

# KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

*Department of Mechanical Engineering*  
B. Sc. Engineering 2<sup>nd</sup> Year 1<sup>st</sup> Term Examination, 2022

**EE 2105**  
(Electronics)

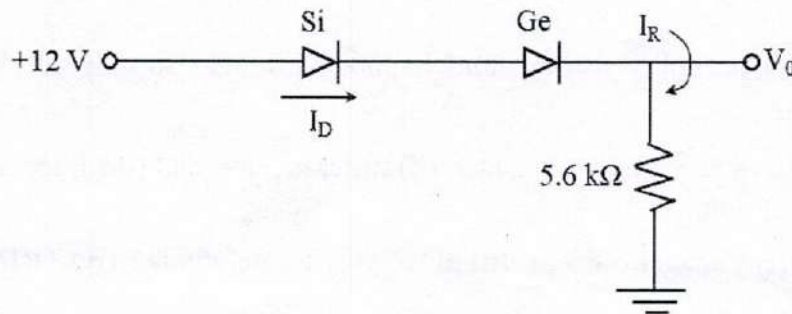
Time: 3 Hours

Total Marks: 210

- N.B.:** i) Answer any THREE questions from each section in separate scripts.  
ii) Figures in the right margin indicate full marks.  
iii) Assume reasonable data if any missing.

## SECTION-A

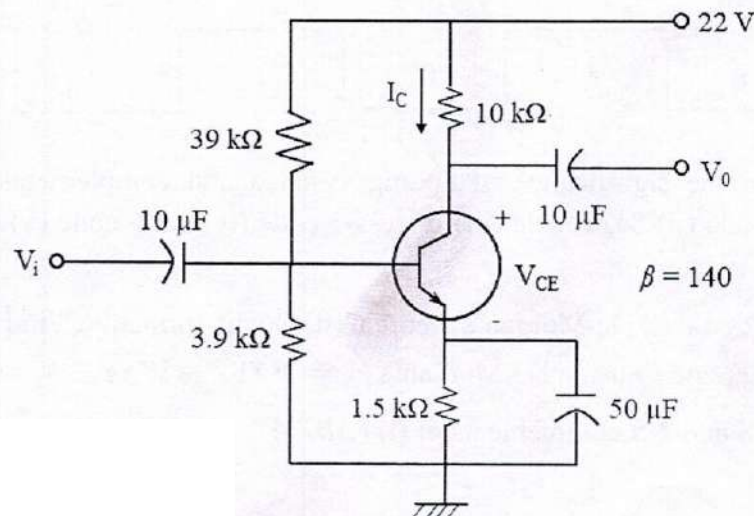
- 1(a) Why p-n junction is used as a rectifier? Explain the effects of forward and reverse biasing on the depletion layer of p-n junction with neat sketch. 08
- 1(b) Draw the circuit diagram of different full-wave rectifier. Also, find out the expression of their efficiency and ripple factor. 12
- 1(c) "A Zener diode can act as a voltage stabilizer"- Justify your answer with necessary diagrams. 08
- 1(d) Determine  $V_O$  and  $I_D$  for the series circuit of the following figure. 07



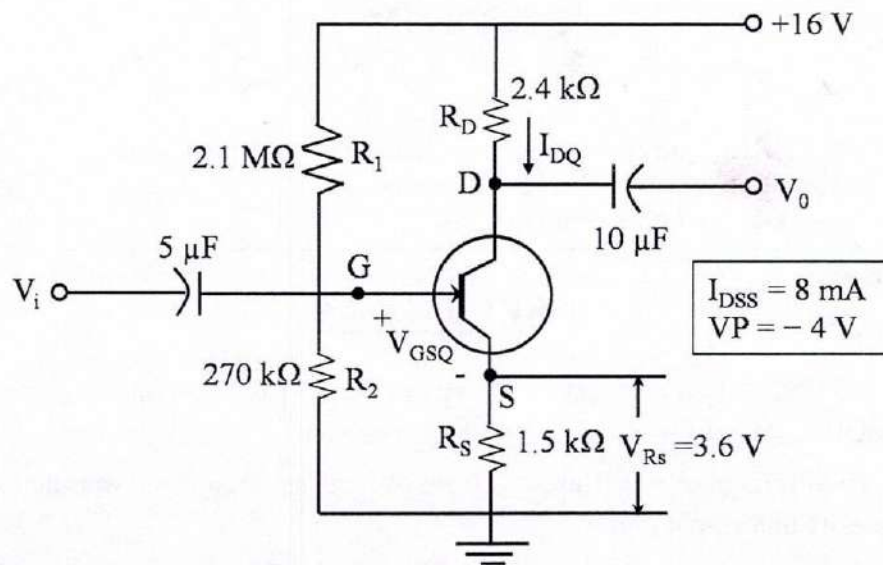
- 2(a) Define faithful amplification. Explain the requirements of faithful amplification with proper schematics. 08
- 2(b) Explain transistor biasing. Briefly explain different operating regions of transistor. Why mid-point biasing is good for an amplifier? 10
- 2(c) For an n-p-n transistor, show that 10

$$(i) \beta = \frac{\alpha}{1 - \alpha} \quad (ii) I_C = \frac{\alpha}{1 - \alpha} I_B + \frac{I_{CBO}}{1 - \alpha} \quad \text{and} \quad (iii) S = \frac{\beta + 1}{1 - \beta \frac{dI_B}{dI_C}}$$

- 2(d) Determine the dc bias voltage  $V_{CE}$  and the current  $I_C$  for the voltage-divider configuration of the following figure. 07



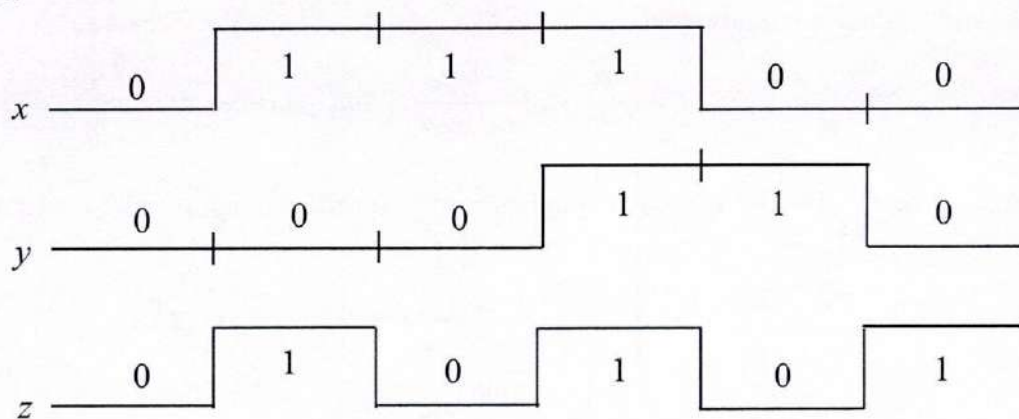
- 3(a) Explain the operating characteristics of a JFET for (i)  $V_{GS} = 0\text{ V}$  and (ii)  $V_{GS} < 0\text{ V}$ . Also define pinch of voltage. 12
- 3(b) For the network shown in figure, determine (i)  $V_{GSQ}$ , (ii)  $I_{DQ}$ , (iii)  $V_D$  & (iv)  $V_{DS}$ . 13



- 3(c) “Enhancement type MOSFET is a normally off device”– Justify this statement. 10
- 4(a) What is meant by controlled rectification? Explain SCR and also show its characteristics curve. 10
- 4(b) How an OP-amp can be used as (i) adder, (ii) differentiator, and (iii) Integrator? Explain with associated circuit. 12
- 4(c) Briefly explain (i) Varactor diode, (ii) uJT, (iii) Tunnel diode, (iv) TRIAC. 13

## SECTION-B

- 5(a) Why using of digital electronics are more superior to analog electronics? Perform the following (i) NAND (ii) NOR (iii) EX-OR for the following input signal as shown in figure. 09



- 5(b) Briefly explain the significance of coding systems and complements. Also, explain (i) Hamming code (ii) 8421 code (iii) Excess-3 code (iv) Gray code (v) BiQuinary code with necessary illustrations. 08
- 5(c) Write short notes on: (i) De-Morgan’s theorem (ii) Duality principle. Find the complement of the function  $F_1$  and  $F_2$  using De-Morgan’s  $F_1 = \overline{W}XY\overline{Z} + W\overline{X}YZ$ ,  $F_2 = \overline{A}B\overline{C}D\overline{E} + AD$ . 12
- 5(d) Find out the 1’S and 2’S complements of (i)  $(ADDA)_h$  (ii)  $(DADA)_h$ . 06



6(a)	Discuss the resistance welding and induction heating. Also, explain different types of resistance welding with necessary figure.	10
6(b)	Design on 3bit counter with JK and D FF'S which can count 0, 2, 3, 7, 6, 4, 5 and repeat.	12
6(c)	Mention the differences between Flip-Flops and latches. Describe JK, D, and T FF'S with $ch^q$ tables, $ch^q$ equation and neat sketch.	08
6(d)	Discuss serial and parallel data transfer with necessary diagrams.	05
7(a)	What is instrumentation? What are the essential parts of instrumentation? Why people prefer electronic instruments more?	10
7(b)	Write four differences between the following items:	09
	(i) CRT monitor and CRO	
	(ii) Microprocessor and microcontroller	
	(iii) Transducer and sensor	
7(c)	Define register and counter. Draw the logic diagram and timing diagram of a BCD ripple counter.	10
7(d)	What is timer and scale integration? Classify them with proper information.	06
8(a)	What is a regulated power supply? Design a +15V regulated dc power supply and show the wave shapes at different points.	12
8(b)	What is parity bit? Design and implement a 4-bit odd parity checker.	08
8(c)	Implement the following function with NAND gates: $F(x, y, z) = \sum(0,6)$ .	09
8(d)	Implement a full-adder circuit with a decoder and two OR gates.	06

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**Mum 2105**

(Industrial Environment and Sociology)

Time: 3 Hours

Total Marks: 210

- N.B.:** i) Answer any THREE questions from each section in separate scripts.  
ii) Figures in the right margin indicate full marks.  
iii) Assume reasonable data if any missing.

**SECTION-A**

- 1(a) What is meant by population growth? Do you think population and economic growth are correlated? Explain with example from Bangladesh. 20
- 1(b) What is meant by environmental pollution? Discuss the responsible factors of environmental pollution and its aftermath. 15
- 2(a) What is meant by industrial and hazardous waste? 07
- 2(b) Describe the waste management system? Do you think that mechanical engineers have a significant role to upgrade it? 18
- 2(c) Evaluate the main goals of Bangladesh Industrial Policy 2010. 10
- 3(a) Explain the expected safety and welfare condition in an industry of Bangladesh. 10
- 3(b) Discuss the leave and holidays rule for an employee of industrial sector. 10
- 3(c) Discuss the main features of Bangladesh Environment Conservation Act 1995. 15
- 4(a) Explain the purpose and principle of Bangladesh labor law 2006. What are the outcomes you see as a result of establishing labor law in Bangladesh? 18
- 4(b) Describe the organizational structure and function of ILO. Do you think the role of ILO have a significance for Bangladesh Industrial section? 17

**SECTION-B**

- 5(a) Define Sociology. What is the nature of sociology? Explain. 15
- 5(b) Explain the scope of sociology. 10
- 5(c) Why sociology is important for the students of Mechanical Engineering? 10
- 6(a) What is meant by community? 05
- 6(b) Discuss different elements of community. 15
- 6(c) Explain the role of association for social development. 15
- 7(a) What is meant by primate city and shanty town? What are the major attributes of primate city in 3rd world countries? 10
- 7(b) Critically evaluate more advanced stages of urbanization from Harris and Ullman's perspective. 15
- 7(c) What are the mode of industrialization in Bangladesh? Find out the barriers of industrialization in our country. 10
- 8(a) Who are Juvenile delinquents? What are the types of offender? 10
- 8(b) Define feminization of poverty. What are the main reasons for the feminization of poverty? 15
- 8(c) Differentiate between violent crime and victimless crime with examples. 10

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**SECTION-A**

- 1(a) Consider the matrix  $A = \begin{bmatrix} 3i & 2-3i & 3 \\ -2-3i & 5i & 1+i \\ -3 & -1+i & x^2-1 \end{bmatrix}$  where  $x$  is not imaginary, 08  
determine the value of  $x$  such that  $A$  is Skew-Hermitian.
- 1(b) If  $A = \begin{bmatrix} 3 & 2 & 2 \\ 1 & 3 & 1 \\ 5 & 3 & 4 \end{bmatrix}$ , find the matrix  $B$  such that  $AB = \begin{bmatrix} 3 & 4 & 2 \\ 1 & 6 & 1 \\ 5 & 6 & 4 \end{bmatrix}$ . 12
- 1(c) Find the reduced row echelon form of  $A = \begin{bmatrix} 1 & -3 & 4 & -1 & 9 \\ -2 & 6 & -6 & -1 & -10 \\ -3 & 9 & -6 & -6 & -3 \\ 3 & -9 & 4 & 9 & 0 \end{bmatrix}$ . Hence find its 15  
normal form and comment about its rank.
- 2(a) Determine the values of  $a, b, c$  such that the matrix  $A = \begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ a & -b & c \end{bmatrix}$  is an orthogonal 10  
matrix.
- 2(b) For what value(s) of  $k$ , the homogeneous linear system  $-5x - 6y + 4z = 0$  15  
 $-8x - 7y + 9z = 0$   
 $-6x + y + kz = 0$   
will pass non-trivial solution? Find the non-trivial solution with the obtained value(s) of  $k$ .
- 2(c) Determine whether the following vectors are linearly dependent or independent: 10  
 $V_1 = [1, 2, -3, 4]$      $V_2 = [-3, -1, 2, 1]$      $V_3 = [1, -5, 8, -7]$
- 3(a) Let  $A$  be a  $4 \times 4$  matrix (not null). (i) If  $A$  is invertible, then what will be its rank? (ii) If 04  
its rank is 3, then  $\det(A) = ?$
- 3(b) Investigate the value of  $\lambda$  and  $\mu$  so that the equations  $2x + 3y + 5z = 9$  10  
 $7x + 3y - 2z = 8$   
 $2x + 3y + \lambda z = \mu$   
have (i) no solution, (ii) a unique solution and (iii) an infinite number of solutions.
- 3(c) Finding the eigenvalues and corresponding eigenvectors, determine whether the matrix 13  
 $A = \begin{bmatrix} 5 & -6 & 1 \\ 1 & 1 & 0 \\ 3 & 0 & 1 \end{bmatrix}$  is diagonalizable or not. If yes, then find the corresponding modal and spectral matrix and if not, explain the reason.
- 3(d) Verify whether  $\lim_{z \rightarrow 0} \frac{\bar{z}}{z}$  exists or not. 08
- 4(a) Show that the function  $f(z) = xy + iy$  is everywhere continuous but is not an analytic 12  
function. Determine the point at which  $f(z)$  is differentiable and the derivative of  $f(z)$  at that point.
- 4(b) Verify that the function  $u(x, y) = x^3 - 3xy^2 - 5y$  is harmonic in the entire complex 15  
plane and hence find the harmonic conjugate of  $u$  and write the corresponding analytic function  $f(z)$  using  $u$  and its conjugate.

- 4(c) Discuss the singularities and their nature of the following functions: 08
- (i)  $\frac{z}{(z^2 + 9)^2}$       (ii)  $\frac{z^4 + 2z + 1}{z^2 + 5z + 2}$

### SECTION-B

- 5(a) The temperature (in degrees Celsius) at a point  $(x, y, z)$  in a metal solid is 12
- $$T(x, y, z) = \frac{xyz}{1 + x^2 + y^2 + z^2}$$
- (i) Find the rate of change of temperature with respect to distance at  $(1,1,1)$  in the direction of the origin.
- (ii) Find the direction along which the temperature drops most rapidly at the point  $(1,1,1)$ .
- (iii) Find the rate at which the temperature drops moving from  $(1,1,1)$  in the direction obtained in (ii).
- 5(b) A heat seeking particle is located at the point  $P(1,4)$  on a flat metal plate whose 12
- temperature distribution is  $T(x, y) = 5 - 4x^2 - y^2$ . Find parametric equations for the trajectory of the particle if it moves continuously in the direction of maximum temperature increase.
- 5(c) Give a physical interpretation of divergence in the context of velocity field of a fluid. 11
- 6(a) The velocity vector field for the 2D flow of an ideal fluid around a cylinder is given by 11
- $$\vec{F}(x, y) = A \left[ \left( 1 - \frac{x^2 - y^2}{(x^2 + y^2)^2} \right) \hat{i} - \frac{2xy}{(x^2 + y^2)^2} \hat{j} \right]$$
- for some constant  $A > 0$ . Determine whether
- (i)  $\vec{F}$  is irrotational    (ii)  $\vec{F}$  is incompressible.
- 6(b) Calculate the flux of  $\vec{F}(x, y) = \langle x^3, y^3 \rangle$  across a unit circle centered at origin and orientated 11
- counterclockwise.
- 6(c) Evaluate  $\iint_S \vec{F} \cdot \hat{n} \, ds$  where  $\vec{F} = y\hat{i} + 2\hat{j} + \hat{k}$  and  $S$  is the part of the surface defined by 13
- $$x^2 + y^2 + z^2 = 9$$
- located on the first two octant where  $z \geq 0$  and  $y \geq 0$ .
- 7(a) Find the acute angle between the surfaces  $xy^2z = 3x + z^2$  and  $3x^2 - y^2 + 2z + 1 = 0$  at 10
- $P(1, -2, 1)$ .
- 7(b) What is the geometrical interpretation of conservative vector field? Show that the vector 15
- $$\vec{V} = xyz(yz\hat{i} + xz\hat{j} + xy\hat{k})$$
- is conservative and also obtain the scalar function  $\phi(x, y, z)$ .
- 7(c) Evaluate  $\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ , where  $C$  is the boundary of the region 10
- bounded by  $y = \sqrt{x}$  and  $y = x^2$ .
- 8(a) Verify Stokes theorem for the vector field  $\vec{F} = 2z\hat{i} + 3x\hat{j} + 5y\hat{k}$  taking  $S$  (surface) to be 15
- the portion of the paraboloid  $z = 4 - x^2 - y^2$ ;  $z \geq 0$  with upward orientation and  $C$  (boundary path of  $S$ ) to be the positively orientated circle  $x^2 + y^2 = 4$  in  $xy$  plane.
- 8(b) Using Divergence theorem find the outward flux of the vector field  $\vec{F} = \langle x^3, y^3, z^3 \rangle$  across 12
- the closed surface of the region that is enclosed by  $z = \sqrt{a^2 - x^2 - y^2}$  and the plane  $z = 0$ .
- 8(c) Sketch the gradient field of  $\phi = x^2 - y^2$  and find the circulation density of this gradient 08
- field.

--) END (--)



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**ME 2105**

(Thermodynamics)

Time: 3 Hours

Total Marks: 210

- N.B.:** i) Answer any THREE questions from each section in separate scripts.  
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**SECTION-A**

- 1(a) Define state, process and cycle. Also, explain their inter-relationship. 07
- 1(b) Show that thermodynamic properties are point function whereas heat and work are path function. 06
- 1(c) In the light of 1st law of thermodynamics show that any quantity of work done by a non-flow system is partly the contribution of the system itself and partly the contribution of the surroundings. 10
- 1(d) 6 kg of a gas expands within a flexible container so that the pressure-volume relation is of the form  $PV^{1.35} = C$ . The initial pressure is 1.0 MPa and the final pressure is 5.50 kPa. The initial volume is 1.45 m<sup>3</sup>. The specific internal energy of the gas decreases by 40.50 kJ. Find the heat transfer in magnitude and direction. 12
- 2(a) What are the assumptions made to drive SFEE? Deduce the expression for SFEE and apply it to pump. 10
- 2(b) What is meant by reversibility? What factors render process irreversible? 10
- 2(c) In a gas turbine, the gas enters at the rate of 5.5 kg/sec with a velocity of 50 m/sec, enthalpy of 900 kJ/kg and elevation 2.5 m. The gas leaves the turbine with a velocity of 155 m/sec and enthalpy of 300 kJ/kg. The loss of heat from the gases to the surroundings is 25 kJ/kg. Assuming for the gas  $R = 0.283$  kJ/kg.K and  $C_p = 1.003$  kJ/kg.K and the initial conditions to be at 0.1 MPa and 303 K, determine the power output of the turbine and the diameter of the inlet pipe. 15
- 3(a) What are the limitations of 1st law of thermodynamics? Write the two statements for 2nd law of thermodynamics. 09
- 3(b) Prove that Kelvin-Plancks statement and clausius statement for 2nd law of thermodynamics are equivalent. 08
- 3(c) Show that the efficiency of a reversible engine is higher than any other engine, when it operates between same reservoirs. 10
- 3(d) Explain why an aeroplane cannot run in atmosphere, although the atmosphere contain a lot of energy. 08
- 4(a) Draw the following cycles on P-V and T-S plane indicating heat and work transfer: 06  
i) Carnot cycle;      ii) Stirling cycle;      iii) Atkinson cycle
- 4(b) Derive an expression for the efficiency of four-stroke Diesel engine working on air standard cycle and hence show that for same compression ratio an Otto cycle efficiency is more than a Diesel cycle efficiency. 14
- 4(c) An ideal Diesel engine operates on 0.6 kg of air with a suction state of 0.1 MPa and 35°C, the pressure at the end of compression is 36 bar and the cut off is at 6% of the stroke from the head end dead centre position. Using air properties, determine- (i) the compression ratio, (ii) the percentage clearance, (iii) the heat supplied, (iv) the thermal efficiency and (v) mep. 15



## SECTION-B

- 5(a) Why Carnot cycle is not used in practical vapor power cycle? 07
- 5(b) "When the condenser temperature, superheat temperature, and steam quantity at outlet of the turbine is fixed, the boiler operating pressure is also fixed". Justify the statement. 08
- 5(c) What is meant by work ratio? Explain its physical significance. 04
- 5(d) A reheat cycle using steam, works between pressure of 130 bar and 0.05 bar. The steam is supplied at 450°C on entry to the turbine and after expansion to a dryness fraction of 0.95, it is reheated to 400°C before completing its expansion to the condenser pressure. Find the reheat pressure and cycle efficiency assuming isentropic expansion in the turbines and feed pump. 16
- 6(a) Define extracted steam and Bled steam. 06
- 6(b) With neat sketch describe the working principle of a binary vapor power cycle. 11
- 6(c) In a regenerative cycle, steam enters a single turbine at 48 bar and 520°C and is condensed at 0.5 bar. Some steam bled at a pressure of 3 bar and is passed to an open type single feed heater. Calculate the amount of bleed steam, the SSC and cycle efficiency. 18
- 7(a) Distinguish between dry bulb and wet bulb temperature. 05
- 7(b) What is meant by degree of saturation? Why the minimum value of degree of saturation is zero? 08
- 7(c) Prove that the relative humidity is given by- 10

$$\varphi = \frac{\mu}{\left[1 - (1 - \mu) \frac{p_s}{p_b}\right]}$$

where  $\varphi$  is relative humidity,  $\mu$  is degree of saturation,  $p_s$  saturation pressure of vapor in moist air and  $p_b$  is barometric pressure of moist air.

- 7(d) Air at 25°C, 45% relative humidity is mixed adiabatically with air at 38°C, 45% relative humidity in the ratio of 3 kg of the former with 5 kg of the later (on dry basis). Find the final condition of air. 12
- 8(a) Define pyrolysis and Gasification. 05
- 8(b) Write down the advantages and disadvantages of liquid fuel over solid fuel. 06
- 8(c) Why solid fuels are need to be modified? Explain the process of briquetting in laboratory in brief. 10
- 8(d) A mixture of ideal gases consists of 4 kg of N<sub>2</sub> and 6 kg of CO<sub>2</sub> at a pressure of 305 kPa and temperature of 25°C. Calculate the 14
- (i) mole fraction of each constituent;
  - (ii) equivalent molecular weight of the mixture;
  - (iii) volume and density of the mixture and
  - (iv) C<sub>P</sub> and C<sub>V</sub> of the mixture.

Consider  $\gamma$  for CO<sub>2</sub> and N<sub>2</sub> to be 1.3 and 1.4 respectively.

--> END (-->