

**Q. P. Code : 545800**

Duration: 3 Hours

(Revised Course)

Total Marks: 80

N.B. : 1) Q.1. is compulsory.

2) Attempt any three from the remaining.

**Q1.** a) If  $f(x)$  is an algebraic polynomial in  $x$  and  $\lambda$  is an eigen value and  $X$  is the corresponding eigen vector of a square matrix  $A$  then  $f(\lambda)$  is an eigen value and  $X$  is the corresponding eigenvector of  $f(A)$ . (5)

b) Find the extremal of  $\int_{x_0}^{x_1} (x + y')y' dx$  (5)

c) Express  $(6, 1, 6)$  as linear combination of  $v_1 = (2, 1, 4), v_2 = (1, -1, 3), v_3 = (3, 2, 5)$ . (5)

d) Evaluate  $\int_C \frac{z}{(z-1)^2(z-2)} dz$ , where  $C$  is the circle  $|z-2|=0.5$  (5)

**Q2.** a) Find the curve  $y = f(x)$  for which  $\int_0^\pi (y'^2 - y^2) dx$  is extremum if  $\int_0^\pi y dx = 1$ . (6)

b) Evaluate:  $\int_0^{2\pi} \frac{\cos 3\theta}{5 + 4 \cos \theta} d\theta$  (6)

c) Find the singular value decomposition of  $\begin{bmatrix} 2 & 3 \\ 0 & 2 \end{bmatrix}$  (8)

**Q3.** a) Verify Cayley Hamilton theorem for  $A = \begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$  and hence, find the matrix represented by  $A^6 - 6A^5 + 9A^4 + 4A^3 - 12A^2 + 2A - I$ . (6)

b) Construct an orthonormal basis of  $R^3$  using Gram Schmidt process to  $S = \{(3, 0, 4), (-1, 0, 7), (2, 9, 11)\}$  (6)

c) Find all possible Laurent's expansions of  $\frac{z}{(z-1)(z-2)}$  about  $z = -2$  indicating the region of convergence. (8)

[Turnover

Q.4. a) Reduce the quadratic form  $2x^2 - 2y^2 + 2z^2 - 2xy - 8yz + 6zx$  to canonical form and hence, find its rank, index and signature and value class. (6)

b) If  $\phi(\alpha) = \int_C \frac{4z^2 + z + 5}{z - \alpha} dz$ , where C is the contour of the ellipse  $\frac{x^2}{4} + \frac{y^2}{9} = 1$ , find the values of  $\phi(3.5), \phi(i), \phi'(-1), \phi''(-i)$  (6)

c) Using Rayleigh-Ritz method, solve the boundary value problem  $I = \int_0^1 (y'^2 - y^2 - 2xy) dx$ ;  $0 \leq x \leq 1$ , given  $y(0) = y(1) = 0$ . (8)

Q.5. a) Find the extremal of the function  $\int_0^{\pi/2} (2xy + y^2 - y'^2) dx$ ; with  $y(0) = 0, y(\pi/2) = 0$  (6)

b) Find the orthogonal matrix P that diagonalises  $A = \begin{bmatrix} 4 & 2 & 2 \\ 2 & 4 & 2 \\ 2 & 2 & 4 \end{bmatrix}$  (6)

c) Using Cauchy's Residue theorem, evaluate  $\oint_C \frac{z^2 + 3}{z^2 - 1} dz$  where C is the circle (i)  $|z - 1| = 1$  (ii)  $|z + 1| = 1$ . (8)

Q.6. a) Find the sum of the residues at singular points of  $f(z) = \frac{z}{(z-1)^2(z^2-1)}$  (6)

b) If  $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ , prove that  $A^{50} - 5A^{49} = \begin{bmatrix} 4 & -4 \\ -2 & 2 \end{bmatrix}$  (6)

c) (i) Check whether  $W = \{(x, y, z) | y = x + z, x, y, z \text{ are in } \mathbb{R}\}$  is a subspace of  $\mathbb{R}^3$  with usual addition and usual multiplication. (4)

(ii) Find the unit vector in  $\mathbb{R}^3$  orthogonal to both  $u = (1, 0, 1)$  and  $v = (0, 1, 1)$ . (4)

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Instructions to the candidates if any:-

- N.B. (1) Question No. 1 is compulsory.  
 (2) Answer any Three out of remaining questions.  
 (3) Assumptions made should be clearly stated.

Q. No.	Marks
Q.1) Answer the following	20
a) Briefly explain the working principles of DC Generator and DC Motor.	
b) With a neat figure, explain the use of slip rings and brush assembly	
c) What is Eddy current damping?	
d) Explain the working principle of Induction Motor.	
Q.2 a) Explain the constructional features of a DC machine with a neat figure	10
b) A 4-pole, 250V DC Shunt Motor takes 4A on no load, running at 1200 r.p.m. The armature resistance is $0.1 \Omega$ and shunt field resistance is $125 \Omega$ . Total brush drop is 2V. If the motor takes total current of 61A on full load, calculate its Full Load Speed. (Assume that flux gets weakened by 5% on full load condition due to armature reaction)	10
Q.3 a) Explain in detail the three characteristics of DC Shunt Motor with suitable graphs	10
b) With a neat circuit diagram and phasor diagram, explain in detail Split Phase Induction motor, Also draw the Torque-Speed curve.	10
Q.4 a) Explain working of single phase motor with the help of double field revolving theory	10
b) Explain why ADC is required? Explain any one method of ADC	10
Q.5 a) Explain working of Energy meter with neat diagram	10
b) Explain working of Megger for High Resistance measurement	10
Q.6 a) Explain working of PMMC instrument	10
b) Explain Maxwell's bridge for Inductance measurement	10

## COMMUNICATION SYSTEM

Q.P. Code : 551403

(3 hours)

Marks : 80

- Note :** 1. Question No. 1 is **compulsory**.  
 2. Attempt **any three** questions from the remaining questions.  
 3. Assume suitable data wherever necessary.

1. Solve Following. (Any **four**) 20
    - a) A broadcast radio transmitter radiates 5kW power when the percentage modulation is 60. Determine carrier power.
    - b) Compare NBFM and WBFM.
    - c) What are the different types of quantization errors? Explain with suitable diagram.
    - d) Describe FM Telemetry.
    - e) Explain GPIB Bus.
  2. a) With a suitable diagram explain adaptive delta modulation. 10  
 b) Compare AM and FM. 10
  3. a) Compare PAM/PWM/PPM. 10  
 b) Draw and explain working of Super-heterodyne Receiver. 10
  4. a) Describe the importance of different layers of OSI reference model. 10  
 b) An AM transmitter supplies 10kW of carrier power to a 50 Ohm load. It operates at a carrier frequency of 1.2MHz and is 80% modulated by a 3 kHz sine wave. 10
    - i) Sketch neatly labelled frequency spectrum.
    - ii) calculate the total average power in the signal in watts.
  5. a) Describe the various modes of data transmission used in communication. 10  
 b) Compare TDM and FDM. 10
  6. a) With a neat diagram explain the working of Armstrong method of FM generation. 10  
 b) Explain the phase shift method of SSB generation. 10
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(3 Hours)

[ Total Marks : 80

- N.B. : (1) Question No.1 is compulsory.  
 (2) Answer any **three** from the remaining **five** questions.  
 (3) Assumptions made should be **clearly** stated.  
 (4) **Figures** to the right indicate the marks.

1. Attempt any four :- 20
  1. Define properties of fluids with their units.
  2. Explain "Vena Contracta" with pressure diagram.
  3. Explain and derive "Hydrostatic Law".
  4. What is ORP ? Why it is required to measure ?
  5. Classify different types of density measurement methods.
2. a) Explain Calibration procedure with neat diagram using Dead Weight Tester. 10  
 b) Explain Coriolis Mass Flow Meter in detail. 10
3. a) Explain "Variable Area" type flow meter. 10  
 b) A strain gauge is bounded to a beam 0.1 m long & has a cross sectional area  $4\text{cm}^2$ . Young's modulus for steel is  $207\text{GN/m}$ . The strain gauge has an unstrained resistance of  $240\Omega$  and G.F. of 2.2. When a load is applied, the resistance of gauges changes by  $0.013\Omega$ . Calculate the change in length of the steel beam and an amount of force applied to the beam. 10
4. a) Compare Orifice & Venturi meter. 10  
 b) Explain in details with diagrams types of Venturi meter and Orifice plates. 10
5. a) Explain working of "McLeod Gauge". 10  
 b) Explain pH measurement scheme using suitable diagram. Also give the details about electrodes. 10
6. Write short notes on (Any two) :- 20
  1. Dynamometer
  2. Electromagnetic Flow meter
  3. Solid flow meter

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