Exam Date: 05/01/2023

CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
B.Sc. ENGINEERING LEVEL-1TERM-II (20 Batch) EXAMINATION '2021

DEPARTMENT	: ELECTRONICS AND TELECOMMUNICATION ENGINEERING
FULL TITLE OF PAPER	: Fundamentals of Electrical Machines
COURSE NO.	: EEE183
FULL MARKS	: 210
TIME	: 3 HOURS

The figures in the right margin indicate full marks. Answer any THREE questions from each section. Use separate script for each section.

Section-A

Q.1(a) What is Back E.M.F.? What is the significance of Back E.M.F.? **15**

(b) Justify the statement- "Shaft Torque is always lower than Armature Torque". **10**

(c) A 20KW, 250V d.c. shunt generator has armature and field resistances of 0.1Ω and 125 Ω respectively. Calculate the total power developed when running- **10**
i) as a generator delivering 20KW output
ii) as a motor taking 20KW input.

Q.2(a) Explain the concept of critical external resistance for DC Shunt Generators. **10**

(b) Differentiate between simplex lap and simplex wave winding for DC Generators. **10**

(c) A shunt generator supplies 96A at a terminal voltage of 200 volts. The armature and shunt field resistances are 0.1Ω and 50 Ω respectively. The iron and frictional losses are 2500W. Find- **15**
i) e.m.f. generated
ii) copper losses
iii) commercial efficiency.

Q.3(a) The O.C.C of a separately excited d.c. generator driven at 400 r.p.m. is as follows: **20**

Field Currents (I):	2	3	4	5	6	7	8	9
E.M.F Volts (V):	110	155	186	212	230	246	260	271

The machine is connected as a shunt generator and driven at 400 r.p.m.
Find-
i) The e.m.f. to which machine will excite when the filed circuit resistance is 34 Ω.
ii) The additional resistance required in the field current to reduce e.m.f. to 220V.
iii) The critical value of shunt field resistance.
iv) The critical speed when the field circuit resistance is 34 Ω.

(b) Derive the E.M.F. equation of a transformer. **08**

(c) Justify the statement- "Commutator is a mechanical rectifier." **07**

Q.4(a) Draw and explain the phasor diagram of a practical transformer on capacitive load with winding resistance and leakage reactance. **18**

(b) Explain the transformer tests along with their usages and advantages. **10**

(c) In a no-load test of a single-phase transformer, the primary voltage, primary current, secondary voltage and power input are 220V, 0.5A, 110V and 30W respectively. **7**
Find-
i) turn ratio
ii) magnetizing component of no-load current
iii) iron-loss component of no-load current
iv) iron loss.
The resistance of primary winding is 0.6 Ω.

Section-B

Q.5(a) Explain the operation of a 3-phase induction motor with regards to slip. **15**

(b) Derive the relation between rotor current frequency and supply frequency for a 3-phase induction motor. **10**

(c) A 500 H.P., 3-phase, 440V, 50Hz induction motor has speed of 950 r.p.m. on full-load. The machine has 6 poles. Calculate the full load slip. How many cycles will the rotor voltage make per minute? **10**

Q.6(a) Differentiate between salient pole and non-salient pole rotor construction. **10**

(b) Describe the three lamp (one dark, two bright) method to check the synchronizing between the increasing alternator and finite busbars. **10**

(c) Explain the armature reaction in alternators when- **15**

i) p.f. is unity
ii) p.f. is zero lagging
iii) p.f. is zero leading.

Q.7(a) With proper diagrams, explain the concept of double field revolving theory. **15**

(b) Briefly explain the various starting methods for single phase induction motors. **12**

(c) How does a reluctance motor work? What are the applications of reluctance motors? **08**

Q.8(a) With proper diagrams, explain how a universal motor can operate with both A.C. and D.C. supply. **15**

(b) Differentiate among Stepper, Servo and BLDC motors. **10**

(c) What is step angle and stepping rate of stepper motor? Calculate angle for (i) a 3-phase, 16-tooth rotor VR motor (ii) a 3-phase & 4 pole DM motor. **10**

THE END

Exam Date: 07/03/2022

CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
B.Sc. ENGINEERING LEVEL-1TERM-II(19 Batch) EXAMINATION '2020

DEPARTMENT : ELECTRONICS AND TELECOMMUNICATION ENGINEERING
FULL TITLE OF PAPER : Fundamentals of Electrical Machines
COURSE NO. : EEE183
FULL MARKS : 210
TIME : 3 HOURS

The figures in the right margin indicate full marks. Answer any THREE questions from each section. Use separate script for each section.

Section-A

Q.1(a) Explain the process with neat sketch, how will you get dc voltage from dc generator? **11**

(b) Define the following terminology with suitable diagram: **12**
(i) Back pitch
(ii) Resultant pitch
(iii) Commutator pitch
(iv) Retrogressive winding

(c) A shunt generator delivers 195A at a terminal p.d. of 250V. The armature resistance and shunt field resistance are 0.02Ω and 50Ω respectively. The iron and friction losses equals 950W. Find i) e.m.f. generated ii) Cu losses iii) output of the prime ~~mover~~ motor iv) commercial, mechanical and electrical efficiencies. **12**

Q.2(a) Prove that, in a dc motor the torque $T_a \propto \varphi I_a$, where the symbols have their usual meaning. **12**

(b) Briefly explain the characteristics of series d.c. motor with appropriate diagram. **13**

(c) A 220V shunt motor takes a total current of 80A and runs at 800 r.p.m. Shunt field resistance and armature resistance are 50Ω and 0.1Ω respectively. If iron and friction losses amount to 1600W, find i) Copper losses ii) Armature torque iii) Shaft torque iv) efficiency. **10**

Q.3(a) Briefly explain how does commutating poles solve commutation problem. **10**

(b) Write down the conditions for satisfactory parallel operation of the single phase transformer. **05**

(c) The following figures give the O.C.C of a d.c. shunt generator at 300 r.p.m. **20**

Field Amperes (A):	0	2	3	4	5	6	7
Armature volts (V):	7.5	92	132	162	183	190	212

Plot the O.C.C for 375 r.p.m. and determine the voltage at which the machine will excite if field circuit resistance is 40Ω.
i) What additional resistance would have to be inserted in the field circuit to reduce the voltage to 200 volts at 375 r.p.m.
ii) Without this additional resistance, determine the load current supplied by the generator when its terminal voltage is 200V. Ignore armature reaction and assume speed to be constant. Armature resistance is 0.4Ω.

Q.4(a) Draw the simplified equivalent circuit of a loaded transformer looking from primary side. Show the required calculations and also draw the corresponding phasor diagram. **11**

(b) "Efficiency of a transformer will be maximum when copper losses are equal to constant or iron losses"- justify the statement. **11**

(c) A single-phase transformer has 1000 turns on the primary and 200 turns on the secondary. The no-load current is 3A at a p.f. of 0.2 lagging. Calculate the primary current and power factor when the secondary current is 280 A at a p.f. of 0.8 lagging. **13**

Section-B

Q.5(a) Define distribution factor, K_d and pitch factor, K_p. Derive the expression for K_d and K_p with proper diagram. **15**

(b) Derive the emf equation of an alternator with considering pitch factor and distribution factor. **10**

(c) A 500 kVA, 3-phase, star-connected alternator has a rated line-to-line voltage of 3300V. The resistance and synchronous reactance per phase are 0.3Ω and 4Ω respectively. Calculate the line value of the e.m.f. generated at full-load, 0.8 p.f. lagging. **10**

Q.6(a) "A 3-phase supply produces a rotating field of constant value in 3-φ induction motor"- justify the statement with suitable diagram. **15**

(b) What is slip? Show that $f' = sf^*$ where the symbols have their usual meanings. **08**

(c) An 8-pole, 3-phase, 50 Hz induction motor is running at a speed of 710 r.p.m with an input power of 35 kW. The stator losses at this operating condition are known to be 1200W while the rotation losses are 600W. Find (i) The rotor Cu loss (ii) The gross Mechanical power developed (iii) Mechanical Power output (iv) The net torque. **12**

Q.7(a) With necessary phasor diagram, explain the effect of change in excitation at constant load of synchronous motor for the following condition. **15**

(i) Under excitation
(ii) Normal excitation
(iii) ~~Normal~~ excitation
Over

(b) Distinguish between synchronous motor and induction motor. **10**

(c) A 200V, 3-phase, star-connected motor has resistance and synchronous reactance per phase of 0.2Ω and 1.9Ω respectively. Calculate the generated (back) e.m.f per phase with an input of 800 kW at p.f. of 0.8 lagging. **10**

Q.8(a) What is synchronous condenser? Write down the advantages and disadvantages of the synchronous condenser. **08**

(b) Explain with neat sketch, operation of PM stepper motor. **15**

(c) Prove that, for alternator power output in cylindrical rotor, **12**

$$P = \frac{3Z_0V}{X_s} Sin\delta$$

where the symbols have their usual meaning.

THE END

CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
B.Sc. ENGINEERING LEVEL-I TERM-II EXAMINATION '2019

DEPARTMENT : ELECTRONICS AND TELECOMMUNICATION ENGINEERING
FULL TITLE OF PAPER : Fundamentals of Electrical Machines
COURSE NO. : EEE-183
FULL MARKS : 210
TIME : 3 HOURS

The figures in the right margin indicate full marks. Answer any THREE questions from each section. Use separate script for each section.

Section-A

Q.1(a) With necessary diagram, explain the working principle of a simple loop generator. 13

(b) Deduce the e.m.f equation of dc generator. 10

(d) A shunt generator delivers 195A at a terminal p.d. of 250V. The armature resistance and shunt field resistance are 0.02Ω and 50Ω respectively. The iron and friction losses equal 950W. Find i) e.m.f. generated ii) Cu losses iii) output of the prime mover iv) Mechanical, electrical and commercial efficiencies. 12

Q.2(a) A 4-pole, 240V, wave connected shunt motor gives 11.19kW when running at 1000 rpm and drawing armature and field currents of 50A and 1A respectively. It has 540 conductors. Its resistance is 0.1Ω. Assuming a drop of 1 volt per brush, find i) total torque ii) useful torque iii) useful flux/pole iv) rotational losses and v) efficiency. 13

(b) With necessary diagram and equation, explain why a dc shunt motor should not be started on high load? Why a dc series motor is variable speed motor? 10

(c) What is back emf of a d.c motor? Describe the significance of back emf in dc motor. 12

Q.3(a) Explain the working principle of a transformer. Mention the condition for an ideal transformer with necessary vector diagram. 12

(b) A 200KVA, 2000/440V, 50Hz single-phase transformer gave the following results: 13

O.C. test : 2000V	1.8A	1.75kW	.... On H.V side
S.C test : 13V	300A	1kW	.... On L.V. side

Obtain the equivalent circuit as referred on H.V side

(c) Derive the emf equation of a transformer. 10

Q.4(a) What is armature reaction? How does it affect operation of dc generator?-Explain 08

(b) Explain with necessary diagram, for parallel operations why it is necessary to connect the transformer with regard to their polarities. 07

(c) The O.C.C of a separately excited d.c generator driven at 400 rpm is as follows. 20

Filed Current (I)	2	3	4	5	6	7	8	9
E.M.F (V)	110	155	186	212	230	246	260	271

The machine is connected as a shunt generator and driven at 400r.p.m.
Find:

(i) The e.m.f to which the machine will excite when the field circuit resistance is 34Ω.
(ii) The additional resistance required in the field current to reduce e.m.f to 220V.
(iii) The critical value of shunt field resistance.
(iv) The critical speed when the field circuit resistance is 34 Ω.

Section-B

Q.5(a) With necessary diagram, derive the equation of maximum power output and approximate expression of power output in cylindrical rotor of alternator. 13

(b) Describe about the armature reaction in an alternator for the following conditions: 17
(i) When load p.f is unity
(ii) When load p.f is zero lagging
(iii) When load p.f is zero leading

(c) Distinguish between distribution factor and pitch factor of an alternator. 05

Q.6 (a) Explain torque slip characteristics curve for different slip conditions of 3-φ induction motor. 10

(b) Derive the condition for maximum torque of a 3-φ induction motor under running conditions. 13

(c) Explain the behavior of 3-phase induction motor on different load. 12

Q.7(a) With necessary phasor diagram, explain the effect of change in excitation at constant load of synchronous motor for the following condition. 17
i) Under excitation
ii) Normal excitation
iii) Over excitation

(b) A 3-phase synchronous motor has 12-poles and operates from 440V, 50 Hz supply. Calculate its speed. If it takes a line current of 100Aat 0.8 power factor lead. What torque the motor will developing? Neglect losses. 08

(c) With proper phasor diagram, derive the equation of mechanical power developed by synchronous motor; Consider the armature resistance neglected. 10

Q.8(a) With necessary vector diagram, prove that, 2-phase balanced supply produces rotating magnetic field of constant magnitude. 15

(b) With necessary diagram, describe the construction and operating principle of variable reluctance stepper motor. 13

(c) What is step angle and stepping rate of stepper motor? Calculate angle for (i) a 3-phase,16-tooth rotor VR motor (ii) a 3-phase 24 pole DM motor 07

The End

CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
B.Sc. ENGINEERING LEVEL-I TERM-II EXAMINATION '2018

DEPARTMENT : ELECTRONICS AND TELECOMMUNICATION ENGINEERING
FULL TITLE OF PAPER : Electrical Drives
COURSE NO. : EEE183
FULL MARKS : 210
TIME : 3 HOURS

The figures in the right margin indicate full marks. Answer any THREE questions from each section. Use separate script for each section.

Section-A

Q.1(a) How commutation of a dc generator can convert ac voltage to dc voltage at its terminal ? Briefly explain with necessary diagram. 13

(b) With necessary diagram write short notes on following terms: 12
(i) Front Pitch
(ii) Back Pitch
(iii) Resultant Pitch

(c) In a long shunt compound generator the terminal voltage is 230V when generator delivers 150A. Determine (i) induced emf (ii) total generated power (iii) distribution of this power. Given that shunt field, series field, diverter and armature resistance are 92Ω, 0.015Ω, 0.03Ω and 0.032Ω respectively. 10

Q.2(a) Prove that, in a dc shunt motor $T_a \propto I_a$ and in dc series motor $Ta \propto I_a^2$; where the symbols have their usual meaning. 12

(b) Why a dc series motor should never be started on no load? Why a dc shunt motor is essentially a constant speed motor? Explain both the question with proper diagram. 10

(c) A 220V shunt motor takes a total current of 80A and runs at 800 r.p.m. Shunt field resistance and armature resistance are 50Ω and 0.1Ω respectively. If iron and friction losses amount to 1600W, find i) Copper losses ii) Armature torque iii) Shaft torque iv) efficiency. 13

Q.3(a) Draw the simplified equivalent circuit of a loaded transformer looking from secondary side. Also draw the phasor diagram of the transformer operating at lagging power factor of 0.8. 10

(b) Explain that, for a transformer at any load condition, the net flux passing through the core is approximately same as no-load condition. 13

(c) A 4500/16000V, 1500VA, 50 Hz transformer has the following parameters: 12

$R_1 = 0.03\Omega$ $R_2 = 0.44\Omega$ $R_0 = 1688\ \Omega$
$X_1 = 0.092\ \Omega$ $X_2 = 1.34\ \Omega$ $X_0 = 25\ \Omega$

The transformer is supplying full-load at a power factor 0.8 lagging. Using exact equivalent circuit, find the input current.

Q.4(a) How does compensating winding solve commutation problem? Briefly explain with necessary diagram. 10

(b) Write down the advantages and disadvantages of 3-φ transformer over 1- φ transformer. 05

(c) The open-circuit characteristics of a dc shunt generator driven at rated speed is as follows: 20

Field Amperes (A):	0.5	1.0	1.5	2	2.5	3	3.5
Induced voltage (V):	60	120	138	145	149	151	152

If the resistance of field circuited is adjusted to 53Ω, calculate the open circuit voltage and load current when the terminal voltage is 100V. Neglect armature reaction and assume an armature resistance of 0.1Ω.

Section-B

Q.5(a) Explain the causes of using stationary armature windings in alternators. 10

(b) With appropriate vector diagram prove that, for alternator distribution factor 13
$K_d = \frac{\sin(n\alpha/2)}{n\sin(\alpha/2)}$ and pitch factor $K_p = \cos\left(\beta/2\right)$; where the symbols have their usual meanings.

(c) A 3 phase, 16 pole Synchronous generator has a star connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.03Wb sinusoidally distributed and the speed is 375 r.p.m. Calculate: 12

i) The frequency and

ii) Line induced e.m.f.

Q.6 (a) Explain with proper diagram, why does the rotor of 3-φ induction motor rotate? 10

(b) How rotating magnetic field of constant magnitude is established in 3-φ induction motor, when it is fed from balanced 3-φ supply? Explain with necessary vector diagram. 15

(c) The input power to a 6-pole, 3-phase, and 50Hz induction motor is 42kW; the speed is 970 rpm. The stator losses are 1.2kW and the friction and windage losses 1.8 kW. Find (i) the rotor Cu loss and (ii) the efficiency of the motor. 10

Q.7(a) With necessary diagram explain V curves for synchronous motor. 10

(b) What is pull-out torque? Explain what does happen when different types of mechanical load applied to synchronous motor? 12

(c) A 3980V, 50Hz, 4 pole, star connected synchronous motor generates back emf of 1790V per phase. The resistance and synchronous reactance per phase are 2.2Ω and 22Ω respectively. The torque angle is 300 electrical. Calculate i) the resultant armature voltage/phase ii) armature current/phase iii) power factor of the motor. 13

Q.8(a) With necessary diagram, explain the operation of permanent magnet stepper motor. 13

(b) Describe the operation of split phase induction motor with appropriate diagram. 10

(c) A 4-pole, 3-phase, 50 Hz induction motor has a star-connected rotor. The rotor has a resistance of 0.1Ω per phase and standstill reactance of 2 Ω/phase. The induced emf between the slip rings is 100V. If the full load speed is 1460 rpm. Calculate (i) the slip (ii) the emf induced in the rotor in each phase (iii) the rotor reactance per phase (iv) the rotor current and (v) rotor power factor. Assume slip rings are short-circuited. 12

The End

CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
B.Sc. ENGINEERING LEVEL-I TERM-II (17 BATCH) EXAMINATION '2016

DEPARTMENT : ELECTRONICS AND TELECOMMUNICATION ENGINEERING
FULL TITLE OF PAPER : Electrical Drives
COURSE NO. : EEE183
FULL MARKS : 210
TIME : 3 HOURS

The figures in the right margin indicate full marks. Answer any THREE questions from each section. Use separate script for each section.

Section-A

Q.1(a) With necessary diagram and proper explanation, describe the working principle of a single loop generator. 12

(b) Write short note with necessary diagram on following terms: 11

(i) Fractional pitched coil.
(ii) Progressing Winding.
(iii) Resultant pitch.
(iv) Commutator pitch

(c) A shunt generator delivers 195A at a terminal p.d. of 250V. The armature resistances and shunt field resistance are 0.02Ω and 50Ω respectively. The iron and friction losses are equal 950W. find (i) e.m.f. generated; (ii)Cu losses; (iii) output of the prime mover; (iv) mechanical, electrical and commercial efficiencies. 12

Q.2(a) What is back e.m.f.? Explain the necessity of back e.m.f. in proper load operation for d.c. motor. 12

(b) Deduce the condition for maximum power of dc. motor and also mention the limitation of this condition. 10

(c) A 4-pole, 250V series motor has a wave connected armature with 1254 conductors. The flux per pole is 22mWb, when the motor is taking 50A. Iron and friction losses amount to 1kw. Armature resistance is 0.2Ω and series field resistance 0.2Ω. calculate i) The speed; ii) The b.h.p. iii) The shaft torque; iv) The efficiency at this load. 13

Q.3(a) Briefly explain the working principle of a transformer. Write down the properties of an ideal transformer. 10

(b) Draw the vector diagram of a transformer with magnetic leakage and winding resistance for non-inductive and inductive load. 12

(c) A single-phase transformer has turns ratio of 144/232 and operates at a maximum flux of $7.5X10^{-3}$ wb at 50HZ. When on no load, the transformer takes 0.24KVA at a power factor of 0.26 lagging form the supply. If the transformer supplies a load of 1.2 KVA at a power factor of 0.8 lagging, find (i) The magnetizing current (ii) Primary current (iii) The primary power factor. 13

Q.4(a) How does commutating poles solve commutation problem? Briefly explain with necessary diagram. 10

(b) Draw the circuit diagram for different types of 3-φ transformer. 05

(c) The following table gives the O.C.C. of a d.c. shunt generator at 300 r.p.m. 20

Field amperes:	0	2	3	4	5	6	7
Armature volt:	7.5	92	132	162	183	190	212

Plot the O.C.C. for 375 r.p.m. and determine the voltage to which the machine will excite if field circuit resistance is 40Ω.

(i) What additional resistance would have to be inserted in the field circuit to reduce the voltage to 200 volts at 375 r.p.m.

(ii) Without this additional resistance, determine the load current supplied by the generator, when its terminal voltage is 200V. Ignore armature reaction and assume speed to be constant.

Section-B

Q.5(a) Define pitch factor and distribution factor. Derive the e.m.f equation of an alternator with considering pitch factor and distribution factor. 13

(b) Draw the phasor diagram of alternator with leading power factor of 0.75. 10

(c) A 12 pole, 3-φ, star connected alternator has 72 slots. The flux per pole is 0.0988Wb. Calculate- 12

(i) The speed of rotation if the frequency of the generated e.m.f if 50HZ.
(ii) The terminal e.m.f for full-pitch coils and 8 conductors per slot.
(iii) The terminal e.m.f if the coil span is reduced to 2/3 of the pole pitch.

Q.6 (a) Derive the equation of the maximum power output and approximate expression of power output in cylindrical rotor of alternator. 13

(b) Derive the expression of induced torque under running condition of an induction motor. Also, deduce the condition for maximum torque under running condition from it. 12

(c) A 50HZ, 8-pole induction motor has full load slip of 4%. The rotor resistance and stand still ~~resistance~~ reluctance is 0.01Ω and 0.1Ω per phase respectively. Find (i) The speed at which maximum torque occurs. (ii) The ratio at maximum torque to full load torque. 10

Q.7(a) Explain the effect of change in excitation at constant load of synchronous motor for the following condition: 15

(i) Under excitation.
(ii) Normal excitation.
(iii) Over excitation.

(b) Explain the effect of load on synchronous motor. 08

(c) A 208V, star-connected, 3-φ synchronous motor has a synchronous reactance of 4Ω/phase and negligible armature winding resistance. At a certain load, the motor takes 7.2 Kw at 0.8 p.f. lagging. If the power developed by the motor remains the same while the excitation voltage is increased by 50% by raising the field excitation. Determine- 12

i) The new armature current and
ii) The power factors.

Q.8(a) With proper vector diagram explain the operation of 1-φ capacitor start induction motor. 08

(b) Explain the armature reaction in alternator for the following load condition: 15

i) When p.f. is unity.
ii) When p.f. is lagging.
iii) When p.f. is leading.

(c) Explain the operation of variable reluctance stepper motor with truth table and necessary diagram. 12

The End

CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
B.Sc ENGINEERING LEVEL-I SELF STUDY EXAMINATION '2015

DEPARTMENT : ELECTRONICS AND TELECOMMUNICATION ENGINEERING
FULL TITLE OF PAPER : Electrical Drives
COURSE NO. : EEE 183
FULL MARKS : 210
TIME : 3 HOURS

The figures in the right margin indicate full marks. Answer any THREE questions from each section. Use separate script for each section.

Section-A

Q.1(a) Describe the working principle of a simple loop generator with necessary diagram. 13

(b) What are the equilizers? Why are they needed on a lap around d.c machine? Explain with proper diagram. 12

(c) Estimate the reduction in speed of a generator with constant excitation on bus bars to decrease its load from 500kW to 250kW. The resistance between terminal is 0.015Ω. The bus bar voltage is 500V. 10

Q.2(a) Explain with necessary diagram, the working principle and procedure of d.c motor. 13

(b) What is back e.m.f.? Explain the necessity of back emf in power load operation for d.c. motor. 12

(c) A 220V series motor takes 50A. The armature resistance is 0.1Ω and the series field resistance is 0.8Ω. If iron and friction losses are equal to copper losses at this load, find the b.n.p and efficiency. 10

Q.3(a) Briefly explain the working principle of transformer. Write the properties of an ideal transformer. 10

(b) Draw the equivalent circuit diagram of a loaded transformer referred to secondary side. Fromits also draw the phasor diagram of the transformer operating at logging power factor of 0.8. 13

(c) The voltage on the secondary of a single phase transformer is 200V when supplying a load of 8kW at a p.f. of 0.8 logging. The secondary resistnce is 0.04Ω and secondary leakage reactance is 0.8Ω. Calculate the induced e.m.f. in the secondary. 12

Q.4(a) How does compansating winding solve commutation problem? Briefly explain. 10

(b) Write down the advantages and disadvantages of 3-φ transformer over 1-φ transformer. 05

(c) A shunt generator gave the following open-circuit characteristic: 20

Field –Current (A)	0.5	1	1.5	2	2.5	3	3.5
O.C.emf (V)	54	107	152	185	210	230	245

The armature and field resistance are 0.1Ω and 80Ω respectively. Calculate:

i) The voltage to which the machine will excitewhen run as a shunt generator at the same speed.

ii) The volts lost due to armature reaction when 100 A are passing in the armature at a terminal voltage of 175V. (Graph paper is needed for this question).

Section-B

Q.5(a) Distinguish between salient-pole and non-salient-pole type rotor of alternator. 10

(b) With necessary diagram describe the synchronouscope method for synchronization. 12

(c) A 3-φ, star connected alternator on open circuit is required to generate a line voltage of 3600V at 50Hz when driven at 500 r.p.m. The stator has 3 stots per pole per phase and 10 conductors per slot. Calculate (i) The number of poles and (ii) useful flux per pole. Assume all the conductors per phase to be connected in series and the col is to be full-pitch. 13

Q.6 (a) Explain the torque-slip characterictics curve for different slip condition of 3-φ induction motor. 12

(b) Derive the condition for maximum starting torque of an induction motor. 13

(c) A 6-pole, 50Hz, 3-phase induction motor runs at 960 r.p.m. when the torque on the shaft is 200 N-m. If the stator losses are 1500W and friction and windage losses are 500W, find (i) rotor Cu loss and (ii) efficiency of the motor. 10

Q.7(a) Explain the operaion of shaded pole 1-φ induction motor. 12

(b) Why in 1-φ induction motor is not self- starting? Explain. 08

(c) A 12 pole, 3-φ, star connected alternator has 72 slots. The flux per pole is 0.0988Wb. Calculate 15

(i) The speed of rotation if the frequency of the generated emf is 50 Hz.
(ii) The terminal emf for full-pitch coils and 8 conductors per slot.
(iii)The terminal emf if the coil span is reduced to 2/3 of the pole pitch.

Q.8(a) Explain the process of making self starting synchronous motor. 10

(b) What is synchronous condenser? How does synchronous motor operate as synchronous condenser? Write down the advantages and disadvantages of synchronous condenser. 15

(c) A 3-φ 6000kW, 4kV, 180 rpm, 50Hz motor has per phase synchronous reactance of 1.2Ω. At full load, the torque angle is 20° electrical. If the generator back emf/phase is 2.4kV. Calculate the mechanical power developed. What will be the maximum mechanical power developed? 10

THE END

CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
B.Sc. ENGINEERING LEVEL-I TERM-II EXAMINATION '2014

DEPARTMENT : ELECTRONICS AND TELECOMMUNICATION ENGINEERING
FULL TITLE OF PAPER : Electrical Drives
COURSE NO. : EEE183
FULL MARKS : 210
TIME : 3 HOURS

The figures in the right margin indicate full marks. Answer any THREE questions from each section. Use separate script for each section.

Section-A

Q.1(a) Describe the working principle of a simple loop generator with necessary diagram. 13

(b) What is commutator? Derive the emf equation of a dc generator. 10

(c) A long-shunt compound generator delivers a load current of 50A at 500V and has armature, series field and shunt field resistances of 0.05Ω, 0.03Ω and 250Ω respectively. Calculate the armature current and the generated emf. Allow IV per brush contact loop. 12

Q.2(a) Prove that, in a dc shunt motor $T_a \propto I_a$ and in dc series motor $Ta \propto I_a^2$; where the symbols have their usual meanings. 12

(b) Why a dc series motor should never be started on no load? Why a dc shunt motor is essentially a constant speed motor? Explain both the question with proper diagram. 10

(c) A 4-pole, 240V, wave connected shunt motor gives 11.19kW when running at 1000 rpm and drawing armature and field currents of 50A and 1A respectively. It has 540 conductors. Its resistance is 0.1Ω. Assuming a drop of 1 volt per brush, find i) total torque ii) useful torque iii) useful flux/pole iv) rotational losses and v) efficiency. 13

Q.3(a) Explain that for a transformer at any load condition, the net flux passing through the core is approximately same as no-load condition. 13

(b) What types of parameters and losses in transformer can be determined from short circuit test? Explain the necessary circuit diagram. 10

(c) A single-phase transformer has 1000 turns on the primary and 200 turns on the secondary. The no-load current is 3A at a pf of 0.2 lagging. Calculate the primary current and power factor when the secondary current is 280A at a pf of 0.8 lagging. 12

Q.4(a) How does compensating winding solve commutation problem? Briefly explain. 10

(b) Draw the circuit diagram for different types of 3-φ transformer? 07

(c) The open-circuit characteristics of a separately excited dc generator driven at 1000 rpm is as follows: 18

Filed Current (A):	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6
EMF Volts (V):	30.0	55.0	75.0	90.0	100.0	110.0	115.0	120.0

If a machine is connected as shunt generator and driven at 1000rpm and has a field resistance of 100Ω, find i) open circuit voltage and exciting current ii) the critical resistance.

Section-B

Q.5(a) With appropriate vector diagram prove that, for alternator distribution factor $K_d = \frac{\sin(n\alpha/2)}{n\sin(\alpha/2)}$ and pitch factor $K_p = \cos\left(\beta/2\right)$; where the symbols have their usual meanings. 12

(b) Derive the emf equation of an alternator with considering pitch factor and distribution factor. 10

(c) A 4-pole, 3-φ, 50Hz, star connected alternator has 60 slots with 4 conductors per slot. Coils are short pitched by 3 slots. If the phase spread is 60^0, find line voltage induced for a flux per pole of 0.943 Wb, distributed sinusoidally. All the turns per phase are in series. 13

Q.6 (a) Derive the condition for maximum torque of induction motor under running condition. 10

(b) What is slip? Show that for induction $f'=sf$; where the symbols have their usual meaning. 12

(c) An 8-pole, 3-φ, 50 Hz induction motor is running at a speed of 710rpm with an input power of 35kW. The stator losses at this operating condition are known to be 1200W while the rotational losses are 600W. Find i) the rotor Cu loss ii) the gross mechanical power developed iii) mechanical power output iv) the net torque. 13

Q.7(a) Derive the equation of maximum power output and approximate expression of power output for an alternator with cylindrical rotor. 13

(b) What is V curve for alternator? Explain about this curve with proper vector diagram and graphical representation. 10

(c) Explain the operation of capacitor start 1-φ induction motor. 12

Q.8(a) With ~~power~~ proper diagram explain how can be continuous unidirectional torque developed in synchronous motor? 10

(b) What is pull-out torque? Explain what does happen when different types of mechanical load applied to synchronous motor? 12

(c) A 3980V, 50Hz, 4 pole, star connected synchronous motor generates back emf of 1790V per phase. The resistance and synchronous reactance per phase are 2.2Ω and 22Ω respectively. The torque angle is ~~300~~ 30^0 electrical. Calculate i) the resultant armature voltage/phase ii) armature current/phase iii) power factor of the motor. 13

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Section-A

Q.1(a) Draw the power stages of a dc generator and define various efficiencies. 08

(b) Describe how commutator converts ac voltage to dc voltage in dc generators. 10

(c) Differentiate between lap and wave winding of dc generators. 05

(d) A shunt generator supplies 96A at a terminal voltage of 200volts. The armature and shunt field resistances are 0.1Ω and 50Ω respectively. The iron and frictional losses are 2500W. Find (i) emf generated (ii) copper losses (iii) commercial efficiency. 12

Q.2(a) What is back emf? Explain the significance of back emf in dc motor. 12

(b) Derive the condition for maximum power of dc motor. 08

(c) A 100HP, 500V shunt motor has 4poles and wave winding with 492 armature conductors. The flux is 50mWb per pole and the full load efficiency 92%. The armature and commutating field windings have a total resistance of 0.1Ω. The shunt field resistance is 250Ω. Calculate for full load (i) the speed; (ii) the useful torque. 15

Q.3(a) Draw the simplified equivalent circuit of a loaded transformer looking from secondary side. Also draw the phasor diagram of the transformer operating at lagging power factor of 0.8. 10

(b) Explain- why the transformer is rated in KVA? 05

(c) A simple power system contains a 480V generator connected to an ideal 1:10 step-up transformer, a transmission line, an ideal 20:1 step-down transformer and a load. The impedance of the transmission line is (20+j60) Ω and the impedance of the load is 10 30^0Ω. The base values for this system are chosen to be 480V and 10KVA at the generator. 20

i) Find the base voltage, current, impedance and apparent power at every point in the power system.
ii) Convert this system to its per-unit equivalent circuit.
iii) Find the power supplied to the load in this system.
iv) Find the power lost in the transmission line.

Q.4(a) What is armature reaction? How does it effect operation of dc generator? 10

(b) Write down the advantages and disadvantages of 3-φ transformer over 1- φ transformer. 05

(c) The open-circuit characteristics of a dc shunt generator driven at rated speed is as follows: 20

Filed Amperes (A)	0.5	1.0	1.5	2.0	2.5	3.0	3.5
Induced Voltage (V)	60	120	138	145	149	151	152

If the resistance of field circuited is adjusted to 53Ω, calculate the open circuit voltage and load current when the terminal voltage is 100V. Neglect armature reaction and assume an armature resistance of 0.1Ω.

Section-B

Q.5(a) Explain the causes of using stationary armature windings in alternators. 08

(b) Draw the phasor diagram of alternator with inductive load. 07

(c) The stator of a 3-φ alternator has 9 slots per pole and carries a balanced 3-φ, double layer winding. The coils are short-pitched and the coil pitch is 7 slots. Find the distribution factor and pitch factor. 10

(d) Why induction motor is called rotating transformer? Explain why does the rotor of an induction motor rotate? 10

Q.6 (a) How rotating magnetic field of constant magnitude is established in 3-φ induction motor, when it is fed from a balanced 3-φ supply? 15

(b) Derive the condition for maximum starting torque of an induction motor. 10

(c) A 50Hz, 4pole, 3-φ induction motor has a rotor current of frequency 2Hz. Determine (i) the slip and (ii) speed of the motor. 10

Q.7(a) Describe about the armature reaction in alternator for the following conditions: 15

i) When load p.f. is unity
ii) When load p.f. is lagging
iii) When load p.f. is leading

(b) Why 1-φ induction motor is not self-starting? – Explain 05

(c) Prove that, a rotating magnetic field is produced by 2-φ supply. (with appropriate vector diagram) 15

Q.8(a) Explain the process of making self-starting synchronous motor. 08

(b) Explain the effect of change in excitation at constant load of synchronous motor for the following condition. 15

i) Under excitation
ii) Normal excitation
iii) Over excitation

(c) A 208V, star connected, 3-phase synchronous motor has a synchronous reactance of 4Ω/phase and negligible armature winding resistance. At a certain load, the motor takes 7.2kW at 0.8 pf lagging. If the power developed by the motor remains the same while the excitation voltage is increased by 50% by raising the field excitation, determine 12

(i) The new armature current
(ii) The power factor

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