Max. Marks: 80   **Time: 3 hrs.**

N.B. : 1. Q1 is compulsory
2. Attempt any three questions from Q2 to Q6.
3. Figures to the right indicate full marks.

Q1. (a) A r.v. X has the distribution   [5]

X :	0	1	2	3	4	5	6
$p(x)$:	k	3k	5k	7k	9k	11k	13k

Find i) k   ii) $P(3 < X \le 6)$.

(b) Evaluate the integral $\int_C \dfrac{z^2}{(z-3)^2 (z+2)} \, dz$, C: $|z+1| = 2$.   [5]

(c) Using Gram Schmidt method, find an orthonormal set of vectors   [5]
corresponding to $\{(3,0,4), (1,0,2)\}$.

(d) The given data indicates weight x and heights y of 1000 men. $\bar{x} = 150$ lbs,   [5]
$\bar{y} = 68$ inches, $\sigma_x = 20$ lbs, $\sigma_y = 2.5$ inches, $r = 0.6$. Find the line of regression

of y on x and estimate the height of a person whose weight is 200 lbs.

Q2. (a) If $f(x) = \begin{cases} \dfrac{x}{2} & 0 < x < 2 \\ 0 & \text{otherwise} \end{cases}$ is a pdf of a random variable X, then   [6]

find $E(X)$, $\text{var}(X)$, $\text{var}(3X)$.

(b) Let $W_1 = \{(x, y) \mid x, y \in \mathbb{R}, \ y = 3x + 5\}$ and $W_2 = \{(x,y) \mid x, y \in \mathbb{R}, \ y = 2x\}$.   [6]

Show that W_1 is not a subspace and W_2 is a subspaces of $\mathbb{R}^2$ with usual vector
addition and scalar multiplication.

(c) A Chemical Engineer is investigating the effect of process operating   [8]

temperature x on product yield y. The study results in the following data,

x :	100	110	120	130	140	150	160	170	180	190
y :	45	51	54	61	66	70	74	78	85	89

Find the equation of the least square lines which will enable us to predict

(i) yield on the basis of temperature (ii) temperature on the basis of yield.

Q3. (a) Find the Extremal of   [6]

$$\int_0^1 yy' + (y'')^2 \, dx, \quad y(0) = 0, \ y'(0) = 1, \ y(1) = 2, \ y'(1) = 4.$$

(b) Three factories A, B, C produce 30%, 50% and 20 % of the total production of an item. Out of their production 80%, 50% and 10% are defective respectively. Find the probability of an item chosen at random is defective. If an item chosen is found to be defective, find the probability that it was produced by the factory B. [6]

(c) Find a singular value decomposition of the matrix $\begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}$. [8]

Q4. (a) Evaluate the following integrals using Cauchy Residue theorem, [6]

$$\int_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)^2} \, dz, \quad C : |z| = 3.$$

(b) Find the usual inner product between the two vectors, [6]
$(1,2,0,1)$ and $(-1,0,1,3)$. Find the norm of each vectors and verify the

Cauchy Schwarz inequality.

(c) The income group of 10,000 people were found to be normally distributed [8] with mean Rs. 520 and standard deviation Rs. 60. Find the number of people having income (i) more than Rs 600,   (ii) between Rs. 400 and 550, (iii) less than Rs 450.

Q5. (a) Evaluate using Cauchy integral formula, [6]

$$\int_C \frac{(z+4)^2}{z^2 (z^2 + 5z + 6)} \, dz, \quad C : |z| = 1.$$

(b) Calculate the rank correlation coefficient for the following data. [6]

x	:	10	12	18	16	15	40
y	:	12	18	20	15	50	25

(c) Using Rayleigh-Ritz method, find an approximate solution for the [8]

extremal of $\int_0^1 2xy - y^2 - (y')^2 \, dx, \quad y(0) = 0, \; y(1) = 0.$

Q6. (a) Find the extremal of $\int_{x_1}^{x_2} \sqrt{1 + (y')^2} \, dx$. [6]

(b) Find the Laurent series expansion of $\dfrac{2}{(z+1)(z+3)}$ convergent in [6]

the region i) $|z| < 1$ ii) $|z+1| > 2$.

(c) Reduce the quadratic form $x^2 + 2y^2 + 2z^2 - 2xy - 2yz + xz$ to a diagonal [8]

form using congruent transformation and find its rank, index and class value.

TIME:3Hrs   **MARKS:80**

Note :
- **Question No.1 is compulsory.**
- Solve **ANY THREE** questions from the **remaining** questions.
- Figure to the right indicates full marks.

Marks

Q. 1   Solve **ANY FOUR** questions from following. (Each question carries 5 marks)   **20**

  a)   Explain basic components used in movement of the ICE.

  b)   Compare different energy sources used in EV.

  c)   Importance of lithium ion batteries used in Electric vehicle.

  d)   Explain the general block diagram of Electric vehicle.

  e)   Differentiate between series and parallel architect.

Q. 2   **a)**   Draw and Explain Parallel drive architecture ? Also draw and explain the power flow stages used in the drive.   **10**

  b)   Explain why hybridization of energy sources is important for EV/HEV.   **10**

Q.3   **a)**   Explain the different forces acting on vehicle movement ?   **10**

  b)   Explain the importance of fuel cell with a neat diagram in EV.   **10**

Q4.   **a)**   Explain the design parameters considered for series hybrid drive.   **10**

  b)   Explain with neat diagram G2V concept? Also mention the advantages and disadvantages.   **10**

Q5.   **a)**   Classify Energy Management Strategies. Give the importance of each.   **10**

  b)   Name the motors used in EHEV. Explain the parameter of the AC and DC motors used in EV/HEV   **10**

Q6.   **a)**   Define the key battery parameters (i) Battery capacity (ii) C rating (iii) SoC (iv) DoD (v) Specific Energy   **10**

  b)   Explain working of converters. Draw and explain two quadrant DC-DC choppers.   **10**

****

37465

Time : 3hrs   [Total : 80]

Note: 1) Question No. 1 is compulsory
       2) Attempt any three questions out of remaining five
       3) All Questions carry equal marks
       4) Assume suitable data if required and state it clearly

Q1   Attempt any **FOUR**   **[20]**

   a. Explain construction of D-MOSFET

   b. Draw waveforms of different PWM techniques of inverter   [5]

   c. Compare power MOSFET and IGBT   [5]

   d. What is significance of free-wheeling diode, explain with one example and

      waveforms.   [5]

   e. What is a bootstrap driver circuit? Why it is needed?   [5]

Q2. a) Differentiate between natural and forced commutation circuits. Explain any two

commutation techniques in detail   [10]

   b) Explain single phase full converter with circuit diagram and draw appropriate

   waveforms.   [10]

Q3.a) Draw and explain 3-phase bridge inverter for 120 degree conduction mode.   [10]

   b) Explain Turn-ON and Turn-OFF characteristics of SCR with appropriate waveforms. [10]

Q4. a) Draw and explain Single phase Dual- Converter   [10]

   b) Write different Turn-ON techniques for SCR   [10]

Q5.a) Draw and explain Buck regulator with waveforms and derive the relation for output

   voltage.   [10]

   b) What is Two-transistor's analogy of SCRerive relation for anode current using two-

      transister's   analogy.   [10]

Q6. Write short notes on (**any two)**   [20]

   a) Write short notes on Silicon Carbide (SiC) and GaN devices

   b) Explain SOA of MOSFET with appropriate diagrams

   c)   Performance parameters of Inverter

_____

Duration: 3 hours   **Max. Marks: 80**

1. **Question No.1 is compulsory.**
2. **Attempt any three from the rest.**
3. **Figure to the right indicates full marks.**
4. **Assume suitable data if it is necessary.**

Q1) Answer any four of the following (entire syllabus)
   a. Compare TTL and CMOS logic families.   (05)
   b. Convert Y= (A+B)(A+C)(B+C) equation into POS form   (05)
   c. Explain T & D Flip flop   (05)
   d. Quantization and encoding   (05)
   e. Compare RAM and ROM memory   (05)
   f. Compare PLA and PAL   (05)

Q2)
   a. Convert the given decimal numbers to binary   (10)
      i.   25.5
      ii.   10.625
      iii. 0.6875
   b. Minimize the four variable function using K-Map   (10)
      f(A,B,C,D) = Σm(0,1,2,3,5,7,8,9,11,14)
Q3)
   a. Explain NAND and NOR as universal gates.   (10)
   b. Design a full adder circuit by using K-Map.   (10)
Q4)
   a. Design Binary to Gray code converter.   (10)
   b. Design and explain MOD - 5 counter.   (10)
Q5)
   a. Explain R-2R ladder digital to analog convertor.   (10)
   b. Explain timing diagrams of read and write cycle in case of RAM.   (10)
Q6)
   a. Draw block diagram of CPLD and explain in detail.   (10)
   b. Write short note on: (10)
      i.   Master slave JK flip flop.
      ii.   Content addressable memory.

****

38768   Page 1 of 1

Time: (3 Hours)   **Total Marks: 80**

N.B: (1) Question No. 1 is compulsory.

      (2) Attempt any three from the remaining questions.

      (3) Figures to the right indicate full marks.

      (4) Each question is of 20 Marks.

Q1. Answer any Four.

a.	Explain equivalent circuit of a single phase transformer refer to primary.	**5M**
b.	Explain need of parallel operation of transformer. Explain necessary condition for parallel operation.	**5M** **5M**
c.	Explain connection and phasor diagram of Yd11 transformer.	**5M**
d.	Explain construction detail of auto transformer.	**5M**
e.	Explain torque-slip characteristic of three-phase induction motor.	**5M**

Q2. Answer the following questions.

a.	State different types of starter for three phase induction motor. Explain any one with neat diagram.	**10M**
b.	Explain how to obtain performance of three phase induction motor using circle diagram.	**10M**

Q3. Answer the following questions.

a.	Explain saving of cu in auto transformer with application.	**10M**
b.	Explain Scott connection with neat diagram.	**10M**

Q4. Answer the following questions.

a.	Explain construction and working of 3-phase induction motor with neat diagram.	**10M**
b.	Describe switching intransient phenomenon in three phase transformer.	**10M**

Q5. Answer the following questions.

a.	Explain construction, working, characteristic and application of shaded pole induction motor.	**10M**
b.	Explain power flow stages of 3ph induction motor.	**10M**

Q6. Answer the following questions.

a.	Explain different method of speed control of 3 phase induction motor.	**10M**
b.	Explain in detail parallel operation of two single phase transformers.	**10M**

<p align="center">***************</p>