

Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Electrical & Electronic Engineering

Final Examination, 2023
 Course No: EEE 701
 Time: 03 (Three) hours

4th year 1st Semester
 Course Title: Solid State Device
 Full Marks: 60

N.B. : (i) Answer any three question from each PART
 (iii) Marks allotted are indicated in the margin

(ii) Use separate answer scripts for each PART
 (iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any **three** questions)

1. (a) Define the following: 04
- Direct Semiconductor
 - Indirect Semiconductor
 - Intrinsic Semiconductor
 - Extrinsic Semiconductor
- (b) Write the Ebers and Moll equations. Sketch and explain the circuit model which satisfies these equations. 06
2. (a) Assume the Fermi energy level is 0.30 eV below the conduction band energy. 06
- (a) Determine the probability of a state being occupied by an electron at E_c .
- (b) Repeat (a) for an energy state at E_c+kT . Assume $T=300K$.
- (b) Find the intrinsic carrier concentration in silicon at 04
- (a) $T= 200 K$
- (b) $T= 400 K$
- Where, for silicon at 300K $N_c=2.8 \times 10^{19}$ and $N_v=1.04 \times 10^{19} (cm^{-3})$
3. (a) Define drift current and diffusion current. Write the equation for drift current. 02+01
- (b) Consider a sample of silicon at $T=300K$ doped at an impurity concentration of $N_d = 1 \times 10^{15} cm^{-3}$ and $N_a = 1 \times 10^{14} cm^{-3}$. Assume electron & hole mobilities are given in Table.1 07
- Calculate the drift current density if the applied electric field is $E = 35 V/cm$.

Table.1

	$\mu_n (cm^2/V - s)$	$\mu_p (cm^2/V - s)$
Silicon	1350	480
Gallium arsenide	8500	400
Germanium	3900	1900

4. (a) Derive the relationship $n_i = \sqrt{N_c N_v} e^{-E_g/2KT}$ where, the symbols have their usual meaning. 06
- (b) Consider a silicon pn junction at $T=300k$ with doping densities $N_a = 1 \times 10^{18} cm^{-3}$ and $N_d = 1 \times 10^{15} cm^{-3}$. Assume that $n_i = 1.5 \times 10^{10} cm^{-3}$. Calculate the built-in potential barrier in a pn junction. 04

PART-B

(Answer any **three** questions)

5. (a) Write short notes on Threshold Voltage and Pinch-off. 03
- (b) Given that $V_p = -6V$ and $I_{DSS} = 12 \text{ mA}$. Draw the drain and transfer characteristics of a n channel JFET. 05
- (c) Calculate the collector-emitter saturation voltage of a bipolar transistor at $T = 300K$. 02
Assume that $\alpha_F = 0.99$, $\alpha_R = 0.20$, $I_c = 1\text{mA}$ and $I_b = 50 \mu\text{A}$.
6. (a) Sketch the transfer function for a n-channel depletion type MOSFET with $I_{DSS} = 12\text{mA}$ and $V_p = -5V$. 06
- (b) Assume that in an n-type gallium arsenide semiconductor at $T=300\text{k}$, the electron concentration varies linearly from 1×10^{18} to $7 \times 10^{17} \text{ cm}^{-3}$ over a distance of 0.10 cm . Calculate the diffusion current density if the electron diffusion coefficient is $D_n = 225 \text{ cm}^2/\text{s}$. 04
7. (a) Draw the Energy-band diagram of a MOS structure under different bias condition. 06
- (b) Define transconductance, drain resistance, and amplification factor of an FET. 04
8. (a) Describe the Hall effect. Explain the Hall effect experiment. What properties of a semiconductor are determined from a Hall effect experiment? 05
- (b) Write the volt-ampere equation for a p-n diode. Explain the meaning of each symbol. Plot the volt-ampere curves for germanium and silicon to the same scale, showing the cutoff value for each. 05

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Final Examination, 2023
Course No: EEE 703
Time: 03 (Three) hours

4th year 1st Semester
Course Title: Microprocessor and Embedded Systems
Full Marks: 60

N.B. : (i) Answer any two questions from each PART
(iii) Marks allotted are indicated in the margin

(ii) Use separate answer scripts for each PART
(iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any **two** questions)

1. (a) Write short notes on: 07
 - I. Static RAM (SRAM)
 - II. Dynamic RAM (DRAM)
- (b) Write down the advantages of microcontroller. Draw the basic block of microcontroller. 08
2. (a) Write down the advantages of microcontroller. Explain IC Fabrication Process Steps with pictorial representation. 07
- (b) What is peripheral? What is interface? Draw the pin diagram of 8255 Programmable Peripheral Interface (PPI) and write down the function of pins. 08
3. (a) Explain the different kinds of instruction sets of 8086 microprocessors. 07
- (b) Explain the addressing modes of 8086 microprocessor with example. 08

PART-B

(Answer any **two** questions)

4. (a) List the 8086-microprocessor minimum and maximum mode signals. How are these models selected? 07
- (b) What happens to the constants of AX, BX, DX register after execution of the following 8086 instruction sequence? 08

<i>i) MOV AX, 510D MOV BX, 10D DIV BX</i>	<i>ii) MOV AX, 2456D MOV BX, 48D MUL BX</i>
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5. (a) Write an assembly language converting upper case to lower case. Explain briefly, what happens when the INTR signal goes high in the 8086? 07
- (b) What are the differences between microprocessor and microcontroller? Discuss about memory interfacing of 8086 microprocessor. 08
6. (a) What is Direct Memory Access (DMA)? Discuss DMA operation. 07
- (b) What is interrupt? Name the different types of interrupt. Explain the operation of 8259 Programmable Interrupt Controller (PIC) with block diagram. 08

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Final Examination, 2023
Course No: EEE 705
Time: 03 (Three) hours

4th Year 1st Semester
Course Title: Power Plant Engineering
Full Marks: 60

N.B. : (i) Answer any two question from each PART (ii) Use separate answer scripts for each PART
 (iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any **two** questions)

1. (a) Draw the schematic arrangement of hydroelectric power plant. Mention the disadvantages of this power station. 05
- (b) Enlist the main factors of selecting site of nuclear power plant. Discuss the operation of nuclear power plant with necessary diagram. 06
- (c) A diesel power plant has one 700 kW and two 500 kW generating units. The fuel consumption is 0.28kg per kWh and the calorific value of fuel is 10000 kcal/kg. The plant capacity factor is 40%. Estimate – 04
 - i. The fuel required for February 2020 and
 - ii. Overall efficiency.
2. (a) A hydro-electric power plant has a reservoir of area 3.2 sq. kilometers and capacity of 7.5×10^6 cubic meter. The effective head of water is 90 meters. The penstock, turbine and generation efficiencies are 95%, 90% and 85% respectively. 05
 - (i) Calculate the total electrical energy that can be generated from the power station.
 - (ii) If a load of 20MW has been supplied for 3 hours, find the fall in reservoir level.
- (b) Discuss the operation of diesel engine and derive the mathematical expression of efficiency. 03+03
- (c) Determine the load factor at which the cost of supplying a unit of electricity from a diesel and from a steam station is the same if the annual fixed and running charges are as follows : 04

Station	Fixed Charges	Running Charges
Diesel	Tk. 800 per kW	Tk. 7 per kWh
Steam	Tk. 2500 per kW	Tk. 3 per kWh
3. (a) Draw the functional block diagram and P-V & T-S diagram of regenerative closed cycle gas turbine with intercooling and re-heating. Also write the name of the processes occurred in this system. 06
- (b) What is mass defect? Determine the energy released due to fissioned of 1g of Uranium. 03
- (c) Define scavenging. Write the comparison of gas engine and gas turbine. 03
- (d) What is the power output of a ${}_{92}\text{U}^{235}$ reactor if it takes 45 days to use up 2.5 kg of fuel? 03
 Given that energy released per fission is 200 MeV and Avogadro's number = 6.023×10^{26} per kilo-mole.

PART-B

(Answer any **two** questions)

4. (a) Discover the main factors need to consider for calculating cost of electrical energy. 04
(b) Describe the desirable characteristics of tariff. 03
(c) Describe diminishing value method. Illustrate the defects of diminishing value method. 04
(d) A power distribution company offered you two different tariffs – (i) A fixed cost of Tk.5000 plus 4.50 taka per unit and (ii) A two part tariff of 100 taka per kW and 6.50 taka per unit. Which one is economical for you if your maximum demand is 5 kW? 04
5. (a) Briefly describe sinking fund method mentioning its advantages and disadvantages. 06
(b) What are the effects of low power factor on generating station? A factory has a maximum load of 350 kW at 0.8 p.f. lagging with an annual consumption of 75000 units. The tariff is 350 taka per kVA of maximum demand plus 4.5 taka per unit. Calculate the flat rate. What will be annual saving of penalty if the p.f is raised to unity or reduced to 0.75? 05
(c) The equipment of in a power station costs 35000000 Taka and has a salvage value of 1500000 Taka at the end of 30 years. If the compound interest is 7% find the depreciation amount after 31years using all the methods. 04
6. (a) Describe the factors affecting load forecasting. 05
(b) Describe different types of combine cycle power plant. Mention the advantages of combine cycle power plant. 05
(c) The capital cost of a power station of 60 MW is 15000 Tk per kW. The annual depreciation charges and liability are 11% and 5% of capital cost respectively. A royalty of 10 Tk per kW per year and 0.5 Tk per kWh generated is to be paid for using the river water for generation. The station has a capacity factor of 50% and load factor of 60%. Annual cost of salaries, maintenance charge etc is Tk. 50.5 crores. If 20% of this expense is also chargeable as fixed charges, calculate the reserve capacity and generation cost in two and three part form. 05

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Final Examination, 2023
 Course No: EEE 715
 Time: 03 (Three) hours

4th year 1st Semester
 Course Title: Power Electronics
 Full Marks: 60

N.B. : (i) Answer any three questions from each PART (ii) Use separate answer scripts for each PART
 (iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)-----N/A-----

PART-A
 (Answer any **three** questions)

1. (a) Discuss the Working principle of Power Diodes. 05
 (b) Describe the AC Harmonic Analysis. 05
2. (a) Match the switch arrangement shown in Fig. 2(a) of List I to the steady state $V - I$ 04
 characteristics of List II. The steady state operating points are shown by large black dots.

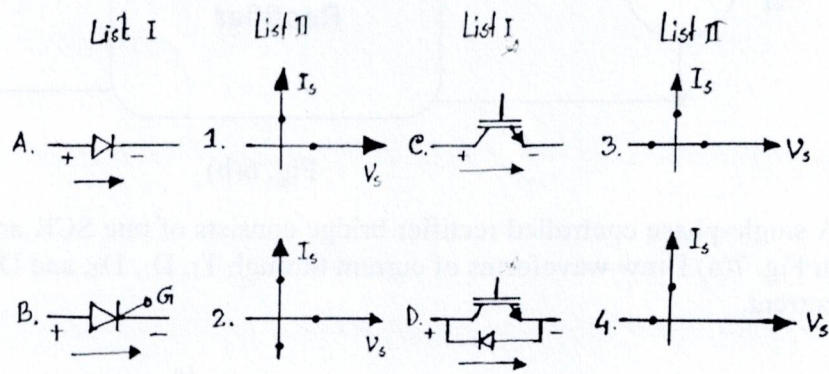


Fig. 2(a)

- (b) How can power losses in the electronic switch be analyzed? 06
3. (a) Design and draw the input and output waveforms of 1ϕ full wave bridge-controlled rectifier. 06
 Also find the following parameters: (i) $V_{0\text{ avg}}$ (ii) t_c (iii) $I_{T\text{ avg}}$ (iv) $I_{T\text{ rms}}$ (v) V_0 (vi) $I_{s1\text{ rms}}$ (vii) THD
- (b) Define Latching current and Holding current. A thyristor carries a current as shown in Fig. 04
 3(b) and the current pulse is repeated at a frequency of $f_s = 50\text{ Hz}$. Determine the average on-state current I_T .

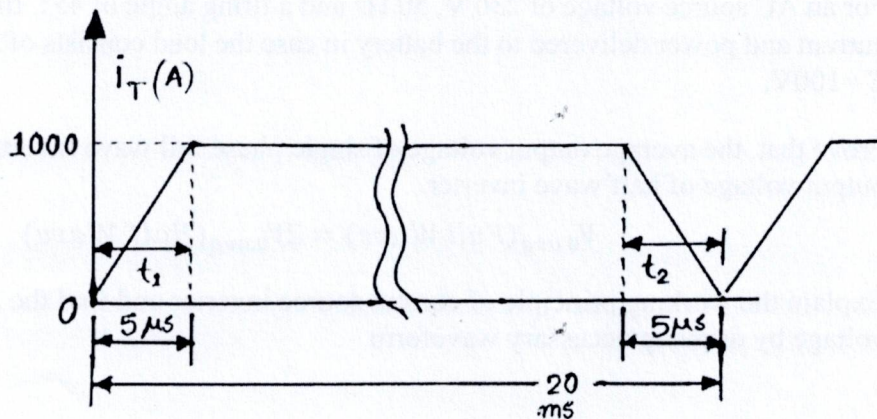


Fig. 3(b)

4. (a) What is converter? What are the types of DC-DC converter? Which type is better? Why? 05
- (b) Show that a BUCK BOOST converter can be used both for step up and step down operation 05
 by deriving proper input output relations.

PART-B

(Answer any **three** questions)

5. (a) What is IGBT ? Described the Transfer Characteristics of IGBT. 05
 (b) Discuss the Operation of Power MOSFET. 05
6. (a) Described the Characteristics of Thyristor. 05
 (b) A single-phase half-wave controlled rectifier, as shown in the figure below, is driving a separately excited DC motor. The DC motor has a back EMF constant of 0.3 V/rpm. The armature current is 4 A without any ripple. The armature resistance is 3 Ω. The converter operates from a 220V, single-phase AC source with a firing angle of 45°. Under these operating conditions, find the speed of the motor. 05

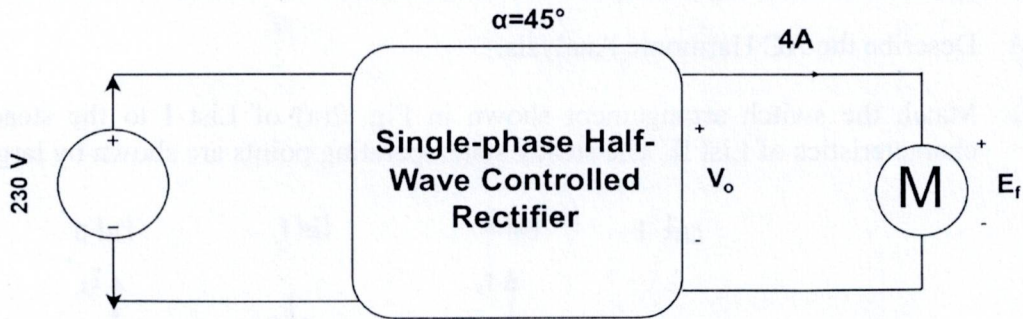


Fig. 6(b)

7. (a) A single-phase controlled rectifier bridge consists of one SCR and three diodes as shown in Fig. 7(a) Draw waveforms of current through T_1 , D_1 , D_2 , and D_3 assuming constant load current. 05

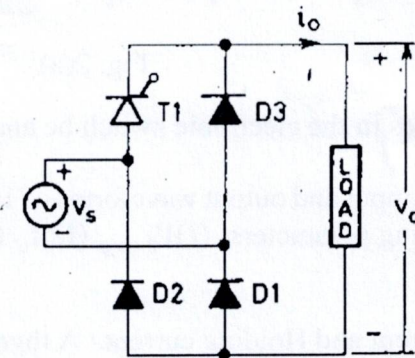


Fig. 7(a)

- (b) For an AC source voltage of 230 V, 50 Hz and a firing angle of 45°, find the average output current and power delivered to the battery in case the load consists of $R = 5\Omega$, $L=8mH$, and $E = 100V$. 05
8. (a) Prove that, the average output voltage of single phase full wave Inverter is twice of average output voltage of half wave inverter. 05
- $$V_{0,avg}(Full\ Wave) = 2V_{0,avg}(Half\ Wave)$$
- (b) Explain the working principle of current source inverter and find the average output voltage by drawing necessary waveform. 05

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Final Examination, 2023
Course No: EEE 723
Time: 03 (Three) hours

4th year 1st Semester
Course Title: Renewable Energy
Full Marks: 60

N.B. : (i) Answer any three questions from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any **three** questions)

1. (a) What is Albedo? 02
(b) What are the factors which affect the amount of solar radiation reaching a surface? 03
(c) Evaluate the extraterrestrial solar radiation on January 1, June 22 and December 1. 05
2. (a) What maximum wavelength can a photon have to create hole–electron pairs in silicon? What minimum frequency is that? Silicon has a band gap of 1.12 eV. 03
(b) Disadvantages of Concentrating Collectors over Flat Plate Type Collectors. 03
(c) What are Solar Collectors? and discuss classification of Collectors. 04
3. (a) Explain Flat Plate Collector's Construction. 05
(b) Discuss the Grid interactive PV systems. 05
4. (a) What is Cell efficiency & Fill Factor. 04
(b) Consider a 100-cm² photovoltaic cell with reverse saturation current $I_0 = 10^{-12}$ A/cm². In full sun, it produces a short-circuit current of 40 mA/cm² at 25°C. Find the open-circuit voltage at full sun and again for 50% sunlight. Plot the results. 06

PART-B

(Answer any **three** questions)

5. (a) What is the Principles of Maximum Power Point Trackers ? 03
(b) Discuss the Standalone PV system. 03
(c) Discuss the types of Inverters and classification. 04
6. (a) What is Wind Energy? 02
(b) If the diameter of a wind turbine to generate 4KW at a wind speed of 7 m/s and a rotor speed of 120 RPM. Assume a power coefficient of 0.4, efficiency of mechanical transmission of 0.9 and efficiency of generator 0.95. 04
(c) Discuss the types of wind turbines. 04
7. (a) How fast does a big wind turbine turns? A 40-m diameter (D), three bladed wind turbine produces 600 KW at a wind speed of 14 m/s, Air density is the standard 1.1225 kg/m³. Under these conditions,
a) At what rpm does the rotor turn when it operates with a TSR of 4.0?
b) What is the tip speed of the rotor?
c) If the generator needs to turn at 1800 rpm, what gear ratio is needed to match the rotor speed to the generator speed?
d) What is the efficiency of the complete wind turbine (blades, gear box, generator) under these conditions? 06
(b) Discuss the Operation of wind Machines 04
8. (a) Briefly discuss the Grid connected Wind Turbine systems. 05
(b) Explain the effects of Wind Generator on the Grid with the help of a simple equivalent circuit and a Phasor diagram. 05