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B.Sc. Engg. (EE)/HDEE, 3rd Sem., B.Sc.TE (2-Yr), 1st Sem. Date: May 05, 2015 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: Math 4301
Course Title: Mathematics III

Winter Semester, A. Y. 2014-2015
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Find the following: 15

(i) $L\{t\sin kt\}$, (ii) $L^{-1}\left\{\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right\}$ and

(iii) $L\{G(t)\}$ where $G(t)=\begin{cases}\sin\left(t-\frac{\pi}{3}\right), & t>\frac{\pi}{3}\\ 0, & t<\frac{\pi}{3}\end{cases}$

b) Solve for $Y(t)$ given that $\int_0^t \frac{Y(u)}{\sqrt{t-u}}du = 1+t+t^2$. 10

2. a) Using Laplace transform find the solution of the boundary value problem: 15

$$\frac{\partial U}{\partial t}=\frac{\partial^2 U}{\partial x^2} \text{ with } U(x,0)=3\sin 2\pi x,\ U(0,t)=0,\ U(1,t)=0,\ t>0.$$

b) Evaluate the integral: $\int_0^\infty \frac{\sin tx}{\sqrt{x}}dx$ by Laplace transform. 10

3. a) An inductor of 2 henrys, a resistor of 16 ohms and a capacitor of 0.02 farads are connected in series with an e.m. f of E volts. At $t = 0$ the charge on the capacitor and current in the circuit are zero. Find the charge and current at any time $t > 0$ if $E = 100\sin 3t$ (volts). 15

b) Find the general solution of $Y''(t)+K^2Y(t)=F(t)$. 10

4. a) If $\underline{a}=(1,1,1)$, $\underline{b}=(2,-1,3)$, $\underline{c}=(1,-1,0)$, $\underline{d}=(6,2,3)$ then express $\underline{d}$ in terms of $\underline{a}\times\underline{b}$, $\underline{b}\times\underline{c}$, $\underline{c}\times\underline{a}$. 15

b) Examine whether $\underline{F}=(2xz^3+6y)\underline{i}+(6x-2yz)\underline{j}+(3x^2z^2-y^2)\underline{k}$ is irrotational. If so find a scalar function $\phi(x, y, z)$ such that $\nabla\phi=\underline{F}$. Also find the work done by it from (1, –1, 1) to (2, 1, –1). 10

5. a) Define directional derivative of a scalar point function and give its interpretation. Find the directional derivative of a function $\phi(x, y, z) = xy^2 + yz^2 + zx^2$ along the tangent to the curve $x = t$, $y = t^2$, $z = t^3$ at (1, 1, 1). 15

b) If a force field $\underline{F} = 2x^2y\underline{i} + 3xy\underline{j}$ displaces a particle in the xy plane form $(0, 0)$ to $(1, 4)$ along $y = 4x^2$, then find $\int_C \underline{F}.d\underline{r}$.

6. State and prove Gauss' divergence theorem and hence verify this theorem for $\underline{F} = 2x^2y\underline{i} - y^2\underline{j} + 4xz^2\underline{k}$ taken over the region in the first octant bounded by $y^2 + z^2 = 9$ and $x = 2$.

7. a) Define the co-efficient of correlation. Write down their important properties. Prove that the co-efficient of correlation is unaffected by the change of origin and scale. Find the correlation co-efficient between age and playing habits of the following students and make a comment.

Age:	15	16	17	18	19	20
No of Students:	250	200	150	120	100	80
Regular Players:	200	150	90	48	30	12

b) Explain the procedure generally followed in testing of hypothesis. Intelligence test given to two groups of boys A and B gave the following information:

	Mean score	S.D.	Number
Group A:	75	10	50
Group B:	70	12	100

8. a) Explain the concept of regression. Arrange in the tabular form the differences between correlation and regression. Find the most likely production corresponding to a rainfall of 40" from the following data.

	Rainfall	Production
Average:	30"	50 quintals
S. D:	5"	10 quintals

and given that $\underline{r} = 0.8$.

b) The means of two random samples of sizes 9 and 7 are 196.42 and 198.82 respectively. The sum of squares of the deviations from the mean are 26.94 and 18 73 respectively. Can the sample be considered to have been drawn from the same normal population? Test the hypothesis at 5% given that the critical value at 5% for 14 d.f. is 2.145.

c) Define Binomial and Poisson distribution. Out of 800 families having 4 children each, what percentage would be expected to have (i) 2 boys and 2 girls, (ii) at least one boy and (iii) at most 2 girls?

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Date: May 07, 2015 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4305
Course Title: Electrical Machines I

Winter Semester, A. Y. 2014-2015
Time: 3 Hours
Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Use suitable assumptions if necessary.

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1. a) Briefly explain the basic operation of a single loop generator. [5]

   b) Derive the equation of the induced EMF of a DC generator. [5]

   c) Classify DC generator with diagram. [5]

   d) The magnetization characteristic for a 4-pole, 110 V, 1000 rpm shunt generator is as follows: [10]

Field current (A)	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6
O.C. voltage (V)	30	55	75	90	100	110	115	120

   Armature is lap-connected with 144 conductors. Field resistance is 100 Ω.

   Determine:

   (i) the voltage that machine will build up at no-load,

   (ii) the critical resistance,

   (iii) resistance to induce 115 V on open circuit and

   (iv) residual flux per pole.

2. a) Explain armature reaction of DC generator with neat diagram. [10]

   b) Draw a developed diagram of a simple 2-layer lap winding for a 4-pole generator with 256 conductors with 16 slots. Hence point out the characteristic of the lap winding. [15]

3. a) Derive the equation of armature torque and the shaft torque of DC motor. [3+3]

   b) Explain the speed control of DC motor controlling the flux in the machine. [10]

   c) With neat diagram and necessary equations explain the dynamic braking of DC motor. [9]

4. a) Derive the terminal characteristics of DC shunt motor. [5]

   b) Derive the condition for maximum power of DC motor. Is it practically feasible? Explain. [5+2]

   c) A 4-pole, 240 V, wave connected shunt motor gives 11.19 kW when running at 1000 rpm and drawing armature and field currents of 50 A and 1.0 A, respectively. It has 540 conductors. Its resistance is 0.1 Ω. Assuming a drop of 1 volt per brush, find: [13]

   (i) total torque,
   (ii) useful torque,
   (iii) useful flux/pole,
   (iv) rotational losses and
   (v) efficiency.

5. a) Write down the application of the transformer.

b) Explain the basic operating principle of ideal transformer with neat diagram and equations.

c) What are the equivalent circuit components of a transformer? With necessary equations, explain the exact and approximate equivalent circuit of transformer in detail.

6. a) With necessary equations discuss the impedance transformation of a load through transformer.

b) Explain with suitable diagrams the components of the primary current of a loaded transformer.

c) A 13.2-kV single-phase generator supplies power to a load through a transmission line. The load's impedance is $Z_{load} = 500\angle 36.87^{\circ}\Omega$, and the transmission line's impedance is $Z_{line} = 60\angle 60^{\circ}\Omega$.

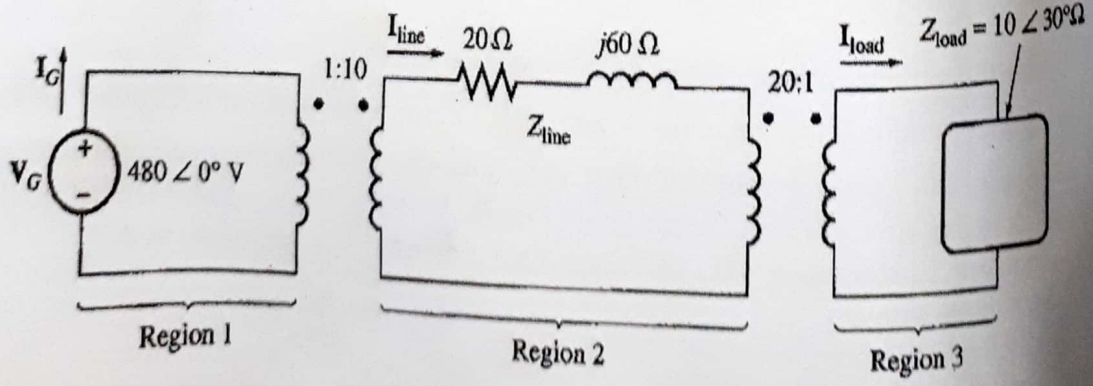
(i) If the generator is directly connected to the load, what is the ratio of the load voltage to the generated voltage? What are the transmission losses of the system?

(ii) If a 1:10 step-up transformer is placed at the output of the generator and a 10:1 transformer is placed at the load end of the transmission line, what is the new ratio of the load voltage to the generated voltage? What are the transmission losses of the system now? (Note: The transformers may be assumed to be ideal.)

7. a) What are the differences between the ideal and real transformer?

b) What is the application of parallel operation of transformer? Write down the conditions of parallel operation of transformer.

c) A simple power system is shown below. This system contains a 480 V 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 + j60Ω, and the impedance of the load is $10\angle 30^{\circ}\Omega$. The base values for this system are chosen to be 480V and 10kVA at the generator.



(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.

8. a) Explain the operation of auto-transformer. Discuss on the apparent power advantage of the auto-transformer. [7+3]

b) A 1000 VA 230/115 V transformer has been tested to determine its equivalent circuit. The results of the tests are shown below. [15]

Open-circuit test	Short-circuit test
$V_{OC} = 230$ V	$V_{SC} = 19.1$ V
$I_{OC} = 0.45$ A	$I_{SC} = 8.7$ A
$P_{OC} = 30$ W	$P_{SC} = 42.3$ W

All data given were taken from the primary side of the transformer.

(i) Find the equivalent circuit of this transformer referred to the low-voltage side of the transformer.

(ii) Find the transformer's voltage regulation at rated conditions and (1) 0.8 PF lagging, (2) 1.0 PF, (3) 0.8 PF leading.

(iii) Determine the transformer's efficiency at rated conditions and 0.8 PF lagging.

B.Sc. Engg. (EE)/HDEE, 3rd Sem. 111

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Date: May 10, 2015 (Morning)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4307
Course Title: Digital Electronics

Winter Semester, A. Y. 2014-2015
Time: 3 Hours
Full Marks: 200

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

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1. a) Using r's complement, ('r' represents the base) perform the subtraction operation of **(i)** and **(ii)** 10.5

(i) $(46894)_{10} - (1883)_{10}$ **(ii)** $(01100101)_2 - (11101000)_2$

(iii) Convert binary 110101 to Gray code.

b) (i) Find the complement of $F = py + yz$; then show that $F.F' = 0$ and $F + F' = 1$. 10.5
(ii) Show that the dual of the exclusive-OR is equal to its complement.

c) Assume an arbitrary number system having a base of *5* and *0, 1, 2, X* and *Y* as its independent digits. Determine: $12\frac{1}{3}$

(i) The decimal equivalent of *(12XY . X1)*.

(ii) The total number of possible three-digit combinations in this arbitrary number system.

2. a) NAND and NOR gates can be defined as Universal gate. How? 8

b) Design a combinational circuit with three inputs and one output. The output is equal to logic-1 when the binary value of the input is less than 3. The output is logic-0 otherwise. 9

c) Construct an 8-bit parallel adder using 8 "full-adder" circuits. What is the draw-back of using this parallel adder? Design the 8-bit parallel adder using look-ahead carry generator. Show all the necessary Boolean expressions and logic diagrams. $16\frac{1}{3}$

3. a) Construct a *D* flip-flop using NOR gates only. Show the characteristic table. 7

b) Analyze the circuit of the Fig. 3(b) and prove that it is equivalent to a T flip-flop. $10\frac{1}{3}$

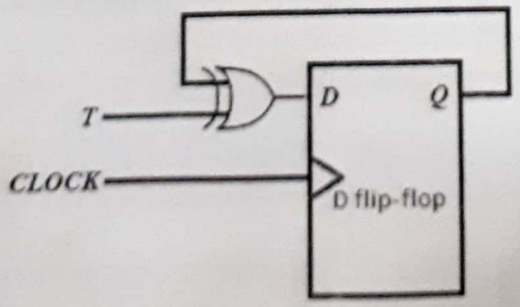

Fig. 3(b)

c) Design a sequential circuit with two *D* flip-flops: A and B, and two inputs: E and x. If E = 0, the circuit remains in the same state regardless of the value of x. When E = 1 and x = 1, the circuit goes through the state transitions from 00 to 01 to 11 to 10 back to 00, and repeats. When E = 1 and x = 0, the circuit goes through the state transition from 00 to 11 to 10 to 01 back to 00, and repeats.

4. a) Show the operation of a basic flip-flop circuit.

b) Draw the logic diagram of a master-slave flip-flop.

c) For a positive edge-triggered *J-K* flip-flop with inputs as shown in the Fig. 4(c), determine the Q output relative to the clock. Assume Q starts LOW.

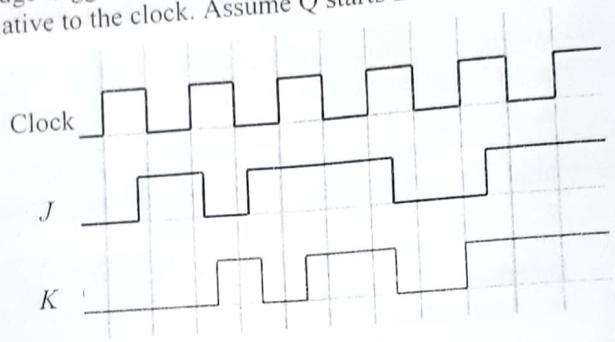

Fig. 4(c)

5. a) (i) Reduce the following state table to a minimum number of states

Present State	Next State		Output	
	x = 0	*x = 1*	*x = 0*	*x = 1*
a	*a*	*e*	1	0
b	*c*	*f*	0	0
c	*b*	*h*	0	0
d	*e*	*f*	0	0
e	*d*	*a*	0	0
f	*b*	*f*	1	0
g	*d*	*h*	0	0
h	*h*	*g*	1	0

(ii) You are given two identical sequential circuits which realize the state table of (i). One circuit is initially in state *b* and the other circuit is initially in state *g*. Specify an input sequence of length three which could be used to distinguish between the two circuits and give the corresponding output sequence from each circuit.

b) Given the 8-bit data word 11000100, generate a 13-bit composite word for the Hamming code that corrects single error and detects double error.

6. a) What is the difference between a synchronous counter and an asynchronous counter?

b) Design a 3-bit binary synchronous even counter.

c) Three 4-bit BCD decade counters are connected in cascade. The MSB output of the first counter is fed to the clock input of the second counter, and the MSB output of the second counter is fed to the clock input of the third counter. If the counters are negatively edge triggered and the input clock frequency is 256 kHz, what is the frequency of the waveform available at the **LSB** of the third counter? Show the calculations. $13\frac{1}{3}$

7. a) Define RAM. Show the logic diagram of a single bit memory cell. $13\frac{1}{3}$

b) Draw the block diagram of 1 k× 8 bit RAM showing the number of input lines, output lines, address lines and other necessary pins. Design an 8k× 8 bit RAM using several 1 k× 8 bit RAM block. 20

8. a) Write the steps of converting an analog signal to digital signal. $10\frac{1}{3}$

b) Determine the output of the DAC in Fig. 8(b)(i) if the waveforms representing a sequence of 3-bit numbers in Fig. 8(b)(ii) are applied to the inputs. Input *Do* is the LSB. Draw the output wave shape. 23

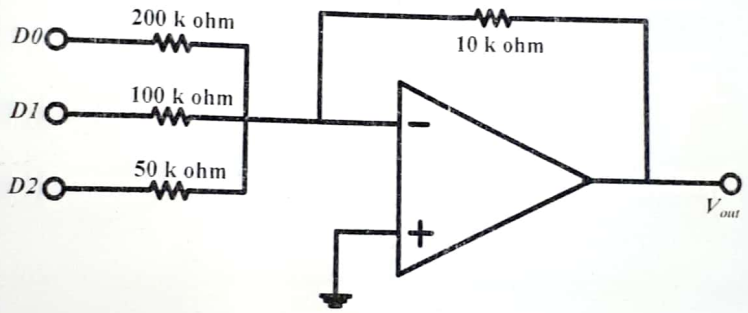

Fig. 8(b)(i)

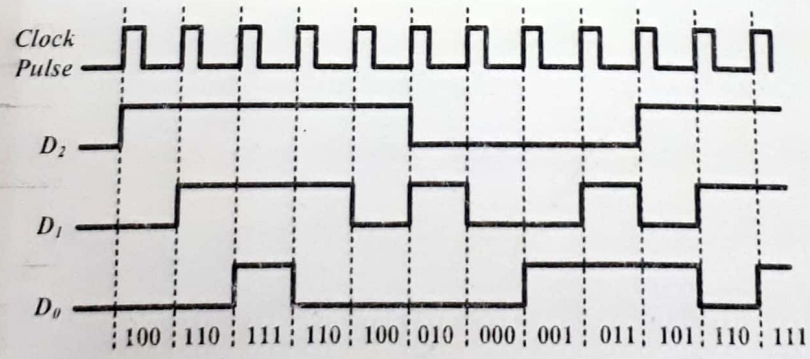

Fig. 8(b)(ii)