resistance required in the armature circuit to reduce the speed to 800 rpm when
   (i) the load torque is proportional to speed,
   (ii) the load torque varies as the square of the speed. [8]

   b) What is slip power recovery scheme? Describe in detail about slip power recovery scheme using static Scherbius drive and static Kramer drive. [8]

4. a) What type of train service correspond to trapezoidal and quadrilateral speed time curve? [5]

   b) What are the main requirements of an ideal traction system? [5]

   c) An electric locomotive is accelerated and retarded at 0.8 kmphs and 3.2 kmphs respectively. If the ratio of maximum to average speed is 2 and time of stop is 30 seconds. Find scheduled speed for the run of 3 km assuming trapezoidal speed time curve. [6]

5. a) Why is customer acceptance important in implementation of demand side management? How can it be achieved? [8]

   b) A 3ϕ induction motor has pf 0.9 and efficiency of 0.9 at full load, power factor 0.5 and efficiency 0.8 at half full load. At no load the current is 25% of full load current and power factor 0.1. Capacitors are supplied to make the line power factor 0.8 at half full load. With those capcitors connected find line power factor at full load and no load. Also find the cost of electricity use for a month at no load assuming the machine operates for 80% of time. Tarrif: Rs. 200 of max kVA per month plus 50 paisa per kWh. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy *(EE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. a) Elaborate the role of electrical energy in the sustainable development of the country. Describe on the basis of the utilization of the electrical energy. [8]

   b) A household water tank having cubical structure has the surface area of $6m^2$ and if filled to 90% capacity six times daily. The water is heated from 20°C to 65°C. The losses per square meter of tank surface is 6.3 W/°C. Find the loading in kW and the efficiency of the tank. Assume specific heat of water = 4,200 J/kg/°C and 1kWh = 3.6MJ, $1m^3$ of water = 1000 kg. [8]

2. a) A horizontal belt conveyor moving at a uniform speed of 0.9 m/s transports material at 95 tons/hour. Belt is 180 m long and is driven by motor at 1500 rpm.

   (i) Find load inertial to motor shaft,
   (ii) Find the torque of motor to accelerate the belt from stand still to fall speed in 6 seconds. Moment of inertia of motor is 0.15 Kg/m^2. [8]

   b) A 25 H.P., 220 V DC shunt motor with a full load speed of 600 rpm is to be braked by plugging. Estimate the value of resistance which should be placed in series with it to limit the current to 130 A. what should be the initial value of the electrical breaking torque and value when speed has fallen to half of its full load value? Armature resistance- 0.1 Ω. Full load armature current = 95A. [8]

3. a) The speed of the separately excited dc motor is controlled by a single phase full controlled bridge rectifier with the field also being controlled by the full converter. The field current is set to maximum possible value. The supply voltage to the armature and field converters are 220 V, 50 Hz. the armature resistance and field resistance are 0.2 Ω and 150 Ω respectively. The motor voltage constant, $K' = 1.1(V/A)$. (rad/s). The armature current corresponding to the load demand is 25 A. Assume that the armature and field currents are continuous and ripple free and no-load losses are negligible. If the delay angle of the armature converter is $\alpha = 45°$ and armature current is 25 A. Determine:
   (i) The torque developed by the motor
   (ii) The speed of the motor and
   (iii)The power factor of the drive [8]

   b) How can slip power loss to be recovered by Kramer's System and Scherbius System? [8]

4. a) Explain the requirements of the Ideal Traction System. Explain Self Contained Vehicle with its various transmission systems. [6]

   b) Draw speed time curves for urban, sub-urban and main line services. Compare their characteristics. [4]

   c) An electric train is to have acceleration and braking retardation of 0.7 km/h/s and 3.2 km/h/s respectively. If the ratio of maximum to average speed is 1.4 and time for stops is 25 seconds, find the schedule speed for a run of 1.5km. Assume simplified trapezoidal speed-time curve. [6]

5. a) What do you mean by electrical tariff? What are different types of electrical tariff used in our country? Also write why NEA (Nepal Electricity Authority) impose such tariffs to its consumers? [8]

b) A 340 kW, 50 Hz, 3- phase star connected induction motor has full load efficiency of 85% and p.f of 0.8 lagging. It is desired to improve the power factor to 0.96 lagging by using bank of three capacitors. Calculate:
(i) The kVAR rating of the capacitor bank.
(ii) The capacitance of each limbs of the condenser bank connected in delta.
(iii) The capacitance of each capacitor, if each one of the limb of the delta – connected condenser bank is formed by using 6 similar 3300 V capacitors. [8]

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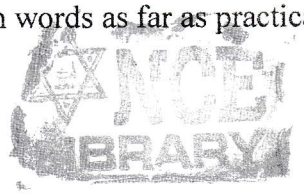
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy *(EE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*



1. a) How electrical consumers are classified, discuss about their demand characteristics. Also state how these classification differs according to countries? [8]

   b) What are the characteristics of heating element? Explain the design of heating element in resistance heating. [8]

2. a) State the methods of power transfer. Compare flat belt drive and V belt drive. [4]

   b) What are the classes duties to be performed by the motor on the basis of load variations? Give examples of each. [4]

   c) A 230V, 25kW d.c. shunt motor running at its rated speed of 1500 rpm is to be braked by reverse current braking. The armature resistance is 0.1 ohm and the rated efficiency of the motor is 88 percent. Calculate

   (i) the resistance to be connected in series with the armature to limit the initial braking current to twice the rated current,
   (ii) the initial braking torque and
   (iii)the torque when the speed of the motor falls to 600 rpm. [8]

3. a) Explain ward-Leonard system of speed control with diagram. Also state the advantages and disadvantages of this method. [8]

   b) A star-connected induction motor has the following data:
   440V, 50 Hz, 4-pole, 1460 rpm, Rs = 2 ohm, $R_r' = 2$ ohm, $X_s = X_r' = 3$ ohm
   Calculate the starting torque and the starting current of this motor at 50 Hz and 10 Hz for v/f control. [8]

4. a) What do you mean by electrical traction system? Compare the features of at least three electrical traction locomotives. [6]

   b) Define average speed, crest speed and schedule speed and discuss the factor affecting schedule speed of train. [4]

   c) The schedule speed of an electric train with stations 777m apart is 27.3 km per hour and the maximum speed is 20% higher than average running speed. The braking rate is 3.22 kmphps and the duration of stop is 20s. Find the acceleration required. Assume simplified speed time curve with free running at the maximum speed. [6]

5. a) What is importance of Load Management? What are the technique to manage demand side in an effective way? Explain in detail. [8]

   b) The load on a certain industrial premises is about 1200 kVA @ 0.75 lagging power factor for 3,000 hours per annum. The Tariff is Rs 1,300 per kVA maximum demand plus 80 paisa per kWh. Determine annual charge of energy. also if a power factor improving apparatus is installed to improve the power factor to 0.95 lagging. Determine the kvar required and the new annual charge of energy if the power factor improving apparatus costs Rs 1200 per kvar, annual interest and depreciation charges are 10% of the capital cost. [8]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy *(EE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What are the advantages of electrical energy over other forms of energy? Also discuss different types of electrical consumer on basis application and end use. [8]

   b) What are the factors which limit the choice of high frequency in induction and dielectric heating? Calculate KVA and KW drawn from supply, its p.f. and electrical efficiency with the following data pertaining to an electric arc furnace three phase. Current drawn = 4500 A, arc voltage = 50 V, resistance of transformer referred to secondary = 0.002 ohms and reactance of transformer referred to secondary = 0.004 ohms. [4+4]

2. a) Explain 4-quadrant operation of a dc motor with help of loaded and unloaded cage. [8]

   b) A 550 V, 45kW, 600 rpm dc shunt motor has a full load efficiency of 90%. The field resistance is 200 Ω and armature resistance is 0.2 Ω. Find the speed under each of the following conditions at which will develop an electromagnetic torque equal to the related value: [8]

      i) Regenerative braking with no limiting resistance
      ii) Plugging with external limiting resistance of 5.5 Ω inserted.
      iii) Dynamic braking with external limiting resistance of 2.6 Ω inserted. The field current is maintained constant and armature reaction and brush drop may be neglected.

3. a) A 500 V, 1500 rpm, 100 A separately excited motor is fed from a 350 V, 3-phase supply through a 3-phase. Semi-controlled bridge converter. Armature resistance is 1.1 ohm. If firing angle is 45° find rms source current, rms thyristor current, and average thyristor current and power factor at input terminals. Assume constant armature current and speed of 1200 rpm. [8]

   b) What do you mean by slip power recovery system? Explain in detail the different methods of slip power recovery. [8]

4. a) Why tramways are losing ground to other system of traction? And what is the scope of application of battery drive? [4]

   b) A train runs between two stations 2 KM apart at an average speed of 40km/hr. The run is to be made according to simplified quadrilateral speed-time curve. If the maximum speed to be limited to 80 km/hr, acceleration to 2 km/hr/s, coasting retardation to 0.15 km/hr/s and braking retardation 3 km/hr/s. Determine the duration of acceleration, coasting and branking periods. [8]

   c) Explain how actual speed-time curve for an electric train service can be replaced by a curve having a simple geometric shape. What type of train services corresponds to trapezoidal and quadrilateral speed time curves? [2+2]

5. a) What are the importance of demand side management? Explain its objectives for effective demand side management. [4]

b) What is two part tariff? Compare it with power factor tariff. [4]

c) A 35 kW induction motor has p.f.0.9 and efficiency 0.9 at full load, power factor 0.6 and efficiency 0.7 at half load. At no-load the current is 25% of full-load current and power factor 0.1. Capacitor are supplied to make the line power factor 0.8 at half full-load. With these capacitor in the circuit, find the power factor at (i) full load and (ii) no load. [8]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy *(EE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Classify and explain different types of electrical consumers on the basis of voltage level.

   b) What are the factors to be considered for electric heating in building design?

2. a) What do you mean by electric drive? Compare between individual, group and multi-motor drives with applications.

   b) A horizontal conveyer belt moving at uniform speed of 2.2 m/s transports material at the rate of 200 tones/hour. Belt is 100m long and driven by a motor at 1500 rpm.

   (i) Determine load inertia referred to motor shaft.
   (ii) Calculate torque that motor should develop to accelerate the belt from standstill to full speed in 8 sec. Moment of Inertia of motor is 0.1 kg-m^2.

3. a) Explain Ward-Leonard type variable speed drives enlisting its major benefits and dis benefits.

   b) A 8-pole 25 Hz 3 phase induction motor is running at 4% slip when delivering full load torque. It has standstill rotor resistance of 0.1 Ω and reactance 0.6 / phase. Calculate the speed of motor if additional resistance of 0.5 Ω / phase is used.

4. a) What do you mean by electric traction? Draw the speed-time curve for urban, sub-urban and main line services explaining the following terms: Free run period, Coasting Period.

   b) A train runs between 2 stations 2 km apart at an average speed of 40 km/hr. The run is to be made according to simplified quadrilateral speed-time curve. If the maximum speed is to be limited to 60 km/hour, acceleration to 2 km/h/sec, coasting retardation to 0.15 km/h/sec and braking retardation 3 km/h/sec, determine the duration of acceleration, coasting and braking periods.

5. a) What are the causes and disadvantages of low power factor? Briefly describe the differences between static capacitors and synchronous capacitors used for improving power factor of a machine.

   b) The load on an installation is 600 kW, 0.8 lagging which works for 2000 hours per annum. The tariff is Rs 80 per kVA plus 20 paisa per kWh. If the power factor is to be improved to 0.9 lagging by the means of capacitors costing Rs.50 per kVAR, find the annual saving. Allow 10% per annum for interest and depreciation on capacitors.

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15 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Utilization of Electrical Energy *(EE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. a) What do you mean by electrical energy? Explain the different class of electrical consumers and their demand.

   b) A low frequency induction furnace operating at 10V in the secondary circuit takes 500kW at 0.5 p.f when the hearth is full. If the secondary voltage be maintained at 10V, estimate the power absorbed and the p.f when the hearth is half full. Assume the resistance of the secondary circuit to be thereby halved and the reactance to remain the same.

2. a) A 30 kW, 220V, dc shunt motor with a full load speed of 535 rev/min is to be braked by plugging. Estimate the value of resistance which should be placed in series with it to limit the initial braking current to 200A. What would be the initial value of the electric braking torque and the value when the speed has fallen to half its full load value? (Given: armature resistance of motor = 0.086 Ω, Full load armature current = 150A)

   b) For the selection of various types of motor, what are the classes of duties to be performed by the motor on the basis of load variations? List out some examples of driver/machine applicable to various classes of duties.

3. a) How three phase induction motor has controlled by variable frequency method? Explain with necessary mathematical relation and figures.

   b) A separately excited dc motor is fed from a three phase six pulse fully controlled bridge converter. The motor develops its full load torque at a rated speed of 1800 rpm taking a current of 60 A from a 400 V supply. Determine the rms value of supply voltage if the motor runs at its rated conditions for $\alpha = 0$. What is the range of firing angles for a speed control of 1800 rpm to 900 rpm. The armature resistance is 0.5 ohm. The supply and thyristors are ideal.

4. a) An electric train is to have accleration and braking retardation of 1.2 km/h/s and 3.8km/h/s respectively. If the ratio of maximum to average speed is 1.6 and time for stop 45 seconds, find the schedule speed from a run of 2.5 km. Assume simplified trapezoidal speed time curve.

   b) What is self-contained electric vehicle? What are transmission system employed in these types of electric vehicle? Explain.

5. a) What is demand side management? Explain the effective techniques for effective demand side management.

   b) A 50 Hz HP induction motor has power factor 0.9 and efficiency 90% at full load, power factor 0.6 and efficiency 70% at half load. At no-load the current is 25% of the full-load current and power factor 0.1. Capacitors are supplied to make the line power factor 0.8 at half load. With these capacitors in circuit, find the line power factor at (i) full-load and (ii) no-load

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