Sylhet Engineering College, Sylhet

(Shahjalal University of Science & Technology)

Department of Electrical & Electronic Engineering

Final Examination, 2023 — **2nd year 2nd Semester**

Course No: EEE 403 — **Course Title: Electrical Machines II**

Time: 03 (Three) hours — **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) You can use pen for drawing any sketch

PART-A

(Answer any three questions)

1. **(a)** What are the basic difference between synchronous motor & alternator? **02**

   (b) Establish the EMF equation of DC generator for both wave and lap wound types. **04**

   (c) When driven at 1000 r.p.m. with a flux per pole of 0.02 Wb, a d.c. generator has an e.m.f. of 200 V. If the speed is increased to 1100 r.p.m. and at the same time the flux per pole is reduced to 0.019 Wb per pole, what is then the induced e.m.f. ? **04**

2. **(a)** Why is synchronous motor needed a rotor winding like induction motor? Explain briefly. Why it is called synchronous motor? **1+4 +1**

   (b) A 60KVA ,220V, 50HZ 1-phase alternator has the effective armature resistance is 0.016 ohm and leakage reactance is 0.07 ohm. Compute the voltage induced at armature when the the alternator is delivering rated current at a load factor of (a) unity (b) 0.7 lagging (c) 0.7 leading. . **04**

3. **(a)** Explain the working principle of synchronous motor. **04**

   (b) A 6-pole dc generator runs at 1200 r.p.m. on no-load and has a generated e.m.f. of 250 V. Its armature diameter is 350 mm and the radial air-gap between the field poles and the armature is 3 mm. The axial length of the field poles is 260 mm and the field pole effective coverage is 80% including fringing. If the armature has 96 coils having 3 turns per coil and is wound duplex lap, calculate **(a)** flux per pole **(b)** effective pole arc length and **(c)** average air-gap flux density. **03**

   (c) What is full-pitched coil? What is lap & wave winding? What is dummy coil? **1+1+1**

4. **(a)** What are the characteristics of DC generator? Explain the open circuit characteristics. **2+4**

   (b) What is critical resistance of DC generator? **04**

   Open circuit characteristics of a separately excited dc generator at 1500rpm is as follow:

Field current	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6
EMF	30	55	75	90	100	110	115	120

   Find and draw the characteristics curve at 1000rpm with same excitation

PART-B

(Answer any three questions)

5. **(a)** What is critical resistance? What are the losses of DC generator? **1+1**

(b) Draw the power stage of DC generator. Explain the significance of back emf of dc motor. **1+1**

(c) The following figures give the O.C.C. of a d.c. shunt generator at 300 r.p.m. **06**

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 40 Ω.

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

(b) Without this additional resistance, determine the load current supplied by the generator, when its terminal voltage is 200 V. Ignore armature reaction and assume speed to be constant. Armature resistance is 0.4 Ω.

6. **(a)** Why is back emf so important in dc motor? **02**

(b) What are the method of speed control of dc shunt motor? **1+4**

A 250 V, d.c. shunt motor has an armature resistance of 0.5 Ω and a field resistance of 250 Ω. When driving a load of constant torque at 600 r.p.m., the armature current is 20 A. If it is desired to raise the speed from 600 to 800 r.p.m., what resistance should be inserted in the shunt field circuit? Assume that the magnetic circuit is unsaturated.

(c) Explain the working principle of DC motor. **03**

7. **(a)** Explain "what will happen if we change the load of synchronous motor at fixed excitation?" **05**

(b) A 400V 3 phase synchronous motor takes 52.5A at a pf of 0.8 leading. Calculate the power supplied and the induced emf. The motor impedance is (0.25+ j3.2) ohm **05**

8. **(a)** What is synchronous reactance? What is excitation? **1+1**

(b) What are the condition of parallel operation of alternator? Explain one dark & two bright lamp method of parallel operation with complete circuit & vector diagram. **1+4**

(c) A 230V dc shunt motor runs at 800rpm and takes current of 50A. Find the resistance to be added to the circuit to increase speed to 1000rpm at an armature current of 80A. Assume flux proportional to field current. Armature resistance is 0.15 ohm and field winding resistance is 250 ohm. **03**

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

Final Examination 2023 — **2nd Year 2nd Semester**
Course No: Math 403 — **Course Title: Probability and Statistics**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. (i) Answer any **three** questions from each (ii) Use separate answer script for each PART
(iii) Marks allotted are indicated in the margin (iv) You can use pen for drawing any sketch

PART A
(Answer any three questions)

1. a) Define with example: 1+1+1+2=05

   i) Harmonic mean
   ii) Quartiles
   iii) Kurtosis
   iv) Central moments

   b) In an office of 100 employees, 75 read English, 50 read Bangla dailies and 40 read both, An employee is selected at random.What is the probability that the selected employee reads (i) English newspaper (ii) at least one of the newspaper (iii)none (iv)English but not Bangla. 05

2. a) Find out the Geometric mean, 3rd Quartile and 37th percentile from the following frequency distribution. 07

Class interval	5-10	10-15	15-20	20-25	25-30	30-35	35-40
Frequency	4	6	8	5	3	8	6

   b) Define standard deviation. For two unequal observations show that MD=SD=R/2, where MD= Mean deviation, SD = Standard deviation, and R= Range. 03

3. a) Find the relationships among the first four central moments and row moments. 05

   b) Compute the first four central moments from the following distribution of hourly wages of 131empoyees of a departmental store using raw moments about the arbitrary value x=20 05

Wages in Dollars	5	6	7	8	9	10	11	12	13	14	15
No of employees	1	2	5	10	20	51	22	11	5	3	1

4. a) Define skewness. For any set of observations $x_1, x_2, x_3, \ldots . x_n$ show that $\beta_2 \geq 1 + \beta_1$, where β_1 *and* β_2 are skewness and kurtosis respectively. 05

   b) Compute mean deviation of the following data from mean, median and mode. 05

Class interval	49-53	54-58	59-63	64-68	69-73	74-78	79-83	84-88	89-93	94-98
Frequency	2	2	3	5	5	5	5	7	10	6

PART B

(Answer any three questions)

5. a) Define probability density function .A random variable x has the following probability density function f(x) = cx(7-2x); $0 \leq x \leq 3$ 1.5+3.5=05

i) Determine c ii) Find the probability that $1 \leq x \leq 2$.

b) Define probability. A class is made up of 15 girls and 10 boys. It is decided to distribute 5 complementary tickets by lottery to 5 students of the class. What is the probability that 05

i) the tickets go to 5 girls? and ii) the tickets goes to 3 boys and 2 girls?

6. a) The probability function of a discrete random variable X is 05

$$f(x) = \begin{cases} \alpha\left(\frac{3}{4}\right)^x, x = 0,1,2,3, \ldots \ldots \infty \\ 0, elsewhere \end{cases}$$

Evaluate α and find $P(X \leq 3)$.

b) Define Binomial distribution. Four unbiased coins are tossed simultaneously. What is the Probability of getting i) exactly three heads ii) At least two heads? 05

7. a) Define Poisson distribution. Derive Poisson distribution from Binomial distribution. 05

b) Seven coins are tossed at a time and the number of heads is noted. The experiment is repeated 128 times and the distribution are obtained as below. 05

Number of heads	0	1	2	3	4	5	6	7
Frequencies	7	6	19	35	30	23	7	1

Fit a Binomial distribution to the above data assuming that the coins are unbiased.

8. a) Define correlation. Find the correlation coefficient of the following data. 05

Years of education	0	1	2	3	4	5	6	7
Age of entry in the job	7	S6	19	35	30	23	7	1

b) If the variables x and y are uncorrelated ,and $v(x) = s_x^2$ and $v(y) = s_y^2$, show that the correlation coefficient between x+y and x-y is $\frac{s_x^2 - s_y^2}{s_x^2 + s_y^2}$. 05

Sylhet Engineering College, Sylhet

(Shahjalal University of Science & Technology)

Department of Electrical & Electronic Engineering

Final Examination, 2023 — **2nd year 2nd Semester**

Course No: ME 401 — **Course Title: Fundamental of Mechanical Engineering**

Time: 03 (Three) hours — **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) You can use pen for drawing any sketch

Part A

1. (a) "Electrical and mechanical engineering disciplines are closely related and often collaborate on projects"- Explain — 02
   (b) Biomass is one kind of source of renewable energy-Justify. Explain a bio-gas plant with figure. — 05
   (c) What are the main sources of energy in Bangladesh? Show their share in total energy used in Bangladesh. — 03

2. (a) "In electricity generation, Boiler is an important element" -why? — 02
   (b) Boiler can be considered both equipment and a type of machine. How? — 02
   (c) Sketch a Cochran boiler and level its components. Explain how does it work? — 06

3. (a) Explain the following fittings with reference to their function, location, construction and operation. Draw necessary figures. — 06
   i) lever safety valve ii) water level indicator
   (b) What is scavenging? Differentiate between Two stroke and four stroke engines. — 04

4. (a) With the aid of a simple diagram describe the operation of four stroke internal combustion engine. — 06
   (b) Draw a valve timing diagram for a petrol engine. Give the reasons for early opening of the exhaust valve and the late closing of the inlet valve. — 04

Part B

5. (a) In most cases, coefficient of performance of a refrigerator is greater than one- why? — 02
   (b) Explain, with reference to temperature-entropy diagram, the stages involved in the vapour compression process of refrigeration. — 04
   (c) Mention various types of refrigerator. — 02
   (d) What are the similarities and differences of refrigerator and air-conditioner? — 02

6. (a) Explain the working principle of an impulse turbine with necessary sketch. — 04
   (b) Differentiate between inward and outward reaction turbine with figures. — 03
   (c) Compare impulse and reaction turbine. — 03

7. (a) How does a centrifugal pump work? Explain with necessary sketch. — 04
   (b) Write down the advantages, disadvantages and application of a gas turbine. — 04
   (c) State the Fourier law of heat conduction. Why is thermal conductivity important for selecting the material of a heat exchanger? — 02

8. (a) What is critical thickness of insulation? Mention it's physical significance. — 02
   (b) Explain the concept of finned surfaces. — 02
   (c) A wall of (3m) high and (4m) wide consists a long (16cmx22cm) cross- section horizontal bricks of thermal conductivity (0.72W/m.°C), separated by (3cm) thick plaster layer of thermal conductivity (0.21W/m.°C). There are (2.5cm) thick plasters on the brick on each of its sides and (3cm) of rigid foam with thermal conductivity (0.026W/m.°C) on the inner wall side as shown in Figure-8(c). The temperatures at indoor and outdoor are (22°C) and (47°C), and the coefficients of convection heat transfer on inner and outer sides are (12W/m².°C) and (42W/m².°C). Determine heat transfer rate through the wall neglecting radiation by assuming it one-dimensional heat transfer . — 06

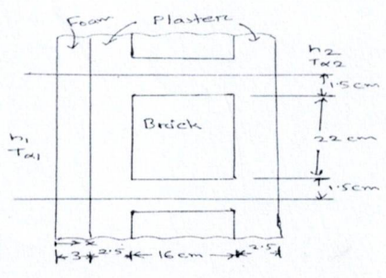


Fig. 8(C)

Sylhet Engineering College, Sylhet

(Shahjalal University of Science & Technology)

Department of Electrical & Electronic Engineering

Final Examination, 2023 — **2nd year 2nd Semester**

Course No: EEE 401 — **Course Title: Electronics II**

Time: 03 (Three) hours — **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) You can use pen for drawing any sketch

PART-A

(Answer any three questions)

1. (a) As a second-year, second-semester student in Electrical and Electronic Engineering (EEE), you have completed the introductory course, Electronics-I, where you learned about basic electronic elements such as diodes, BJTs, MOSFETs, JFETs, etc. In the Electronics-II course, you have been introduced to a new type of amplifier circuit known as the operational amplifier (op-amp). 05

Transistors are known for their excellent performance as amplifier circuits and have a wide range of practical applications, particularly in amplification. In contrast, op-amps present unique advantages and are widely used in various applications due to their versatility and performance. Now,

i. Discuss the significance of learning and understanding op-amp circuits in the context of practical applications in the industry.

ii. Highlight and explain the key differences between transistor amplifiers and op-amps in terms of their design, characteristics, and performance.

iii. Discuss the important parameters by which both op-amp circuits (such as CMRR, Slew Rate, GBP, BW) and transistor amplifier circuits (such as α, β, γ) are evaluated. Explain how these parameters affect the performance of each circuit.

In your discussion, provide a thorough explanation that an industry professional could easily understand, focusing on the practical significance and use cases of op-amp circuits. Finally, conclude with a comparative statement between transistor amplifiers and op-amps, addressing their respective advantages and limitations in real-world applications.

(b) What does it mean by DA amplifier. Provide a detail discussion about the operation and application of DA. Draw the r_e model of a DA amplifier and establish the relation between output voltage V_0 and difference voltage V_d. 05

2. (a) Discuss the theory of feedback and various feedback topologies used in operational amplifier (op-amp) circuits. Additionally, explain how negative feedback can enhance the following parameters to improve the efficiency of an op-amp circuit: 05

i. Reduction in the transfer parameter

ii. Improvement in the sensitivity factor

iii. Enhancement of linearity

iv. Improvement in bandwidth

Provide a detailed explanation of each point, highlighting how negative feedback positively impacts the performance and efficiency of an op-amp circuit in practical applications

(b) i. Provide a detailed analysis of the gyrator circuit, explaining its operation, components. 05

ii. Simulates an inductive impedance by incorporating gyrator circuit.

iii. Simulates negative resistance using active component op-amp.

iv. Finally design and demonstrate how these three elements such as op-amp, gyrator, and simulated negative resistance work together to produce a stable harmonic LC oscillator.

3. (a) Draw the circuit diagram of a Wien bridge oscillator and explain how barkhausen criteria are satisfied in this circuit. Also, explain the expression of oscillation frequency for this oscillator. 05

(b) It is desired to design a phase-shift oscillator shown in Fig. 3(b) using an FET having $g_= 500\mu S, r_d = 40K\Omega$, and a feedback circuit value of $R = 10K\Omega$. Select the value of C for oscillator operation at $5KHz$ and R_D for $A > 29$ to ensure oscillator action. 05

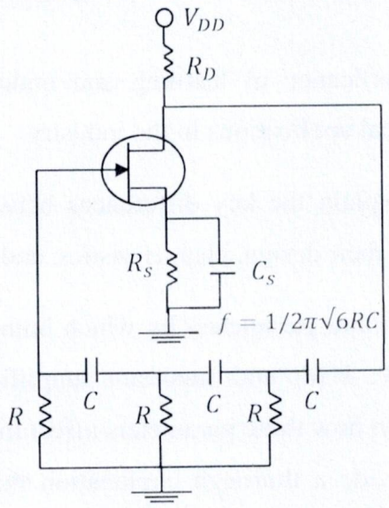


Fig. 3(b)

4. (a) Explain the working principal of Hartley oscillator. For Hartley oscillator as shown in Fig. 4(a) calculate the (i) operating frequency and (ii) feedback fraction. The mutual inductance between the coils, $M = 20\mu H$. 04

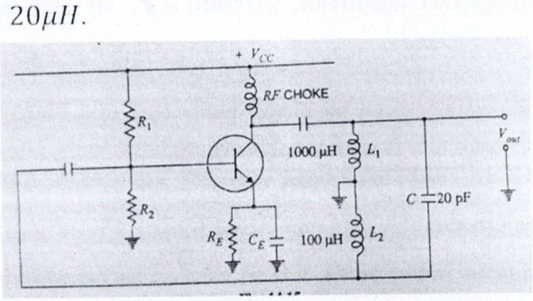


Fig. 4(a)

(b) Define Power amplifier. Explain the working principle of a class B push pull amplifier and shows that the maximum efficiency of push pull amplifier is 78.5%. 04

(c) Determine the input power, output power, efficiency and the maximum values of these quantities for the push-pull amplifier with the given parameters: 02

$$V_{cc} = 30V;\ R_L = 0.0625S;\ N_1 : N_2 = 2;\ I_P = 1000mA$$

PART-B

(Answer any three questions)

5. (a) A square wave input of 8V peak to peak magnitude and frequency 2 MHz is applied to a voltage follower which produces the triangular output as shown in Fig. 5(a). What is its slew rate? 04

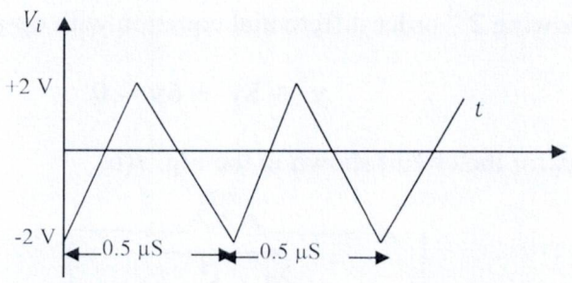
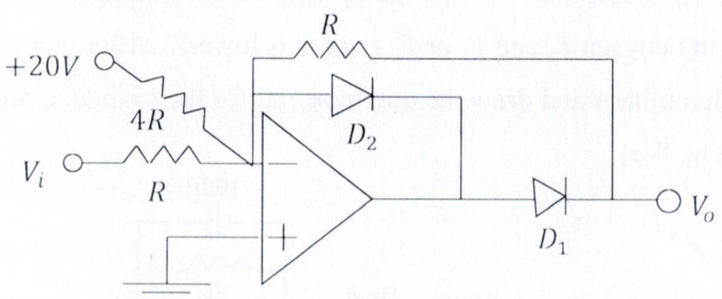
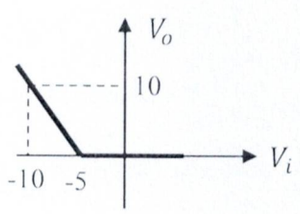


Fig. 5(a)

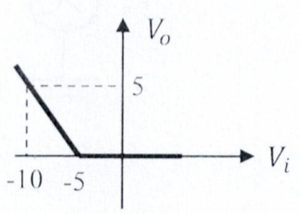
(b) The transfer characteristics for the precision rectifier ckt shown in Fig. 5(b) (assumed ideal op-amp and practical diodes). Choose the appropriate transfer characteristics curve with mathematical derivation. 06



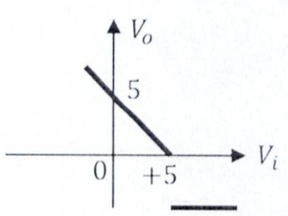
a)



b)



c)



d)

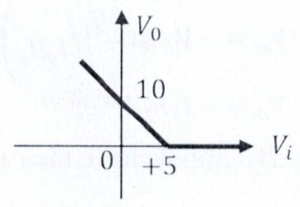


Fig. 5(b)

6. (a) Determine the output voltage of an op-amp for input voltage of $V_{i1} = 150\mu V$ and $V_{i2} = 140\mu V$. The amplifier has a differential gain of $A_d = 4000$ and the value of $CMRR$ is (a) 100 and (b) 10^5. 04

(b) Draw the output of the circuit shown in Fig. 6(b) 06

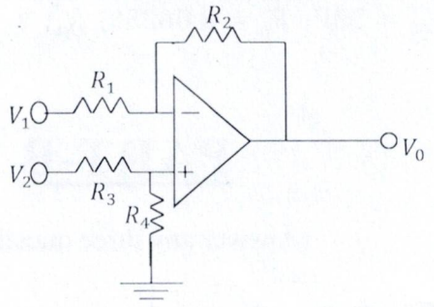


Fig. 6 (b)

7. (a) Simulate the following 2nd order differential equation with op-amp. 02

$$y'' + 5y' + 6y = 0$$

(b) Find the output v_0 for the circuit shown in the Fig. 7(b). 08

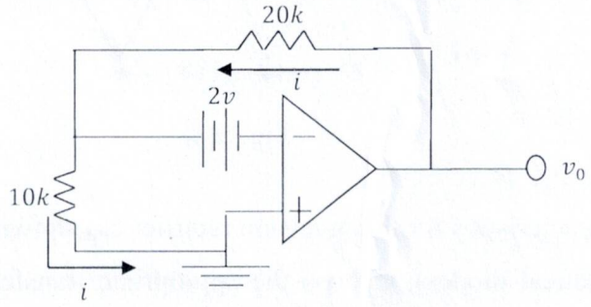


Fig. 7(b)

8. (a) Justify the statement that "To operate op-amp as differentiator we need to maintain signal frequency in between f_0 and F_1 or F_2 (which is lower)". After that find the frequency limits for the differentiator and draw the output signal for the triangular wave input for the circuit shown in Fig. 8(a). 06

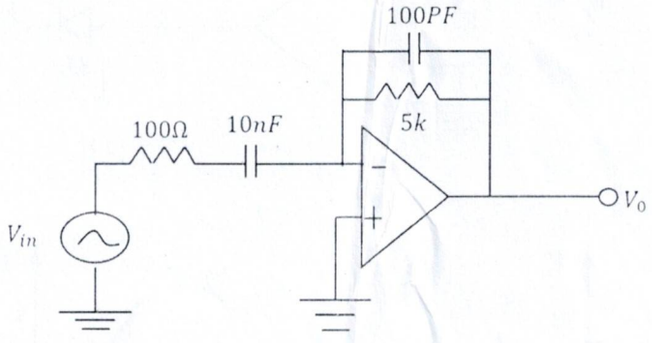


Fig.8(a)

(b) Design an op-amp circuit to simulate the output given by the following equations: 04

i. $V_0 = -V_T \ln\left(V_i / I_s R_i\right)$

ii. $V_0 = -I_s R_f e^{(V_i/V_T)}$

Where all symbols have their usual meanings.

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

Final Examination 2023 — **2nd Year 2nd Semester**
Course No: EEE 405 — **Course Title: ELECTROMAGNETIC FIELDS AND WAVES**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. (i) Answer any three questions from each PART (ii) Use separate answer script for each PART
(iii) Marks allotted are indicated in the margin (iv) You can use pen for drawing any sketch

PART A
(Answer any three questions)

1. a) What does it mean by Electrostatic field and Electromagnetic field. 01

b) A vector field **S** is expressed in rectangular coordinates as $S = [125/\{(x-1)^2 + (y-2)^2 + (z+1)^2\}]\{(x-1)\boldsymbol{a}_x + (y-2)\boldsymbol{a}_y + (z+1)\boldsymbol{a}_z\}$. 1.5+

01+

(i) evaluate **S** at $P(2, 4, 3)$.
(ii) Determine a unit vector that gives the direction of **S** at P. 2.5
(iii) Specify the surface $f(x, y, z)$ on which $|\mathbf{S}| = 1$.

c) (i) Express the field $\mathbf{D} = (x^2 + y^2)^{-1}(x\boldsymbol{a}_x + y\boldsymbol{a}_y)$ in cylindrical components. 02+

(ii) Evaluate **D** (in cylindrical components) at the point where $\rho = 2$, $\varphi = 0.2\pi$, and $z = 5$. 01+

(iii) Evaluate **D** (in rectangular components) at the point where $\rho = 2$, $\varphi = 0.2\pi$, and $z = 5$. 01

2. a) Find the total charge contained in an electron beam. Its radius is 1 cm, consider the beam is centered through positive Z-axis, from $z = 2$ cm to $z = 4$ cm. Assume volume charge density of the beam, $\rho_v = -5 \times 10^{-6} e^{-10^5 \rho z}$ C/m^2. 05

b) **Without using Gauss's law**, show that for a uniform line charge density, $\boldsymbol{E} = \frac{\rho_L}{2\pi\varepsilon_0\rho}\boldsymbol{a}_\rho$ where the symbols have their usual meaning. 05

3 a) Write down the integral form of Maxwell's equations and their physical interpretation. 1+2

b) Describe the propagation of plane electromagnetic wave in a perfect dielectric in terms of electric field intensity and magnetic field intensity. 05

c) Write four properties of uniform plane wave. 02

4 a) Determine the boundary conditions at a boundary between a conductor and free space by using appropriate closed path and Gaussian surface. 06

b) Summarize the principles which apply to conductors in electrostatic fields. 04

PART B
(Answer any three questions)

5 a) State and derive Poynting theorem. 04

b) Derive $\mathbf{E} = -\nabla V$, where the symbols have their usual meaning. 06

6 a) Discuss the co-axial cable property corresponding to electric flux density. 05

b) A 50-cm length of coaxial cable has an inner radius of 1 mm and an outer radius of 4 mm. The space between conductors is assumed to be filled with air. The total charge on the inner conductor is 30 nC. Find the charge density on each conductor, and the E and D fields. 05

7 a) The volume charge density $\rho_v = \rho_0 e^{-|x|-|y|-|z|}$ exists over all free space. Calculate the total charge present. 03

b) Find out the wave equation for plane wave in loss less medium. 07

8 a) Show that for an infinitely long straight filament, the magnitude of the magnetic field (**H**) is not a function of z or φ. 04

b) Given the potential, $V = 100(x^2 - y^2)$ and a point $P(2, -1, 3)$ that is stipulated to lie on a conductor-to-free-space boundary, find V, **E**, **D**, and ρ_s at P, and also the equation of the conductor surface. 04

c) What is meant by image of the original charge? Show using a sketch. 02