7270

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

Date: May 18, (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-IV

Winter Semester: 2015-2016
Full Marks: 150
Time: 3 Hours

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.

---

1. a) Give the physical interpretation of $\underline{a}\times(\underline{b}\times\underline{c})$, $\underline{b}\times(\underline{c}\times\underline{a})$, $\underline{c}\times(\underline{a}\times\underline{b})$. 15

If $\underline{a}$, $\underline{b}$, $\underline{c}$ are three vectors such that $\underline{a}\times(\underline{b}\times\underline{c})=\frac{1}{2}\underline{b}$ then find the angles that $\underline{a}$ makes with $\underline{b}$ and $\underline{c}$ but $\underline{b}$ and $\underline{c}$ non-parallel.

b) What do you understand by ∇f, $\nabla.\underline{F}$ and $\nabla\times\underline{F}$? 10

Given $\underline{V}=\left(x^2-y^2+2xz\right)i+\left(xz-xy+yz\right)j+\left(z^2+x^2\right)k$, find curl $\underline{V}$ and examine whether the vectors given by curl $\underline{V}$ at $p_0(1, 2, -3)$ and $p_1(2, 3, 12)$ are orthogonal.

2. a) Define line integral and surface integral and derive their respective formula. 15

If $\underline{F}=3xyi-y^2j$ then find $\int_C \underline{F}.d\underline{r}$ where 'C' is the curve $y=2x^2$ in the xy-plane from $(0, 0)$ to $(1, 2)$.

b) Evaluate $\iint_S \underline{F}.\hat{n}ds$ where $\underline{F}=zi+xj+3y^2zk$, and S is the surface of the cylinder $x^2+y^2=16$ included in the first octant between $z=0$, $z=5$. 10

3. State and prove Gauss' divergence theorem and hence verify the theorem for $\underline{F}=4xi-2y^2j+z^2k$ where S is the surface bounded by $x^2+y^2=4$, $z=0$ and $z=3$. 25

4. a) Find the following (i) $L\{t^{10}e^{-kt}\}$ (ii) $L^{-1}\left\{\frac{5s+3}{(s-3)(s^2+2s+5)}\right\}$ 15

(iii) $L\{G(t)\}$ where $G(t)=\begin{cases}\sin\left(t-\frac{\pi}{6}\right), & t>\frac{\pi}{6}\\ 0, & t<\frac{\pi}{6}\end{cases}$

b) Solve for $Y(t)$ from the integro-differential equation: $\int_0^t Y'(u)Y(t-u)du=24t^3$ with $Y(0)=0$. 10

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

$$\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial x^2} \text{ with } U(x, 0) = 6\sin 2\pi x,\ U(0, t) = 0,\ U(1, t) = 0,\ t > 0.$$

b) Evaluate the integral: $\int_{-\infty}^{\infty} \frac{x \sin tx}{x^2 + a^2} dx$ by Laplace transform.

6. a) Explain the meaning and significance of the term 'correlation'. Show that,
(i) Co-efficient of correlation 'r' lies between $-1 \le r \le 1$.
(ii) Correlation co-efficient 'r' is independent of the change of origin and scale.
You are given the following data of marks obtained by 11 students in statistics on two tests, one before and the other after special coaching:

First test (before coaching):	23	20	19	21	18	20	18	17	23	16	19
Second test (after coaching):	24	19	21	18	20	22	20	20	23	20	27

Do the marks indicate that the special coaching has benefited the students? (Given that at 5% for $\nu = 10$ d.f. the chart value is 2.22).

b) Five coins tossed 3200 times and the number of heads appearing each time was noted. At the end, the following results were obtained:

No. of heads:	0	1	2	3	4	5
Frequency:	80	570	1100	900	500	50

Fit the data to Binomial distribution and test the goodness of fit at 5%. (The critical value at 5% for $\nu = 5$ is 11.07).

7. a) Explain the procedure generally followed in testing of a hypothesis. Two types of new cars produced in Japan were tested for petrol mileage. One group consisting of 36 cars averaged 14 kms. per litre with $\sigma_1^2 = 1.5$ while the other group consisting of 72 cars averaged 12.5 kms per litre with $\sigma_2^2 = 2.0$. Test whether there is a significant difference in the petrol consumption of these two type of cars. Use 1% level of significance.

b) Distinguish differences between correlation and regression analysis and point out their role in business. The following figures related to the length of service and income of the employees of an organization:

Length of service: (Yrs.) X:	11	7	2	5	8	6	10
Income (Tk. in thousand) Y:	7	5	3	2	6	4	8

Find the two regression equations and examine the relationship.

8. a) Define conditional probability, independent and dependent events, mutually exclusive events and mathematical expectation with examples.
A bag contains 2 white and 3 black marbles. Four persons A, B, C, D in the order named, draws one marble and does not replace it. The first to draw a white marble receives $100. Determine their expectation.

7492

b) In certain town 10 accidents took place in a span of 50 days. Assuming that the number of accidents per day follows Poisson distribution, find the probability that there will be three or more accidents in a day. 10

c) Write short notes on: 05
   i) Sample and population,
   ii) one tailed and two tailed tests and
   iii) estimation of parameters.

7224

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

Date: May 20, 2016 (Morning)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4303
Course Title: Electronics II

Winter Semester, A. Y. 2015-2016
Time: 3 Hours
Full Marks: 150

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

1. a) Draw an op-amp summing amplifier for three inputs and show that the output will be equal to the sum of the three inputs.

   b) Draw an op-amp differentiator circuit and derive its output equation.

2. a) Sketch the basic construction of depletion type MOSFET and describe its basic operation and characteristics.

   b) Draw the circuit of a CMOS and describe its operation.

3. a) Discuss the characteristics of an ideal op-amp. How practical op-amp characteristics differ from ideal one?

   b) Draw an op-amp bi-stable multi-vibrator circuit and describe its operation.

4. a) Discuss the advantages of negative feedback in an amplifier.

   b) An amplifier without any feedback has a gain of -1000. Its gain changes by 20% due to temperature. If this amplifier is now provided with a negative feedback of $\beta = 0.1$, calculate the change in gain of this feedback amplifier.

5. For an op-amp RC-phase shift oscillator, show that
   i) frequency of oscillation is given by $1/(2\pi RC\sqrt{6})$ and
   ii) gain of the amplifier should be ≥ 29.

6. a) Implement a mono-stable multi-vibrator using a 555 IC timer so that it will be in the quasi-stable state for 11 μs.

   b) Implement an astable multi-vibrator using a 555 IC timer so that it will oscillate at 100 kHz with 50% duty cycle.

7. a) Draw a comparator circuit that will give a high output if the input is more than or equal to 5 V. Explain how the circuit operates.

b) Figure 7 (b) depicts a window comparator. The op-amp is using a supply of ±15 V. Find the upper trip point (UTP) and the lower trip point (LTP) for this window comparator.

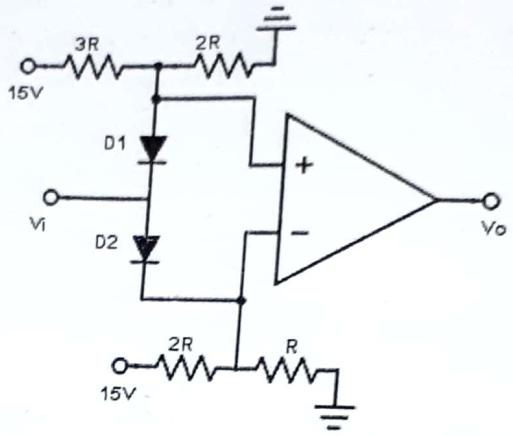

Fig. (b)

8. a) What is *hysteresis* in Schmitt trigger? What advantages does it have?

b) How can we get square wave from a triangular wave and vice-versa?

B.Sc. Engg. (EE)/HDEE, 3rd Sem. 726

Date: May 12, 2016 (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. 2015-2016
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.

---

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

b) The magnetization characteristic for a 4-pole, 110 V, 1000 rpm of a 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.

c) The following information is given for a 4 pole, lap wound short shunt generator: [5]
$E_g = 230$ V, $I_a = 50$ A, $I_{sh} = 5$ A, $V = 200$ V, $R_a = 0.3$ Ω. Find R_{sh}, R_{se} and R_L.

d) A long-shunt generator delivers 50 A at 500 V and the resistances of the series field, shunt field and the armature are 0.03 Ω, 250 Ω and 0.05 Ω respectively. Calculate the generated E.M.F. [5]

2. a) What is lost torque? [2]

b) Derive the terminal characteristics of a DC series motor and hence explain why a series motor cannot be started under unloaded condition. [5+2]

c) A 100 hp, 250 V, 350 A D.C. shunt motor has an armature resistance of 0.05 Ω. It is desired to design a starter circuit for this motor which will limit the maximum starting current to twice its rated value and which will switch out sections of resistance as the armature current falls to its rated value. [7+2+7]

(i) Derive the formula for calculating the number of stages.

(ii) How many stages of resistance will be required to limit the current to the range specified?

(iii) What should be the value of each segment resistor? At what voltage each segment of resistance be cut out?

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

b) Explain the speed control of DC shunt motor controlling the applied voltage in the machine.

c) With a neat diagram and necessary equations explain the reverse current or plugging braking of DC shunt motor.

d) Briefly discuss the speed control of DC series motor.

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

b) Explain with suitable diagrams the components of the primary current of a loaded transformer (with different types of load).

c) Discuss the basic difference between power system transformers and instrumentation transformers.

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

5. a) Discuss the advantage of per-unit system in solving circuits containing transformers.

b) A simple power 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 $20 + j60\ \Omega$, and the impedance of the load is $10\angle 30^{0}\ \Omega$. The base values for this system are chosen to be 480 V and 10 kVA 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.

6. a) Briefly explain the principle of auto-transformer.

b) Discuss the importance and conditions of parallel operation of transformers.

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

7. Design a 100 kVA, single phase, 50 Hz. 11000/415 V forced cooled core type transformer. Find: [25]

i. Voltage per turn (Assume K = 0.75),
ii. Cross-sectional area of core,
iii. Cross-sectional area of conductor for low voltage side,
iv. Cross-sectional area of conductor for high voltage side,
v. Number of turns in low voltage winding,
vi. Number of turns in high voltage winding,
vii. Window area,
viii. Yoke and approximate frame size (Assume $B_m = 1.6$ Tesla, $\delta = 2$ A/mm^2 and $k_w = 0.2$) and
ix. Calculate copper used in window area and verify window space factor.

8. a) Write short note on three phase transformer. [5]

b) A 15 kVA, 2300/230 V transformer has been tested to determine its equivalent circuit. The results of the tests are shown below. [20]

Open-circuit test	Short-circuit test
V_{OC} = 2300 V	V_{SC} = 47 V
I_{OC} = 0.21 A	I_{SC} = 6.0 A
P_{OC} = 50 W	P_{SC} = 160 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 at power factor of 0.8 lagging, 1.0 and 0.8 leading.

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

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

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Date: May 16, 2016 (Morning)

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

Winter Semester, A. Y. 2015-2016
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.

---

1. a) Convert the following hexadecimal numbers to binary:
(i) 5716 (ii) F80B16 10

b) Simplify the following functions and implement them with two-level NOR gate circuits; 10
(i) $F = wx' + y'z' + w'yz'$
(ii) $F(w, x, y, z) = \sum(5,6,9,10)$

c) Show that the dual of the exclusive-OR is equal to its complement. $8\frac{1}{3}$

d) The (r-1)'s complement of base-6 numbers is called the 5's complement. 5
(i) Obtain 5's complement of $(543210)_6$
(ii) Perform subtraction operation $(543210)_6 - (553210)_6$ by taking (r-1)'s complement of the subtrahend.

2. a) Design a 4-bit magnitude comparator. 15

b) Design a 4-bit binary number divider which divides four bits by 5 (101 in binary). The output should show the quotient and the remainder in binary form. If the dividend is less than the divisor, the value of the quotient and the remainder are to be shown zero. $18\frac{1}{3}$

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

b) Design a sequential circuit with two D flip-flops, A and B, and one input, x. When x = 0, the state of the circuit remains the same. When x = 1, the circuit goes through the state transition from 00 to 01 to 11 to 10 back to 00, and repeats. $10\frac{1}{3}$

c) Convert a D flip-flop to a JK flip-flop by including input gates to the D flip-flop. The gates needed for the input of the D flip-flop can be determined by means of sequential-circuit design procedures. The sequential circuit to be considered will have one D flip-flop and two inputs, J and K. 16

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

b) Design a synchronous BCD counter with JK flip-flops.

c) For a positive edge-triggered JK flip-flop with inputs as shown in the Fig. 4(c), determine the Q output relative to the clock (CP).

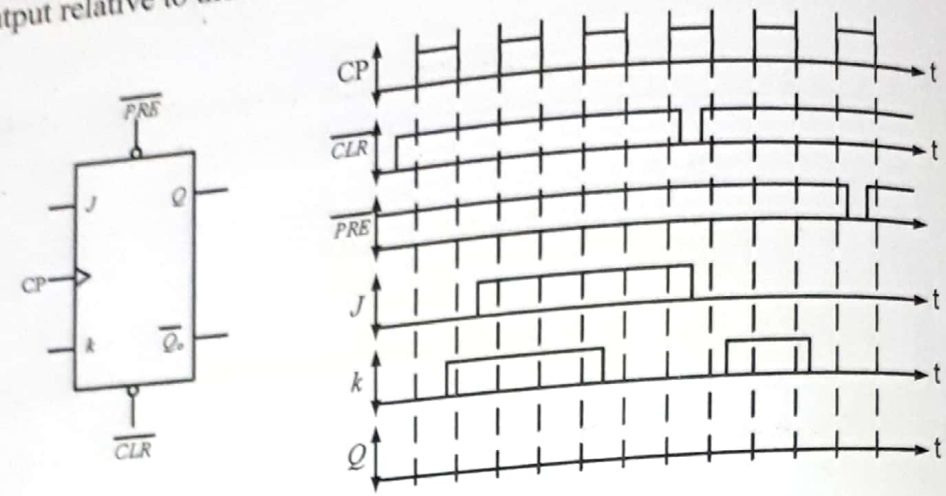

Fig. 4(c)

5. a) A sequential circuit with two D flip-flops, A and B; two inputs, x and y; one output, z, is specified by the following next-state and output equations:

$$A(t+1) = x'y + xA$$
$$B(t+1) = x'B + xA$$
$$z = B$$

i. Draw the logic diagram of the circuit.
ii. Derive the state table.
iii. Derive the state diagram.

b) Derive the state table and the state diagram of the sequential circuit shown in Fig. 5 (b).

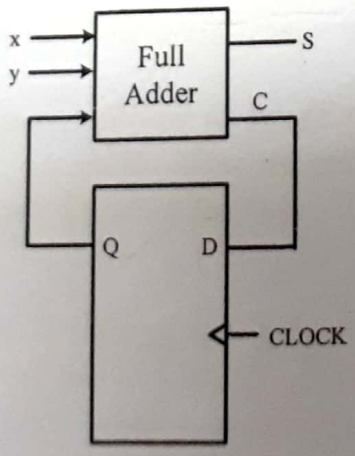

Fig. 5 (b)

6. a) Suppose, you have a 40 kHz signal generator as input. Design a 10 kHz signal generator using D-flip flop.

b) Design a 3-bit binary synchronous odd counter. 158

c) A 4-bit ring counter and a 4-bit Johnson counter are in turn clocked by a 10 MHz clock signal. Determine the frequency of the output flip-flop in the two cases. 10

7. a) Define RAM. Show the logic diagram of a single bit memory cell using J-K flip flop. $10\frac{1}{3}$

b) The following memory units are specified by the number of words times the number of bits per word. How many address lines and input-output data lines are needed in each case: $13\frac{1}{3}$

i. 2 K × 16
ii. 64 K × 8
iii. 16 M × 32
iv. 96 K × 12

c) Design a 4 × 6 bit RAM. You must show the logic diagram, address lines, read/write input, data inputs and data outputs. 8

8. a) Write the steps of converting an analog signal to digital signal. 12

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. $10\frac{1}{3}$

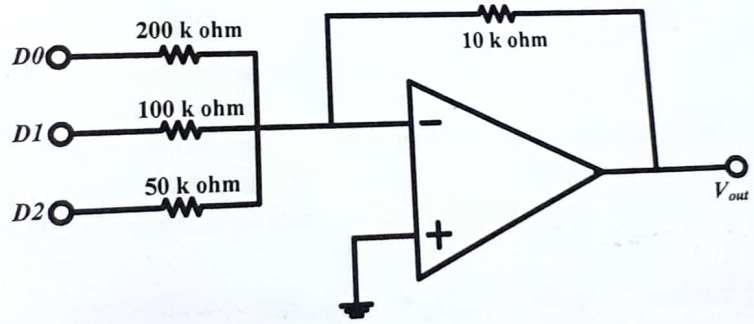

Fig. 8(b)(i) 23

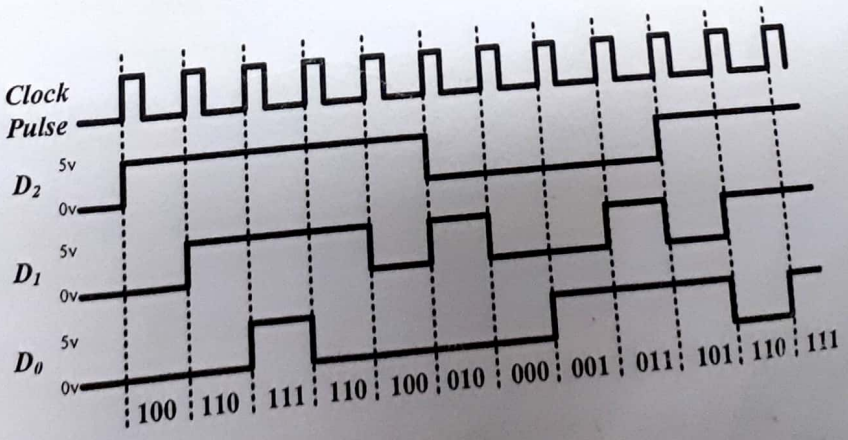

Fig. 8(b)(ii)