

Total No. of Questions :10]

SEAT No. :

PE5998

[Total No. of Pages : 2

[6585]-501

M.E. (Civil-Environmental Engineering)

**PCC-501-ENE:ADVANCED WATERAND WASTEWATER TREATMENT
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Your answers will be valued as a whole.*
- 4) *Assume suitable data, if necessary.*
- 5) *Use of electronic pocket calculator and steam table is allowed.*

Q1) Answer the following.

[5+5=10]

- a) Enlist and discuss the types of reactions. What is reversible and irreversible reaction?
- b) Differentiate following with suitable example.
 - i) Rate of Reaction
 - ii) Reaction order

OR

Q2) Answer the following.

[5+5=10]

- a) Explain the concept of hydraulic loading and organic loading in wastewater treatment units.
- b) Explain the principles of mass transport in treatment systems.

Q3) Answer the following.

[7+3=10]

- a) Calculate the height of a cascade aeration system for a wastewater treatment plant in a warm climate where the wastewater temperature is 20°C in winter and that of 25°C in the summer. The DO in influent (C_0) is 1 mg/L and the required final DO concentration (C) is 6.0 mg/L. (Take C_s for 20°C as 9.08 mg/L and C_s for 25°C as 8.24 mg/L). Assume suitable data.
- b) Enlist the types of air diffuser.

OR

P.T.O.

Q4) Answer the following. **[5+5=10]**

- a) Explain the role of electrical double layer (EDL) in colloid stability.
- b) What is meant by perikinetic and orthokinetic flocculation?

Q5) Answer the following. **[5+5=10]**

- a) Discuss about Fluidization and bed expansion in backwashing in detail.
- b) Enlist the Non-Chemical Methods for Disinfection. Discuss any one in detail.

OR

Q6) Answer the following. **[7+3=10]**

- a) A filter bed is composed of 900 mm of unit-size spherical sand of 0.5 mm diameter with a porosity of 46%. Calculate the head loss when the clean bed is operated at rate of 135 m/d. Kinematic viscosity of water at 20°C is $1.01 \times 10^{-6} \text{ m}^2/\text{s}$.
- b) Give short note on the principles of backwash hydraulics.

Q7) Answer the following. **[5+5=10]**

- a) Discuss the working of Activated Sludge Process (ASP).
- b) Enlist and discuss any two the Biological Treatment Systems.

OR

Q8) Solve the following. **[10]**

The sewage is flowing at the rate of 4.8 MLD from a primary clarifier to a standard rate trickling filter. The 5-day BOD at influent is 160 mg/L. The adopted organic loading is $165 \text{ gm/m}^3/\text{day}$ with surface loading of $2050 \text{ L/m}^2/\text{day}$. Determine the volume of the filter and its depth. Also calculate the efficiency of this filter unit. Assume suitable data if required.

Q9) Answer the following. **[6+4=10]**

- a) What is Membrane Filtration? What are the selection criteria for membrane selection?
- b) Give note on -Advanced Oxidation Processes (AOPs).

OR

Q10) Answer the following. **[4+6=10]**

- a) Compare sludge drying beds with mechanical dewatering methods.
- b) Explain the mechanisms of membrane fouling and state methods of mitigation.



Total No. of Questions : 8]

SEAT No. :

PE5999

[Total No. of Pages : 2

[6585]-502

M.E. (Civil) (Environmental Engineering)

**PCC-502-ENE : GEO-INFORMATICS FOR ENVIRONMENTAL
ENGINEERING**

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.*
- 2) *Figures to the right indicates full marks.*
- 3) *Use of calculator is allowed.*
- 4) *Assume suitable data if necessary.*

Q1) a) Write a detailed note on Geoinformatics in detail. **[5]**

b) Discuss the fundamental principles and explain in detail the historical developments of Remote Sensing. **[4]**

OR

Q2) a) Write in detail about Electromagnetic Radiation. **[4]**

b) What is the multi-concept of Remote Sensing? Explain multi-date, multi-spectral and multi-angular sensing in detail with examples. **[5]**

Q3) Describe in detail, the role of Digital Image Processing in Remote Sensing.

Explain the following:

a) Atmospheric Correction **[3]**

b) Radiometric Correction **[3]**

c) Geometric Correction **[3]**

OR

Q4) Describe in detail, Principal Component Analysis (PCA) and discuss its applications in image analysis. **[9]**

P.T.O.

- Q5)** a) Write a detailed note on significance in mapping and remote sensing. [8]
b) Differentiate between vertical, low-oblique and high-oblique photographs. Support your answer with suitable example. [8]

OR

- Q6)** a) Describe the principles of stereoscopy. Explain in detail, the concepts of forward overlap, side overlap and scale calculation required for stereo-pair formation and 3D viewing. [8]
b) Discuss the role of programming in geospatial data processing. Explain in detail, how Python and R are used in geospatial analysis with examples of common libraries and operations. [8]

- Q7)** a) Which are the different types of geospatial data ? Write the applications in geospatial analysis. [8]
b) Define Abstract Data Types (ADTs). How abstract data types are used in representing geospatial applications? [8]

OR

- Q8)** a) What is reflectance spectroscopy and explain in detail, its role in hyperspectral remote sensing? [8]
b) Mention the importance of dimensionality reduction in hyperspectral datasets. Explain in detail: PCA and feature selection, also elaborate your answer with suitable examples. [8]



Total No. of Questions : 10]

SEAT No. :

PE6000

[Total No. of Pages : 2

[6585]-503

M.E. (Civil - Environmental Engineering)

**PCC-503-ENE : ADVANCED ENVIRONMENTAL CHEMISTRY
& MICROBIOLOGY**

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Figures to the right indicate full marks.
- 3) Your answer will be valued as a whole.
- 4) Assume suitable data, if necessary.
- 5) Use of electronic pocket calculator and steam table is allowed.

Q1) Answer the following : **[10]**

- a) Explain in detail adsorption with a simple example relevant to pollution control.
- b) What is acid-base equilibrium? Explain its importance in acid rain chemistry in detail.

OR

Q2) Answer the following : **[10]**

- a) What is biodegradation? State in detail its advantages and disadvantages.
- b) What are enzymes? How are they used in biological wastewater treatment?

Q3) Answer the following : **[10]**

- a) Explain in detail, how does temperature influence the rate of atmospheric chemical reactions.
- b) Explain in detail the process of rain scrubbing. State its significance.

OR

Q4) Answer the following : **[10]**

- a) Describe in detail the formation of acidic aerosols through chemical reactions.
- b) Explain in detail the formation of peroxyacyl nitrates (PANs) under sunlight.

Q5) Answer the following : **[10]**

- a) What is environmental persistence and why do some compounds resist degradation? Explain in detail.
- b) What environmental factors influence the rate of hydrocarbon degradation? Explain in detail.

OR

P.T.O.

Q6) Answer the following : **[10]**

- a) How does DDT bio accumulate in the food chain? State its long term health impacts.
- b) What are modified surfactants? Give one example and its application.

Q7) Answer the following : **[10]**

- a) What are microplastics? What are the potential health risks of microplastics to humans?
- b) List out various compounds of lead and explain in detail it's pathways of environmental dispersion.

OR

Q8) Answer the following : **[10]**

- a) What are biodegradable plastics? State its advantages in detail.
- b) Explain in detail why single used Plastics are considered as major source of environmental pollution?

Q9) Answer the following : **[10]**

- a) What are the main environmental impacts of industrial wastewater? Explain in detail.
- b) What is ion chromatography? What types of ions can be detected using IC? Explain in detail.

OR

Q10) Answer the following : **[10]**

- a) Write a detailed note on staining techniques.
- b) Explain in detail working of flame photometer.



Total No. of Questions : 10]

SEAT No. :

PE12205

[6585]-503CR

[Total No. of Pages : 2

M.E. (Civil-Environmental Engineering)

**PCC-503-ENE : ADVANCED ENVIRONMENTAL CHEMISTRY
& MICROBIOLOGY
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) Your Answer will be valued at whole.*
- 3) Figures to the right indicates full marks.*
- 4) Assume Suitable data, if necessary.*
- 5) Use of electronic pocket calculator and steam table is allowed.*

Q1) Answer the following.

[10]

- a) Define half-life. Why is it important in nuclear waste management?
- b) Explain in detail with example Tyndall effect? State its significance.

OR

Q2) Answer the following.

[10]

- a) What is adsorption? Explain in detail the importance of adsorption phenomenon for pollution control.
- b) Explain in detail aerobic and anaerobic respiration in microorganisms.

Q3) Answer the following.

[10]

- a) Describe in detail effects of following things on pollutants in atmosphere-
 - i) Temperature
 - ii) Wind current
- b) Describe in detail the vertical movement of pollutants in the boundary layer.

OR

P.T.O.

Q4) Answer the following. [10]

- a) Describe in detail the process of transport of pollutants by wind.
- b) What is thermal inversion and in detail how does temperature affect pollutant trapping?

Q5) Answer the following. [10]

- a) Explain in detail the ecological impact of oil spills on aquatic ecosystems?
- b) Describe the biodegradation of linear alkylbenzene sulfonates (LAS) in detail.

OR

Q6) Answer the following. [10]

- a) Explain in detail photodegradation and its relevance in pesticide breakdown?
- b) What is pesticide drift? Why is it dangerous? in detail.

Q7) Answer the following. [10]

- a) What environmental factors affect the rate of polymer degradation? in detail.
- b) Describe in detail dispersion mechanism of lead through water and soil.

OR

Q8) Answer the following. [10]

- a) What are Microplastics? Explain in detail their sources.
- b) Describe in detail classification of pesticides and their chemical stability.

Q9) Answer the following. [10]

- a) Discuss in detail the scope of Environmental Microbiology.
- b) Explain in detail high performance liquid chromatography.

OR

Q10) Answer the following. [10]

- a) Explain in detail microbial cell structure with neat sketch.
- b) Enlist and explain in detail the various methods of enumeration of microorganism.



Total No. of Questions :10]

SEAT No. :

PE12001

[Total No. of Pages : 2

[6585]-504

M.E. (Civil-Environmental Engineering)

PCC-504-ENE : ENVIRONMENTAL IMPACT ASSESSMENT

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Figures to the right indicate full marks.
- 3) Your answers will be valued as a whole.
- 4) Assume suitable data, if necessary.
- 5) Use of electronic pocket calculator.

Q1) a) Explain in detail different methods used in EIA for predicting environmental impacts. **[5]**

b) Describe the role of matrices in impact identification within EIA. **[5]**

OR

Q2) a) What are project thresholds in EIA? Explain with suitable examples. **[5]**

b) Explain in detail the need for public participation in the EIA process. **[5]**

Q3) a) Discuss the concept and objectives of Life Cycle Assessment (LCA) in environmental Management. **[5]**

b) What is an Environmental Setting? Describe its key components in the context of project site evaluation. **[5]**

OR

Q4) a) Define the Water Quality Index (WQI). Explain in detail how it is used to interpret water quality status. **[5]**

b) Describe interaction matrix methodologies used in EIA with suitable examples. **[5]**

Q5) a) Discuss the basic concepts of noise pollution and its major sources in urban environments. **[5]**

b) Explain in detail the concept of air quality standards and discuss their importance in environmental regulation. **[5]**

OR

P.T.O.

- Q6)** a) Describe the process of impact prediction and assessment in air pollution Studies. [5]
b) Explain in detail existing noise level standards and their importance in noise impact assessment. [5]

- Q7)** a) Explain in detail the process of impact prediction and assessment in water quality evaluation. [5]
b) Describe the basic characteristics and components of the soil environment essential for impact assessment. [5]

OR

- Q8)** a) Explain in detail the purpose and major provisions of the Clean Water Act. [5]
b) Describe the basic characteristics and components of the soil environment essential for impact assessment. [5]

- Q9)** a) Apply the impact assessment process to evaluate the effect of a proposed dam project on archaeological or cultural heritage sites in the region. [5]
b) Discuss the rules and regulations related to the protection of archaeological and historical structures during development projects. [5]

OR

- Q10)a)** Explain in detail the significance of E-Waste Management Rules 2016 and Construction & Demolition Waste Management Rules 2016 in sustainable development [5]
b) Describe the procedure for preparing a Consent Form I in the documentation of EIA. [5]



Total No. of Questions : 10]

SEAT No. :

PE12139

[Total No. of Pages : 2

[6585]-505

M.E. (Civil - Structure)

**PCC-501-STR : THEORY OF ELASTICITY AND PLASTICITY
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data, if necessary and clearly state.

- Q1)** a) Obtain the strain displacement relations for the six independent strain components in an elastic body. [5]
b) Write short notes on Airy's Stress Function. [5]

OR

- Q2)** a) Derive the equilibrium equation for three dimensional problem considering body forces as F_x , F_y and F_z along X, Y and Z. direction respectively. [5]
b) Write short notes on [5]
i) Plane stress and Plane strain.
ii) Spherical coordinates.

- Q3)** a) Explain the generalized Hook's law for isotropic material [5]
b) Examine the given strain field satisfy the compatibility condition or not
 $\epsilon_x = 2x^2 + 3y^2 + z + 1$, $\epsilon_y = x^2 + 2y^2 + 3z + 1$, $\epsilon_z = 3x^2 + 2y + z^2 + 1$,
 $\gamma_{xy} = 10xy$, $\gamma_{yz} = \gamma_{xz} = 0$. [5]

OR

- Q4)** a) Explain boundary condition for plate element and respective forces. [5]
b) Derive the strain-displacement relation in polar coordinate system. [5]

- Q5)** a) A rectangular bar of size 40 mm $\times$ 20 mm is subjected to a torque of 50 N.m. Using the approximate torsion constant formula for rectangles, calculate the maximum shear stress. [5]
b) Derive the torsion formula for rectangular cross section of size (a, b) using Prandtl's stress function as $\phi = p(x^2 - c^2)(y - d^2)$. [5]

OR

P.T.O.

- Q6)** a) Derive the torsion formula for elliptical cross section of boundary condition as $x^2/a^2 + y^2/b^2 = 1$. [5]
b) Derive the relationship between the applied torque T and the Prandtl's stress function ϕ . [5]

- Q7)** a) Define strain energy and explain its role in elasticity-based analysis. [5]
b) State and explain the Principle of Virtual Work for an elastic body. [5]

OR

- Q8)** a) Using the Rayleigh - Ritz method, estimate the tip deflection of a cantilever beam of length 2m carrying a point load P at the free end. Assume a trial function $y = ax^2$. [5]
b) Explain the finite difference method (FDM) and its application to beam bending analysis. [5]

- Q9)** a) A mild steel bar is subjected to the following principal stresses : [5]
 $\sigma_1 = 180 \text{ MPa}$, $\sigma_2 = 60 \text{ MPa}$, $\sigma_3 = 0$.
Check for yielding using :

- i) Tresca criterion
- ii) von Mises criterion

Take yield stress = 250 MPa

- b) What is limit analysis? State and explain the upper bound and lower bound theorems. [5]

OR

- Q10)**a) Describe the von Mises yield criterion and compare it with the Tresca criterion for ductile metals. [5]
b) Derive the Tresca yield criterion and discuss its yield surface in principal stress space. [5]

x x x

Total No. of Questions : 10]

SEAT No. :

PE12002

[Total No. of Pages : 3

[6585]-506

M.E. (Civil-Structures)

PCC-502-STR : STRUCTURAL DYNAMICS

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*

- Q1)** a) A concrete platform of dimensions $9.0 \text{ m} \times 9.0 \text{ m} \times 1.5 \text{ m}$ supports a machine weighing 444.8 kN . The platform is supported by four concrete columns of height 7.62 m , each with a cross-section of $0.60 \text{ m} \times 0.60 \text{ m}$, fixed at the base and rigidly connected to the platform. Assuming the concrete modulus of elasticity $E_c = 24.8 \text{ GPa}$ and unit weight of concrete $\gamma = 23,590 \text{ N/m}^3$, determine the lateral natural frequency of the platform. **[5]**
- b) For a damped SDOF system where m , c and k are known to be $m = 1 \text{ kg}$, $c = 2 \text{ N} \cdot \frac{\text{s}}{\text{m}}$, and $k = 10 \text{ N/m}$. Calculate the value of ζ and w_n . Is the system overdamped, underdamped or critically damped? **[5]**

OR

- Q2)** A single-degree-of-freedom system with mass 1500 kg , stiffness $1.8 \times 10^6 \text{ N/m}$, and damping ratio 0.04 is subjected to a harmonic force of amplitude 20 kN acting at a frequency of 30 rad/s . Determine the steady-state displacement amplitude and the corresponding dynamic amplification factor for the system, and comment on how the amplification would change if the damping ratio is increased to 0.10 . **[10]**

- Q3)** A SDOF system has mass $m = 250 \text{ kg}$, stiffness $k = 150 \text{ kN/m}$, and damping coefficient $c = 1000 \text{ N.s/m}$. The system is initially at rest and subjected to a time-varying force $F(t)$ defined as: **[10]**

$$F(t) = \begin{cases} 0 & t < 0 \\ 1000 \text{ N} & 0 \leq t \leq 2 \text{ s} \\ 2000 \text{ N} & t > 2 \text{ s} \end{cases}$$

Use Duhamel's integral to determine the displacement $x(t)$ at $t = 3 \text{ s}$.

OR

P.T.O.

Q4) A damped SDOF system with mass $m = 1000 \text{ kg}$, stiffness $k = 200 \text{ kN/m}$, and damping coefficient $c = 1500 \text{ N}\cdot\text{s/m}$ is subjected to a harmonic ground displacement $y(t) = 5 \sin(10t) \text{ mm}$. Determine the steady-state amplitude of the relative displacement of the mass. [10]

Q5) Determine the eigenvalues and eigenvectors for the building shown in Fig. 3 [10]

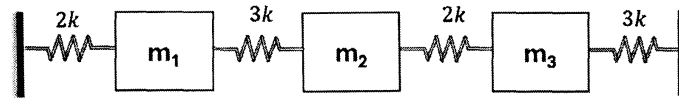


Fig. 3

OR

Q6) Determine the eigenvalues and eigenvectors for the system shown in Fig. 4 [10]

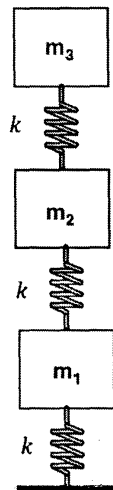


Fig. 4

- Q7)** a) Compare tuned mass dampers, base isolation, and viscous dampers in terms of governing principles, energy dissipation mechanisms, and typical applications. [5]
- b) Explain the concept of lengthening the fundamental period through base isolation. How does this reduce seismic forces on superstructures? [5]

OR

- Q8)** a) Describe the key components of an active vibration control system. How do sensors, controllers, and actuators work together to reduce dynamic response? [5]
- b) Discuss the advantages of buckling-restrained braces over conventional bracings for vibration control. [5]

- Q9)** a) Explain the Wilson- θ method and its advantage over Newmark- β in nonlinear dynamic analysis. [5]
- b) Define stability and convergence in numerical time integration of dynamic systems. [5]

OR

- Q10)** a) How does the average acceleration method calculate displacement and velocity at each time step? [5]
- b) What is the difference between direct integration and modal superposition in MDOF dynamic analysis? [5]



Total No. of Questions : 10]

SEAT No. :

PE12003

[Total No. of Pages : 3

[6585]-507

M.E. (Civil Engineering) (Structures)
PCC-503-STR : STRUCTURAL MECHANICS
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

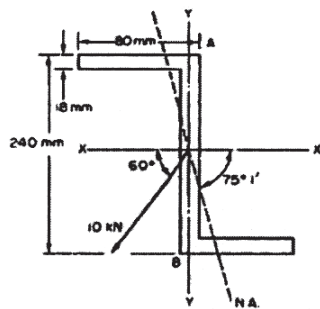
- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Figures to the right indicate full marks.
- 3) Assume suitable data if necessary.
- 4) Use of non programmable calculator is allowed.

Q1) A compound cylinder is made by shrinking a cylinder of external diameter 300 mm and internal diameter of 250 mm over another cylinder of external diameter 250 mm and internal diameter 200 mm. The radial pressure at the junction after shrinking is 8N/mm^2 . Find the final stresses set up across the section, when the compound cylinder is subjected to an internal fluid pressure of 84.5N/mm^2 . [10]

OR

- Q2)** a) A boiler is subjected to an internal steam pressure of 2N/mm^2 . The thickness of boiler plate is 2cm and permissible tensile stress is 120N/mm^2 . Find out the maximum diameter when efficiency of longitudinal joint is 80% and that of circumferential joint is 30%. [5]
- b) A water main 80cm diameter contains water at a pressure head of 100m. If the weight density of water is 9810N/m^3 , find the thickness of the metal required for the water main given the permission stress as 20N/mm^2 . [5]

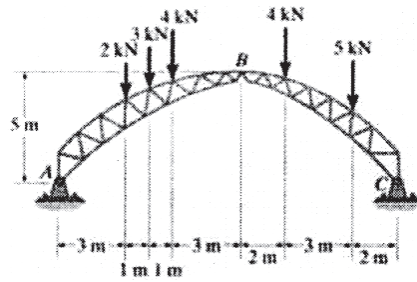
Q3) A horizontal cantilever 2 m long is constructed from the Z-section shown below. A load of 10KN is applied to the end of the cantilever at an angle of 60° to the horizontal as shown. Assuming that no twisting moment is applied to the section, determine the stresses at points A and B. [10]
($I_{xx} = 48.3 \times 10^{-6}\text{ m}^4$, $I_{yy} = 4.4 \times 10^{-6}\text{ m}^4$).



OR

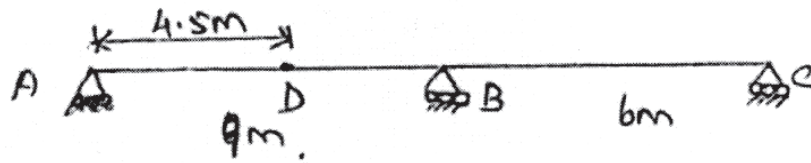
P.T.O.

- Q4) a)** Determine the resultant forces at the pins A, B and C of the three hinged arched roof truss. [5]



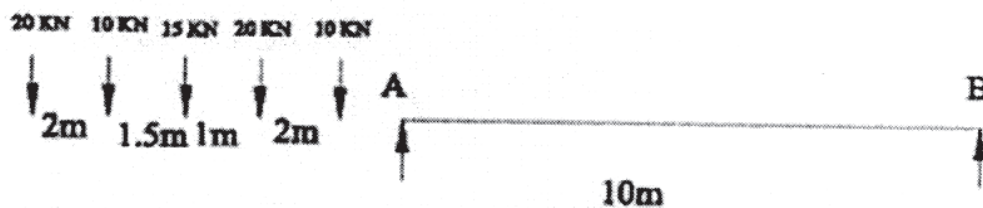
- b) Locate the position of shear centre for a thin channel section having total depth of 500mm, width of flange 150mm and thickness of web and flange is 10 mm each. [5]

- Q5)** Using Muller Breslau principle, draw the influence line for bending moment at the mid-point of span AB of the continuous beam ABC shown in fig, determine the influence line ordinate at suitable intervals and plot them. [10]



OR

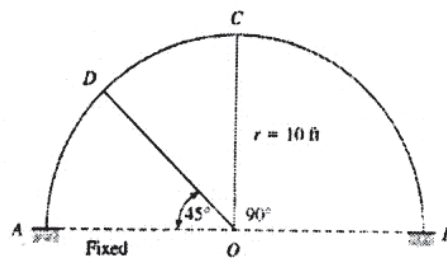
- Q6)** A system of concentrated load, role beam left to right, s.s beam span of 10m and 10kN load leading. [10]



Find :

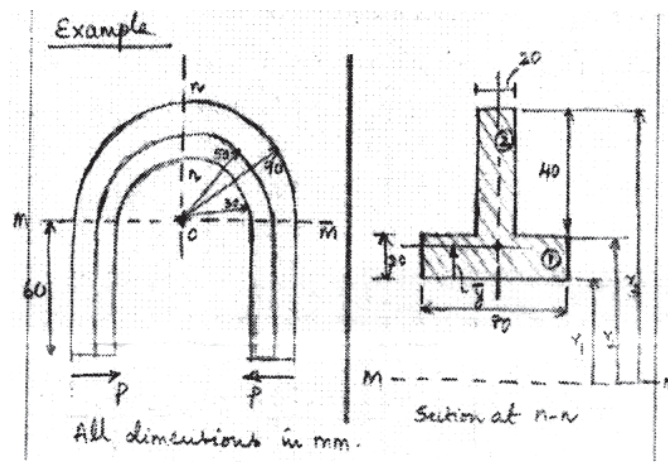
- Absolute max +ve S.F
- Absolute max -ve S.F
- Absolute max BM

- Q7)** Determine the factored bending and torsional moments in sections C and D of the 3.05m radius semicircular beam ADCB shown in Fig. The beam is part of a floor slab that carries a uniform factored load of 14.556kN/m^2 (including self-weight). [10]



OR

- Q8)** A curved beam is subjected to end loads as shown, if the allowable compressive stress is 50 MPa ; find the largest P applicable. [10]



- Q9)** a) In a portal frame, how does the $P \Delta$ moment change if the story height is doubled while the lateral drift stays the same? [5]
 b) Explain key ingredients of a second order stability check. [5]

OR

- Q10)** a) What is the “ $P \Delta$ ” effect and why does it arise only in a geometrically nonlinear analysis? How does the element stiffness matrix change when geometric nonlinearity is included? [5]
 b) Explain typical failure modes one can see due to p-effect in a frame. [5]



Total No. of Questions : 10]

SEAT No. :

PE12206

[6585]-507CR

[Total No. of Pages : 4

M.E. (Civil-Structures)

PCC-503-STR : STRUCTURAL MECHANICS

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Assume suitable data, if necessary.*

- Q1)** a) Define hoop strain, longitudinal strain, and volumetric strain in a thin cylinder. Derive the expression for total volumetric strain. [5]
- b) A cylindrical shell of 1 m diameter and 12 mm thickness is subjected to an internal pressure of 1.5 MPa. Find the hoop strain and longitudinal strain if $E = 200 \text{ GPa}$ and Poisson's ratio $= 0.3$. [5]

OR

- Q2)** a) A thin-walled cylindrical vessel has internal diameter $D=900$, wall thickness $t=10 \text{ mm}$ and length $L=3.0 \text{ m}$. It is closed at both ends and carries an internal pressure $p=1.2 \text{ MPa}$. Material properties: $E=200 \text{ GPa}$, Poisson's ratio $\nu=0.30$. Neglect end-cap bending. Determine:
- i) Hoop (circumferential) stress σ_θ and longitudinal stress σ_l .
 - ii) Hoop strain ϵ_θ , longitudinal strain ϵ_l .
 - iii) Approximate volumetric strain of the vessel $\Delta V/V$ due to elastic deformation of the shell (ignore fluid compressibility). [5]
- b) A cylindrical pressure vessel with internal diameter 120 mm and external diameter 240 mm is subjected to an internal pressure of 60 MPa. Calculate the maximum hoop stress and radial stress. [5]
- Q3)** a) Explain unsymmetrical bending of beams. Why does bending occur simultaneously about both axes in asymmetric cross-sections? [5]
- b) A channel section beam 600mm over all depth 450mm wide flanges of thickness 20 mm and 20mm thick web is subjected to a bending moment of 4 kN-m about an axis inclined 20° from the principal axis. Calculate the stress at the top and bottom edges due to unsymmetrical bending. [5]

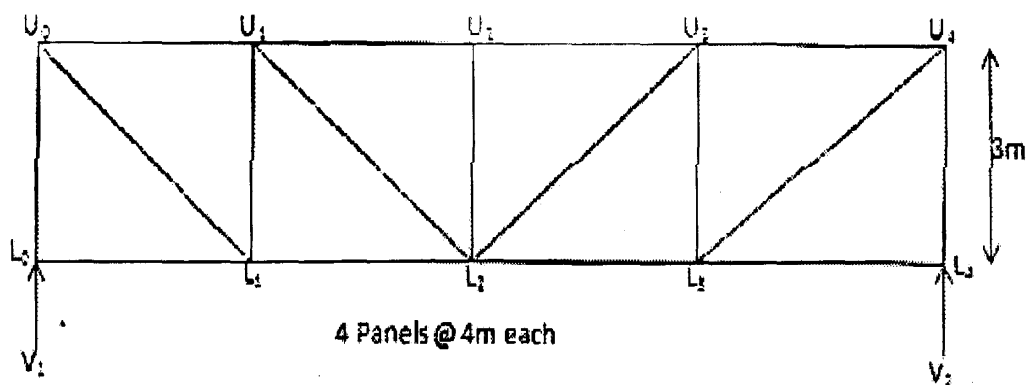
OR

P.T.O.

- Q4) a)** A thin-walled, closed rectangular section with a uniform wall thickness of 6 mm encloses an area of 4200 mm² and is subjected to an applied torque of 800 Nm; using thin-walled closed-section torsion theory, determine the shear flow and the shear stress in the wall due to the applied torque. [5]
- b) A three-hinged parabolic arch with a span of 20 m and rise 5 m carries a point load of 20 kN at 5 m from the left support. Determine: Horizontal thrust and Bending moment at 5 m. [5]
- Q5) a)** Draw the ILD for the reaction at support A of a simply supported beam of 10 m span. Using the ILD, determine the reaction at A when a 25 kN load is placed 3 m from support A. Also draw ILD for SF and BM. [5]
- b) A simply supported beam of span 20 m carries a single moving load of 50 kN. Determine the absolute maximum bending moment and sketch the ordinate positions on the ILD. [5]

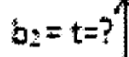
OR

- Q6) a)** Draw ILD for a trough truss shown in figure for members U₁U₂, L₁L₂, U₁L₂. If this truss is traversed by udl of intensity 10kN/m, longer than span then, determine maximum tension and compressive forces in above members. [5]



- b) A continuous beam ABC with spans AB = 12 m and BC = 10 m is subjected to a moving UDL of 20 kN/m over the spans. Find the maximum negative moment at support B using ILD methods. [5]

- [5]**



- [5]

3

- Q8) a)** A curved beam is subjected to a bending moment of 2 kN/m. The section is rectangular: width = 30 mm and depth = 60 mm. Radius of curvature = 100 mm. Using Winkler-Bach theory, determine the maximum tensile and compressive stresses. [5]
- b) A curved beam used in a machine frame has an I-section with inner radius 120 mm. A bending moment of 3 kN·m is applied. Find the maximum bending stresses using curved-beam formulae. [5]
- Q9) a)** Explain the difference between $P-\Delta$ and $P-\delta$ effects with suitable diagrams. Discuss how each influences the stability of slender columns or frames. [5]
- b) A simply supported beam of span $L = 6.0$ m has a rectangular $b = 150$ mm $d = 300$ mm and steel yield $f_y = 250$ MPa. Using plastic hinge theory, find the collapse load P_c for a concentrated central load. [5]

OR

- Q10) a)** A pin-ended column 3 m long carries an axial load of 300 kN and a transverse load of 10 kN at mid-height. $EI = 2 \times 10^4$ kNm². Use the $P-\Delta$ method to compute the mid-span deflection and the maximum moment considering second-order effects. Assume small initial sway $\Delta = 10$ mm at top. [5]
- b) Explain the $P-\Delta$ effect and derive the additional moment produced by an axial load P when the structure has an overall lateral displacement Δ . [5]



Total No. of Questions :10]

SEAT No. :

PE12004

[Total No. of Pages : 3

[6585]-508

M.E. (Civil) (Structures)

**PCC-504-STR : DESIGN OF PRESTRESSED CONCRETE
STRUCTURES
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Use of non-programmable electronics calculator is allowed.*
- 5) *Assume suitable data, if necessary.*
- 6) *Assessment will be based on complete solution and not on final answer.*
- 7) *IS : 1343, allowed in the examination.*

Q1) a) Explain in detail the codal provisions for calculating creep, shrinkage, and relaxation losses as per IS 1343. **[5]**

b) A prestressed beam 200 mm wide and 300 mm deep, is prestressed by 10 wires of 7 mm diameter initially stressed to 1200 N/mm^2 , with their centroid located 100 mm from the soffit. Find the maximum stress in concrete immediately after transfer, allowing only for elastic shortening of concrete. **[5]**

OR

Q2) a) Discuss the materials used for prestressing: high-strength steel and high-strength concrete. **[5]**

b) A post tensioned concrete beam of rectangular section 100 mm wide and 300 mm deep is stressed by a parabolic cable with zero eccentricity at the support and an eccentricity of 50 mm at the centre of span. The area of the cable is 200 mm^2 and initial stress in the cable is 1200 N/mm^2 . If the ultimate creep strain is $30 \times 10^{-6} \text{ mm/mm}$ per N/mm^2 of stress and modulus of elasticity of steel is $2.1 \times 10^5 \text{ N/mm}^2$. Calculate the loss of stress instead only due to creep of concrete. **[5]**

P.T.O.

- Q3) a)** Explain the concept of Pressure Line (Line of Thrust) in PSC beams. [5]
- b)** Using IS code, determine the ultimate moment capacity of a post tension bounded beam of T section having flange 1.5m wide and 0.3m thick. The total area of prestressing steel is 4725 mm² and its centroid is 2.1 m below the top face. Concrete is of M-45 grade and ultimate tensile strength of prestressing steel is 1500 N/mm². [5]

OR

- Q4) a)** State the assumptions of IS: 1343 in the elastic analysis of flexure for PSC members. [5]
- b)** A pretensioned prestressed concrete beam having rectangular section 150 mm wide and 350 mm deep has an effective cover of 50 mm. if $f_{ck} = 40 \text{ N/mm}^2$, $f_b = 1600 \text{ N/mm}^2$ and the area of prestressing steel $A_p = 461 \text{ mm}^2$, calculate the ultimate flexural strength of this section using IS-1343 code provisions. [5]

- Q5)** The cross-section of the prestressed concrete beam is rectangular with a width of 350 mm and a depth of 700 mm. The prestressing force of 180 kN acts at an eccentricity of 190 mm. If bending and twisting moments at the section are 80 and 20 kN.m, respectively, calculate the maximum principal tensile stresses. [10]

OR

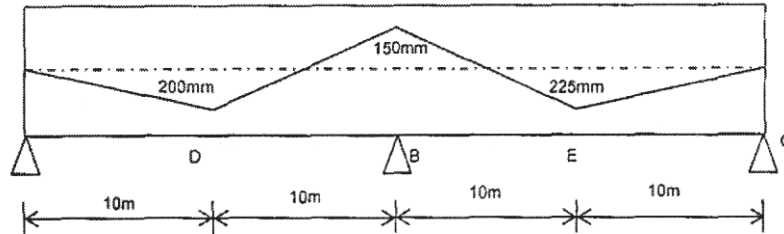
- Q6)** The end block of post tensioned prestressed concrete beam 300 mm wide and 300 mm deep is subjected to a concentric anchorage force of 832800 N by a Freyssinet anchorage of area 11720 mm². Design and detail the anchorage reinforcement for the end block. [10]

- Q7)** A continuous beam ABC (AB=BC=10 m) has rectangular section 400 mm wide and 650 mm deep. The beam is prestressed by concordant cable having a cross-sectional area of 1200 mm², located 50 mm from the soffit at midspan points and 50 mm from the top of the beam at B. If the beam supports two concentrated loads of 200 kN each at mid span points, determine the load factor against the collapse assuming [10]

- a)** Elastic distribution of moments and
- b)** Complete redistribution of moments Assume $f_p = 1600 \text{ N/mm}^2$ and $f_{ck} = 40 \text{ N/mm}^2$.

OR

- Q8)** Fig. shows a two-span continuous beam. Corresponding to the cable profile provided locate the pressure line due to prestress alone. The prestressing force is 1250 kN. **[10]**



- Q9)** Design a post tensioned prestressed concrete two-way slab $6\text{m} \times 9\text{m}$ with discontinuous edges, to supports an imposed load of 3 kN/m^2 . Cables of 4 wires of 5 mm diameter carrying an effective force of 100 kN are available for use. Design spacing of the cable in two directions Assume $f_{ck} = 40\text{ N/mm}^2$ and $f_p = 1600\text{ N/mm}^2$, $E_c = 38\text{ kN/m}^2$. **[10]**

OR

- Q10)** Design a continuous prestressed flat slab floor of overall size $16\text{ m} \times 16\text{ m}$. The column is spaced at 7.5 m intervals in the perpendicular direction. The floor slab has to support a superimposed load 3 kN/m^2 . Freyssinet cables consisting of 12 wires of 5 mm diameter stressed to 1000 N/mm^2 , are available for use. Determine the number of cables required and their spacing in each direction. **[10]**



Total No. of Questions : 10]

SEAT No. :

PE12005

[Total No. of Pages : 3

[6585]-509

M.E. (Civil) (Construction Management)

PCC-501-CON : CONSTRUCTION MANAGEMENT &

PROJECT PLANNING

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Use of electronic pocket calculator is allowed.*
- 5) *Use of cell phone is prohibited in the examination hall.*
- 6) *Assume Suitable data if necessary and clearly state.*

- Q1)** a) Discuss the functions of management in detail. [5]
b) Explain the Hawthorne Experiments conducted by Elton Mayo and their implications. [5]

OR

- Q2)** a) Critically evaluate the role of a Project Manager in a large construction project. [5]
b) Select any five of Henry Fayol's Fourteen Principles of Management and explain how a Construction Project Manager can apply them to improve efficiency, productivity and team coordination on a large-scale infrastructure project. [5]

- Q3)** a) Develop complete Work Breakdown Structure (WBS) for a single storied R.C.C. residential bungalow assuming suitable data. [5]
b) Solve the following CPM Network problem. [5]
i) Draw CPM network
ii) State the critical path and find out total project duration.
iii) Calculate total float for each activity.

Activity	Immediate Predecessor	Duration (Days)
A	-	3
B	-	4
C	A	5
D	B	6
E	C, D	2

OR

P.T.O.

Q4) a) Discuss the primary role of specialized Construction Scheduling Software in modern project management. Analyze three key features of such software as compared to manual Gantt chart or hand-drawn network diagram. [5]

b) Explain the concept of Line of Balance (LOB) technique and its suitability in construction. [5]

Q5) a) Explain how MIS improves project management efficiency. [5]

b) You are the Project Manager monitoring a project using Earned Value Analysis (EVA). At the end of Month 3, you have the following data: [5]

- Planned Value (PV): Rs. 5,00,000
- Earned Value (EV): Rs. 4,50,000
- Actual Cost (AC): Rs. 4,80,000

Calculate the Schedule Performance Index (SPI) and Cost Performance Index (CPI). Evaluate the project's status based on these indices.

OR

Q6) a) Analyze the importance of the Monthly Cement Consumption Report. How does the "Theoretical vs. Actual" comparison in this report help in controlling project costs and quality? [5]

b) Explain the process of Project Updating. How is it different from simple project monitoring and what are the three specific inputs required to update a schedule network? [5]

Q7) a) Analyze the Indirect Costs versus the Direct Costs of a construction injury. Justify that "Safety is an investment, not a cost". [5]

b) Evaluate the role of a Safety Audit in a construction organization. How does it differ from a routine site inspection, and what are the three key phases of conducting an effective audit? [5]

OR

Q8) a) Explain how FMEA can be applied to crane operations. [5]

b) A 3-meter deep trench is being excavated for a sewer line in loose soil. Apply your knowledge of Construction Hazards to identify the specific risks involved and list the safety measures (including shoring types) required to prevent a cave-in. [5]

Q9) a) Define “Work Study” and explain its two main techniques: Method Study and Work Measurement. How do these two techniques complement each other to improve productivity in construction? [5]

b) Analyze the utility of a String Diagram in a workshop or a pre-cast yard. How is it different from a Flow Process Chart and what specific problem does it help identify and solve? [5]

OR

Q10) a) Define job Evaluation and Merit Rating. Differentiate between the two concepts regarding their focus and objective in an organization. [5]

b) Describe symbols used in Flow Process Charts with a suitable example. [5]



Total No. of Questions : 10]

SEAT No. :

PE12006

[Total No. of Pages : 2

[6585]-510

M.E. (Civil-Construction Management)

PCC-502-CON : CONSTRUCTION TECHNOLOGY

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Use of electronic pocket calculator is allowed.*
- 5) *Use of cell phone is prohibited in the examination hall.*
- 6) *Assume suitable data, if necessary.*

Q1) a) Classify piles based on their function and explain the difference between End Bearing Piles and Friction Piles. [5]

b) Analyze the factors governing the selection of pile foundations over shallow foundations. [5]

OR

Q2) a) Define Pile Cap and Pile Shoe. What are their functions in pile construction? [5]

b) Analyze the common causes of failure of piles and suggest precautionary measures. [5]

Q3) a) Define tunnel alignment. Analyze the factors controlling the alignment of a tunnel. [5]

b) Explain the “Heading and Bench” method of tunnelling in hard rock. [5]

OR

Q4) a) Discuss the purpose of Tunnel Shafts and the procedure for sinking them. [5]

b) What is Tunnel Lining? Enlist the types of lining materials and their specific uses. [5]

P.T.O.

- Q5)** a) List the common problems encountered during underwater excavation and briefly explain each. [5]
- b) Explain Jet Grouting and describe a situation where it is most suitable. [5]

OR

- Q6)** a) Analyze different dewatering methods for shallow and deep excavations. When should each method be used? [5]
- b) Illustrate the working principle of the Well Point System for dewatering. [5]

- Q7)** a) Classify Cofferdams based on their construction type and state three criteria for their selection. [5]
- b) Define a Caisson. Differentiate between Box Caissons and Open Caissons based on their structural action and suitability. [5]

OR

- Q8)** a) Describe the construction sequence and critical design features of a Double Wall Sheet Pile Cofferdam. [5]
- b) Explain the role of the Cutting Edge and the corrective measures taken to address Tilting during caisson sinking. [5]

- Q9)** a) Explain the important design features of good shuttering. [5]
- b) Describe the operation and key components of a Ready Mix Concrete (RMC) Plant. [5]

OR

- Q10)** a) Propose a concrete placement plan for a high-rise building using RMC, pumped concrete and SCC. Justify your choices. [5]
- b) Explain the principle and procedural requirements for placing underwater concrete using the Tremie method. [5]



Total No. of Questions : 10]

SEAT No. :

PE12007

[Total No. of Pages : 2

[6585]-511

M.E. (Civil - Construction Management)

PCC-503-CON : TOTAL QUALITY MANAGEMENT

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data if necessary.
- 5) Use of cell phone is prohibited in the examination hall.
- 6) Use of electronic pocket calculator is allowed.

Q1) a) Describe the four stages of the PDCA Cycle and explain how this cycle is used for monitoring and continuous improvement in quality on a construction project. [5]

b) Discuss barriers to implementing TQM in the construction sector. [5]

OR

Q2) a) Differentiate clearly between Quality Control (QC) and Quality Assurance (QA), giving a practical example from a construction site for each. [5]

b) Describe the contribution on Philip Cross-by for quality management process. [5]

Q3) a) Explain Statistical Quality Control (SQC) and discuss its necessity in modern construction industry. [5]

b) Differentiate between Destructive Tests and Non-Destructive Tests used for quality control of RCC work. Give two specific examples of each. [5]

OR

Q4) a) Explain the purpose of testing construction materials used in RCC and discuss the importance of quality verification. [5]

b) Explain the Fishbone (Cause-and-Effect/Ishikawa) Diagram and discuss how it is used to identify root causes of construction quality issues. [5]

Q5) a) Describe how 360° feedback can be effectively used to evaluate and improve the quality performance of a site manager or project engineer. [5]

b) Define Six Sigma and explain its historical evolution. Why is a Six Sigma rating considered an effective tool in TQM? [5]

OR

P.T.O.

Q6) a) Justify the application of the Six Sigma tool for reducing defects in the execution of PQC layers in road construction. [5]

b) Discuss the objectives and structure of Quality Circles in construction project management. [5]

Q7) a) Elaborate in detail certification step process for ISO 9001. [5]

b) Distinguish clearly between the ISO 9001 and ISO 9004 standards based on their purpose, application, and certification status. [5]

OR

Q8) a) Explain the purpose and importance of Project Rework Reduction Tool (PRRT) in quality management. [5]

b) Elaborate on the steps involved in conducting a Training Needs Assessment for human resources involved in a quality management system. [5]

Q9) a) Define Non-Conformity Report (NCR). Describe strategies to reduce incidences of NCR in RCC work. [5]

b) Explain the concept and purpose of Quality Functions Deployment (QFD) and its importance in translating customer needs into technical construction requirements. [5]

OR

Q10) a) Write a note on - Quality functions deployment Construction Projects. [5]

b) Highlight five significant barriers commonly encountered during the implementation of TQM in a construction firm, and suggest a strategy to overcome one of them. [5]



Total No. of Questions : 10]

SEAT No. :

PE12207

[6585]-511CR

[Total No. of Pages : 2

M.E. (Civil-Construction Management)

PCC-503-CON : TOTAL QUALITY MANAGEMENT

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right indicates full marks.*
- 4) Assume Suitable data, if necessary and clearly state.*
- 5) Use of cell phone is prohibited in the examination hall.*
- 6) Use of electronic pocket calculator is allowed.*

- Q1)** a) Discuss barriers to implementing TQM in the construction sector. [5]
- b) Discuss contribution of W. Edwards Deming to the development of quality management with 14 principles. [5]

OR

- Q2)** a) Explain The PDCA Cycle (Plan-Do-Check-Act) and discuss how it supports continuous quality improvement. [5]
- b) Describe the contribution of Philip Cross-by for quality management process. [5]

OR

- Q3)** a) Describe how Pareto Analysis (80/20 Rule) helps identify major quality problems in construction projects. [5]
- b) Explain the Fishbone (Cause-and-Effect/Ishikawa) Diagram and discuss how it is used to identify root causes of construction quality issues. [5]
- Q4)** a) Explain Statistical Quality Control (SQC) and discuss its necessity in modern construction industry. [5]
- b) Explain the purpose of testing construction materials used in RCC and discuss the importance of quality verification. [5]

P.T.O.

- Q5)** a) Discuss the objectives and structure of Quality Circles in construction project management. [5]
- b) Explain the role of Six Sigma in monitoring Pavement Quality Concrete layers and ensuring durability. [5]

OR

- Q6)** a) Write a detailed note on 360° Feedback for quality improvement in construction. [5]
- b) Describe the process and significance of preparing Inspection Reports at different stages of construction. [5]

- Q7)** a) Explain the purpose and importance of Project Rework Reduction Tool (PRRT) in quality management. [5]
- b) Discuss why leadership commitment is critical for QMS success. [5]

OR

- Q8)** a) Elaborate in detail Certification step process for ISO 9001. [5]
- b) Explain the role of strategic planning and quality vision for achieving ISO implementation. [5]
- Q9)** a) Explain CIDC-CQRA rating systems in construction. [5]
- b) Write note on-Quality functions deployment Construction Projects. [5]

OR

- Q10)**a) Discuss any seven types of construction defects and give remedy to reduce it. [5]
- b) Define Non-Conformity Report (NCR). Describe strategies to reduce incidences of NCR in RCC work. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12158

[Total No. of Pages : 2

[6585]-512

M.E. (Civil Engineering) (Construction Management)
PCC-504-CON : MATERIAL MANAGEMENT
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagram must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

- Q1)** a) Discuss Circular Economy in Construction Materials. **[5]**
b) Explain in detail impact of international logistics and global sourcing. **[5]**

OR

- Q2)** a) Describe Net Zero Material Management. **[5]**
b) Illustrate with suitable examples how inter departmental coordination helps in effective material management. **[5]**

- Q3)** a) Explain with suitable examples how codification and classification help in reducing material wastage and errors on site. **[4]**
b) The ten materials listed below are used by a construction company in one of its key projects. Calculate the annual consumption value and categorize the products into A, B, and C classes. **[6]**

Item No.	Material Description	Annual Usage(Units)	Unit Price (Rs.)
1	Cement (bags)	20,000	350
2	Steel (tons)	200	55,000
3	Bricks (Units)	2,00,000	7
4	Paint (liters)	1,500	500
5	Sand(cu.m.)	1,000	1,200
6	Tiles (sq. m.)	5,000	250
7	Plywood (sheets)	1,000	1,000
8	Electrical cables (m)	10,000	70
9	Plumbing Fittings (sets)	800	1,500
10	Glass panels (sq. ft)	2,000	500

P.T.O.

OR

- Q4)** a) Explain Sustainable Procurement Strategies (SPS). [6]
b) List and explain four key criteria used for selecting vendors in construction projects. [4]
- Q5)** a) Explain the significance of proper site layout and site organization in the efficient storage and handling of construction materials. [5]
b) Explain EOQ and Solve the following Example: [5]
A grocery store sells 10 cases of coffee each week. Each case costs 80. The cost of placing an order is 10. Holding or carrying cost is estimated to be 30% of the inventory.
 $D = 520$ case/year
 $C_c = ₹10$ per order
 $C_1 = 30\%$
 $P = ₹80$ per case

OR

- Q6)** a) What are the objectives and benefits of Just-in-time (JIT) adoption of construction site? [5]
b) Enumerate the functions of stores and discuss the procedure relating to receipt, stocking and issue of material. [5]
- Q7)** a) Explain the role of statistical methods in quality control of construction processes. [5]
b) Explain the concept of Life Cycle Assessment (LCA) and its importance in construction material selection. [5]

OR

- Q8)** a) Discuss the necessity of on-site quality control and its economic benefits. [5]
b) Suggest the quality control checklists for accepting materials below : [5]
a) Cement
b) Steel

- Q9)** a) How Material Management System (MMS) can help in controlling material costs and enhance project performance. [5]
b) Explain the role of AI in construction material planning. [5]

OR

- Q10)** a) Describe the common types of construction waste in building projects and methods for their disposal or recycling. [5]
b) Discuss the application of Enterprise Resource Planning (ERP) in material management. [5]



Total No. of Questions : 10]

SEAT No. :

PE12140

[6585]-513

[Total No. of Pages : 3

M.E. (Computer Engineering) (Computer Networks)
PCC-501- COM : PROBABILITY AND STATISTICS
(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicates full marks.
- 4) Assume Suitable data, if necessary.

Q1) a) Solve $2x - 6y + 8z = 24$ **[5]**

$$5x + 4y - 3z = 2$$

$$3x + y + 2z = 16$$

Using Gauss-Jordan Elimination Method

- b) Let $a = (1, 2, -1)$ $b = (2, -1, 3)$ Find their dot product, angle between them, and state whether they are orthogonal. **[5]**

OR

Q2) a) Solve the linear system of equation by Matrix method **[5]**

$$x + y + z = 6$$

$$2x - y + z = 5$$

$$x + 2y + 3z = 10$$

- b) If $\vec{u} = (3, -1, 2)$ and $\vec{v} = (2, 1, -2)$ then find $\langle 2\vec{u} + 3\vec{v}, 3\vec{u} - \vec{v} \rangle$ **[5]**

Q3) a) Analyze and transform the following quadratic form $Q(x) = 6x^2 + 3y^2 + 3z^2 - 4xy + 4xz - 2yz$ to canonical form by congruent transformation. **[5]**

- b) Find the Eigen Values and Eigen Vector of largest Eigen Value for Matrix **[5]**

$$A = \begin{bmatrix} -2 & 5 & 4 \\ 5 & 7 & 5 \\ 4 & 5 & -2 \end{bmatrix}$$

OR

P.T.O.

Q4) a) Diagonalize Matrix $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ Find Modal Matrix P which diagonalizes A. [5]

b) Verify whether the following matrix $A = \frac{1}{3} \begin{bmatrix} 1 & 2 & 2 \\ 2 & -2 & 1 \\ 2 & 1 & -2 \end{bmatrix}$ is Orthogonal or Not. If Orthogonal write A^{-1} . [5]

Q5) a) For the vector field $F(x, y, z) = (xy + yz + xz)$. Find the divergence and curl. [5]

b) Write a short note on directional derivative. [5]

OR

Q6) a) Find $\nabla \cdot (\nabla \times \vec{F})$ for $\vec{F} = x^2\hat{i} + y^2\hat{j} + z^2\hat{k}$ [5]

b) Write short note on [5]

i) Inner product

ii) Divergence of a vector field

Q7) a) Box A contains 5 red marbles and 3 blue marbles and box B contains 3 red marbles and 2 blue marbles. A marble is drawn at random from each box. [5]

i) Find the probability that both marbles are red.

ii) Find the probability that one is red and one is blue marble.

b) Differentiate between discrete and continuous random variables with examples. [5]

OR

Q8) a) The marks of students in an exam are normally distributed with mean 50 and standard deviation 5. Find the probability that a student scores: [5]

i) less than 45

ii) between 45 and 55

b) Compare Binomial and Poisson distributions. [5]

- Q9)** a) The observed frequencies of dice rolls (1-6) in 60 throws are: 8, 10, 12, 11, 9, 10. Test at 5% level whether the die is fair. [5]
- b) Explain the following terms: [5]
- Type I error
 - Type II error

OR

- Q10)a)** The figure given below are (a) the theoretical frequencies of a distribution and (b) the frequencies of a normal distribution having the same mean, standard deviation and the total frequency as in (a) [5]

(a)	1	5	20	28	42	22	15	5	2
(b)	1	6	18	25	40	25	18	6	1

Apply the χ^2 test of goodness of fit. Assume: Table Value: $\chi^2_{6.005} = 12.592$

- b) Explain the terms [5]
- Point Estimation
 - Interval Estimation



Total No. of Questions : 10]

SEAT No. :

PE12008

[Total No. of Pages : 2

[6585]-514

M.E. (Computer Engineering)

PCC-502- COM : ADVANCED ALGORITHMS

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right indicates full marks.*
- 4) Assume Suitable data if necessary.*

Q1) a) What is significance of algorithms in computing and how do they impact the efficiency of a program? **[5]**

b) Describe dynamic programming with examples of algorithms. What are the characteristics of problems that can be solved using dynamic programming. **[5]**

OR

Q2) a) Describe greedy method with examples of algorithms. What are the characteristics of problems that can be solved using the greedy method. **[5]**

b) Explain the branch and bound method with examples of algorithms (e.g. travelling salesman problem, Knapsack problem). **[5]**

Q3) a) How does dynamic programming differ from divide-and-conquer approach? **[5]**

b) What is linear programming? Explain its use in real world applications. **[5]**

OR

Q4) a) What is time complexity of dynamic programming approach for calculating binomial coefficients. **[5]**

b) Discuss the simplex method for solving linear programming problems. Explain the steps involved and provide an example. **[5]**

P.T.O.

- Q5)** a) Explain the reasons for using randomized algorithms, including simplicity, efficiency and robustness. Provide examples to illustrate each reason. [5]
b) Explain the min cut problem and how randomized algorithms can be used to solve it efficiently. [5]

OR

- Q6)** a) Describe the concept of race conditions and how they can occur in parallel algorithms. [5]
b) Write short note on following: [5]
i) Naive string matching algorithm
ii) Rabin-Karp Algorithm

- Q7)** a) Explain the importance of geometric algorithms in various fields such as computer graphics, robotics and geographic information system. [5]
b) Describe segment intersection problem and its applications. Explain any one algorithm for finding segment intersections. [5]

OR

- Q8)** a) Explain the concept of genetic algorithms. Describe the different components of genetic algorithms. [5]
b) Explain the applications of optimization algorithms in various fields, including machine learning, finance & engineering. [5]

- Q9)** a) Explain the definitions & relationships between the classes P, NP, NP-complete and NP-Hard. [5]
b) Explain the PCP and its undecidability. Describe how PCP is used to prove the undecidability of other problems. [5]

OR

- Q10)** a) Describe how the P Vs NP problem relates to cryptography. [5]
b) Describe Cook reductions and their relationship to polynomial-time reductions. [5]



Total No. of Questions : 10]

SEAT No. :

PE12009

[Total No. of Pages : 2

[6585]-515

M.E. (Computer Engineering)

PCC-503-COM : MACHINE LEARNING

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of non programmable calculator is allowed.
- 5) Assume suitable data if necessary.

Q1) a) Explain Pattern Representation and Pattern Recognition with a neat example. [5]

b) Describe Bayes' Decision Theory and its role in classification. [5]

OR

Q2) a) Explain Linear Regression and K-Nearest Neighbor (KNN) algorithms with examples. [5]

b) Write a short note on Parametric Methods : MLE, Bias, Variance, and Gaussian Estimation. [5]

Q3) a) Explain Kernel Methods and list different types of kernels with examples. [5]

b) Describe Principal Component Analysis (PCA) and its applications. [5]

OR

Q4) a) Explain Hidden Markov Models (HMM) with a suitable example. [5]

b) Write a short note on Non-parametric Density Estimation using Parzen Window Method. [5]

Q5) a) Explain the basic architecture of CNN with neat labeled diagram. [5]

b) Describe the role of Convolution and Pooling layers in CNN. [5]

OR

P.T.O.

- Q6)** a) Explain Fully Connected Layers and their importance in CNN. [5]
b) Write a short note on Applications of CNN in real-world problems. [5]

- Q7)** a) Explain the basic architecture of Recurrent Neural Networks (RNN). [5]
b) Describe the Encoder-Decoder Sequence to Sequence Model with example. [5]

OR

- Q8)** a) Explain LSTM (Long Short-Term Memory) with gating mechanism. [5]
b) Write a short note on Optimization for Long-Term Dependencies. [5]

- Q9)** a) Explain Ensemble Learning Methods with suitable examples. [5]
b) Describe Support Vector Machines (SVM) and its applications. [5]

OR

- Q10)** a) Explain Dimensionality Reduction Techniques used in Machine Learning. [5]
b) Write a short note on Machine Learning Applications in Fraud Detection and Medical Diagnosis. [5]



Total No. of Questions : 10]

SEAT No. :

PE12208

[6585]-515CR

[Total No. of Pages : 2

M.E. (Computer Engineering)
PCC-503-COM : MACHINE LEARNING
(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Use of electronic pocket calculator is allowed.*
- 5) *Assume suitable data if necessary.*

- Q1)** a) Explain Bayes' Decision Theory with suitable real-world example. [5]
- b) Describe Maximum Likelihood Estimation and its role in supervised learning. [5]

OR

- Q2)** a) Explain Naïve Bayes algorithm with mathematical formulation. [5]
- b) Write short notes on any two: [5]
- i) Hidden Markov Models (HMM)
 - ii) Decision Trees
 - iii) Parametric Classification

- Q3)** a) What are Kernel Methods? Describe different types of Kernels. [5]
- b) Describe the steps of Principal Component Analysis (PCA) with mathematical formulation. [5]

OR

- Q4)** a) Explain the Parzen-Window Method with suitable diagrams. [5]
- b) Describe Markov Decision Processes with a practical example. [5]

P.T.O.

- Q5)** a) What is a Convolution operation? Explain stride, padding and receptive field. [5]
b) Describe common CNN applications in image classification, object detection and segmentation. [5]

OR

- Q6)** a) Describe the role of Fully Connected Layers in CNN architecture. [5]
b) What is the neuroscientific basis for Convolutional Networks? Explain with example. [5]

- Q7)** a) Explain Long Short-Term Memory (LSTM) architecture. [5]
b) What are Deep Recurrent Networks? Explain their advantages and challenges. [5]

OR

- Q8)** a) Explain different types of Recurrent Neural Networks (RNN) with diagrams. [5]
b) Explain the importance of gating mechanisms in solving long-term dependency problems. Give suitable examples. [5]

- Q9)** a) What is Deep Learning? Explain how deep neural networks differ from traditional machine learning models. [5]
b) Explain how machine learning techniques are used for fraud detection in banking or online transactions. [5]

OR

- Q10)** a) Describe the role of Deep Learning in computer vision applications such as image classification or object detection. [5]
b) How is machine learning applied in medical diagnosis? Explain any real-world healthcare application. [5]



Total No. of Questions :10]

SEAT No. :

PE12010

[Total No. of Pages : 2

[6585]-516

M.E. (Computer Engineering)

PCC-504-COM : DISTRIBUTED COMPUTING

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Assume suitable data, if necessary.*

Q1) a) Discuss the concept of global state in a distributed system with an example. **[5]**

b) Explain the design issues involved in distributed computing systems. **[5]**

OR

Q2) a) What are the challenges in achieving consistency in distributed system? **[5]**

b) Discuss the message-passing and shared-memory communication models with diagrams and examples. **[5]**

Q3) a) Explain total ordering in distributed message communication. **[5]**

b) Differentiate between scalar time and vector time with examples. **[5]**

OR

Q4) a) Explain the concept of physical clock synchronization using NTP. **[5]**

b) Discuss snapshot algorithms for FIFO channels. **[5]**

Q5) a) Explain Suzuki-kasami's Broadcast Algorithm with an example. **[5]**

b) Explain the system model used for distributed deadlock detection. **[5]**

OR

Q6) a) Compare Ricart-Agrawala and Lamport's algorithms on the basis of message complexity, fairness, and performance. **[5]**

b) Explain the Chandy-Misra-Haas algorithm for the OR model. **[5]**

P.T.O.

- Q7)** a) Describe the role of timeouts and rounds in consensus protocols. [5]
b) Explain the consensus problem with its properties: agreement, validity, and termination. [5]

OR

- Q8)** a) Explain in detail why deterministic consensus cannot be achieved in asynchronous systems with failures (FLP theorem). [5]
b) Explain uncoordinated check pointing and its issues with global consistency. [5]

- Q9)** a) Elaborate in detail the cloud service models: IaaS, PaaS, SaaS. [5]
b) Explain the importance of autoscaling in compute services. [5]

OR

- Q10)** a) Discuss different pricing models for compute and storage services. [5]
b) Discuss application-layer services such as: [5]
i) Managed databases
ii) Queueing services
iii) API gateways
iv) Messaging systems



Total No. of Questions : 5]

SEAT No. :

PE12011

[6585]-517

[Total No. of Pages : 1

M.E. (Computer Networks)

PCC-502-CNT : ADVANCED COMPUTER NETWORKS

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right indicate full marks.*
- 4) Assume suitable data, if necessary.*

- Q1)** a) Compare TCP/IP Model and OSI Model. [5]
b) What are equal-sized packets? Explain their importance in ATM networks. [5]
- Q2)** a) Explain how a router builds its routing table? Discuss direct routes, static routes. [5]
b) Describe how OSPF builds a complete network map using LSAs and calculates shortest paths using Dijkstra's algorithm. [5]
- Q3)** a) Explain the concept of VLANs. Describe how VLANs improve network performance, security and traffic management. [5]
b) Explain the purpose of STP. Describe how STP prevents loops in Layer 2 networks using blocking and forwarding states? [5]
- Q4)** a) Compare LANs and WANs in terms of architecture, speed, coverage, devices and cost. [5]
b) Describe the concept of Network Address Translation (NAT). Explain how NAT maps private IP addresses to public IP addresses? [5]
- Q5)** a) Discuss the architecture of SDN, including SDN controller, southbound and northbound interfaces and applications. [5]
b) Discuss the advantages and limitations of optical fiber networks. Include aspects like bandwidth, attenuation and interference. [5]



Total No. of Questions : 10]

SEAT No. :

PE12012

[Total No. of Pages : 2

[6585]-518

M.E. (Computer Networks)

PCC-503-CNT : DISTRIBUTED SYSTEMS

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer any five questions.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data if necessary.*

Q1) a) Describe the different System Models and Architectural Models of distributed systems. **[5]**

b) Explain the difference between Client-Server and Group Communication models with example. **[5]**

OR

Q2) a) Explain the concept of External Data Representation and Marshalling. **[5]**

b) Explain the concept of Resource Sharing in distributed systems with example. **[5]**

Q3) a) Describe the concept of Remote Procedure Call and how it facilitates communication between distributed objects. **[5]**

b) Explain Cryptographic Algorithms and Access Control. **[5]**

OR

Q4) a) Explain the purpose of Kerberos in securing distributed systems. How does it address the problem of secure electronic transactions? **[5]**

b) Describe Needham-Schroeder authentication protocol. **[5]**

Q5) a) Explain the distributed Snapshots algorithm. **[5]**

b) Explain the concepts of Name Services and Directory and Discovery Services with reference to the Domain Name System (DNS). **[5]**

OR

P.T.O.

- Q6)** a) Define Clock Synchronization and explain why it is essential in distributed systems. [5]
- b) Differentiate between Data-Centric Consistency and Client-Centric Consistency models with example. [5]

- Q7)** a) What is a Distributed Transaction? Explain the role of Atomic Commit Protocols (ACPs) in ensuring atomicity across multiple sites. [5]
- b) Discuss how Locks and Optimistic Concurrency Control mechanisms are used to manage concurrent access to shared resources in distributed transactions. [5]

OR

- Q8)** a) Describe the structure and purpose of a Nested Transaction. How do nested transactions help in managing complex operations in a distributed environment? [5]
- b) Explain the concept of distributed Deadlocks and briefly discuss any one method for its detection or prevention. [5]

- Q9)** a) Explain the algorithm for Leader Election in a Ring network. [5]
- b) Explain the problem of Mutual Exclusion in the Asynchronous Shared Memory Model. [5]

OR

- Q10)** a) What is an I/O Automata? Explain the concept of Fairness and its importance. [5]
- b) Explain the function of Termination Detection and how it is used in distributed algorithms to determine when a distributed computation is complete. [5]



Total No. of Questions :10]

SEAT No. :

PE12013

[Total No. of Pages : 2

[6585]-519

M.E. (Computer Networks)

PCC-504-CNT : BLOCKCHAIN TECHNOLOGY

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Numeric figures in square brackets [] indicate full marks.
- 4) Assume suitable data, if necessary.

Q1) a) Explain the role of encryption and key management in ensuring blockchain security. **[5]**

b) Analyze how blockchain improves healthcare data integrity and privacy. **[5]**

OR

Q2) a) Describe DeFi liquidity pools and explain how they enable decentralized trading. **[4]**

b) Discuss the process of creating, minting, and trading an NFT with an example. **[6]**

Q3) a) Explain sharding as a scalability technique and how it improves throughput. **[5]**

b) Compare Layer 2 scaling solutions with block size increase approaches. **[5]**

OR

Q4) a) Describe the need for consensus mechanism optimization and explain any two methods. **[5]**

b) Illustrate transaction processing optimization for reducing network congestion. **[5]**

P.T.O.

Q5) a) What are AI-powered smart contracts? Explain their architecture with an example. [5]

b) Evaluate predictive maintenance as a Blockchain and AI application. [5]

OR

Q6) a) Discuss decentralized AI models and how blockchain enhances trust in AI decisions. [5]

b) Explain cross-chain bridges and their role in multi-chain AI applications. [5]

Q7) a) Explain the architecture of Blockchain-as-a-Service (BaaS) with examples. [5]

b) Analyze challenges and opportunities in blockchain and cloud integration. [5]

OR

Q8) a) Describe how cloud-based node infrastructure supports scalable blockchain deployments. [5]

b) Discuss scalable blockchain solutions in cloud environments with justification. [5]

Q9) a) Explain blockchain applications in banking and financial services with examples. [5]

b) Analyze how blockchain improves supply chain transparency and traceability. [5]

OR

Q10)a) Discuss blockchain applications in healthcare and how it ensures security and interoperability. [5]

b) Evaluate the impact of blockchain in IoT and energy sectors with examples. [5]



Total No. of Questions : 10]

SEAT No. :

PE12014

[Total No. of Pages : 2

[6585]-520

M.E. (Electrical Control System)

**PCC-501-COS : OPTIMIZATION TECHNIQUES IN
CONTROL SYSTEM
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Assume suitable data, if necessary and clearly state.*
- 5) *Use of electronic pocket calculator is allowed.*

Q1) a) Illustrate limitations of using differential calculus for optimization. **[5]**

b) Explain the Hessian matrix? What does it indicate? **[5]**

OR

Q2) a) Calculate the local maxima and minima of $f(x) = x^3 - 3x + 2$. **[5]**

b) What are the necessary conditions for extrema using Lagrange multipliers? **[5]**

Q3) a) Explain the optimality conditions for multivariable functions without constraints. **[5]**

b) Describe the components of an optimization problem with an example. **[5]**

OR

Q4) a) Minimize $f(x) = x^2 - 4x + 5$ Determine the optimal value x^* that minimizes the objective function. The minimum value of the function $f(x^*)$. **[5]**

b) Explain the steepest descent method. Why is it also called the gradient descent method? **[5]**

Q5) a) Explain Linear Programming Problem (LPP). **[5]**

b) Illustrate the main difference between Simplex and Revised Simplex Method. **[5]**

OR

P.T.O.

Q6) a) Explain the dual of an LPP. [5]

b) Write the dual of the following function. [5]

Max $Z = 3x_1 + 2x_2$ subject to

$$2x_1 + x_2 \leq 8$$

$$x_1 + 3x_2 \leq 15$$

$$x_1, x_2 \geq 0$$

Q7) a) Explain the structure of multistage decision problems with a block diagram. [5]

b) Describe the principle of optimality with a block diagram. [5]

OR

Q8) a) Differentiate deterministic and stochastic multistage decision processes with examples. [5]

b) Explain sub-optimization and principle of optimality. [5]

Q9) a) Explain the steps involved in solving a Nonlinear Programming Problem. [5]

b) Explain stochastic programming in detail. Discuss types, structure, and applications. [5]

OR

Q10)a) Explain Geometry Cut Method (Gomory Cuts) using example. [5]

b) Describe the Branch-and-Bound method in brief. [5]



Total No. of Questions :10]

SEAT No. :

PE12015

[Total No. of Pages : 2

[6585]-521

M.E. (Electrical) (Control Systems)

PCC-502-COS : AUTOMATION IN MANUFACTURING

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, or Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Figures to the right indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.

Q1) a) Classify the main types of industrial timers. **[5]**

b) Illustrate the advantages of using PLCs in industrial automation. **[5]**

OR

Q2) a) Explain when PID gains are not properly tuned. **[5]**

b) State different types of transducer for displacement measurement. **[5]**

Q3) a) Explain the significance of pre-loading in ball screws. **[5]**

b) Illustrate the common wear and failure issues in cam systems. **[5]**

OR

Q4) a) Explain with neat diagram the construction and working of stepper motor.
Write equation for step angle. **[5]**

b) Write a Short note on servomechanism. **[5]**

Q5) a) Differentiate Hydraulic and Pneumatic actuating systems. **[5]**

b) Explain different components of Pneumatic actuating system **[5]**

OR

P.T.O.

- Q6)** a) Explain different components of Hydraulic actuating system. [5]
b) Explain classification of Hydraulic Pumps. [5]

- Q7)** a) Explain the architecture of Cyber Physical system. [5]
b) State advantages of Cyber Physical system in Manufacturing. [5]

OR

- Q8)** a) Explain two examples of CPS that are expected to have a high impact. [5]
b) Explain the terms cyber physical system and cyber physical production system. Explain the two main functional components of cyber physical system and its architecture. [5]

- Q9)** a) How does Industry 4.0 differ from previous industrial revolutions? Explain key technologies driving Industry 4.0? [5]
b) Explain characteristics of Industry 4.0. [5]

OR

- Q10)** a) Illustrate the End-to-End Digital Integration mean in Industry 4.0. [5]
b) Explain the impact of cyber security and data protection in Industry 4.0. [5]



Total No. of Questions : 10]

SEAT No. :

PE12016

[Total No. of Pages : 2

[6585]-522

M.E. Electrical (Control Systems)

**PCC-503-COS : SYSTEM IDENTIFICATION AND ADAPTIVE
CONTROL
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) Figures to the right indicate full marks.*
- 3) Neat diagrams must be drawn wherever necessary.*

- Q1)** a) Define parametric model and give two examples. [5]
b) Discuss the practical differences between ARX and ARMAX in industrial systems. [5]

OR

- Q2)** a) Why are Box-Jenkins models preferred in chemical process plants? [5]
b) What is the importance of persistently exciting input signal in system identification? What order of p.e. is white noise? [5]

- Q3)** a) Explain the Maximum Likelihood Estimation (MLE) approach for system identification. [5]
b) Explain the instrumental variable method for identification of systems with correlated noise. [5]

OR

- Q4)** a) Discuss the Prediction Error Method (PEM) for system identification. [5]
b) Define convergence and consistency in parameter estimation. [5]

- Q5)** a) Derive the prediction and correction equations of a linear Kalman filter. [5]
b) Explain the role of the Kalman Filter as a state estimator for linear systems. [5]

OR

P.T.O.

- Q6)** a) Derive the discrete-time Kalman estimator equations. [5]
b) Explain the architecture of a Dual Extended Kalman Filter (DEKF). [5]

- Q7)** a) Explain the process of pattern recognition in learning systems. [5]
b) Compare parametric and nonparametric estimators in terms of model assumptions. [5]

OR

- Q8)** a) Explain how Bayesian decision theory is applied to pattern recognition. [5]
b) Explain unsupervised learning and its role in pattern recognition. [5]

- Q9)** a) Explain Lyapunov stability theory and its relevance in adaptive controller design. [5]
b) Discuss limitations and practical challenges of MIT Rule. [5]

OR

- Q10)** a) Explain Self-Tuning Regulators (STR). [5]
b) Describe and compare different MPC algorithms. [5]



Total No. of Questions : 10]

SEAT No. :

PE12209

[6585]-522CR

[Total No. of Pages : 2

M.E. Electrical (Control Systems)

**PCC-503-COS : SYSTEM IDENTIFICATION AND ADAPTIVE
CONTROL**

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*

- Q1)** a) Explain ARMAX, Box-Jenkins models. [5]
- b) Explain the importance of persistently exciting input signal in system identification? What order of p.e. is white noise? [5]

OR

- Q2)** a) Why are Box-Jenkins models preferred in chemical process plants? [5]
- b) Discuss the practical differences between ARX and ARMAX in industrial systems. [5]

- Q3)** a) Define convergence and consistency in parameter estimation. [5]
- b) Discuss the Prediction Error Method (PEM) for system identification. [5]

OR

- Q4)** a) Discuss the Prediction Error Method (PEM) for system identification. [5]
- b) Explain the instrumental variable method for identification of systems with correlated noise. [5]

- Q5)** a) Explain the role of the Kalman Filter as a state estimator for linear systems. [5]
- b) Explain the architecture of a Dual Extended Kalman Filter (DEKF). [5]

OR

P.T.O.

- Q6)** a) Derive the prediction and correction equations of a linear Kalman filter. [5]
b) Explain the discrete-time state-space model including process and measurement noise. [5]

- Q7)** a) Explain the difference between parametric and nonparametric learning methods. [5]
b) Explain unsupervised learning and its role in pattern recognition. [5]

OR

- Q8)** a) Explain how Bayesian decision theory is applied to pattern recognition. [5]
b) Explain the process of pattern recognition in learning systems. [5]

- Q9)** a) Explain Self-Tuning Regulators (STR). [5]
b) Explain Model Reference Adaptive Control (MRAC) architecture in detail. [5]

OR

- Q10)** a) Explain the MIT rule in adaptive control. [5]
b) Explain Lyapunov stability theory and its relevance in adaptive controller design. [5]



Total No. of Questions :10]

SEAT No. :

PE12017

[Total No. of Pages : 2

[6585]-523

M.E. (Electrical) (Control Systems)

**PCC-504-COS : INDUSTRIAL AUTOMATION & CONTROL
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Questions from Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Explain the typical hierarchical architecture of an industrial automation system. **[5]**

b) Describe the role of AC and DC relays in load control circuits. **[5]**

OR

Q2) a) Explain the difference between centralized automation systems and distributed automation systems (DAS/DCS). **[5]**

b) Discuss the function of auxiliary contacts in relay and contactor circuits. How do they support signaling, feedback, and interlocking? **[5]**

Q3) a) Compare manual tuning Vs auto-tuning of PID controllers. Discuss advantages and limitations of each. **[5]**

b) Describe the steps involved in designing a feedforward controller. What information about the process is required? **[5]**

OR

Q4) a) Discuss the effect of time delay on stability and performance of a closed-loop control system. **[5]**

b) Describe the challenges inverse response systems create for PID controllers. **[5]**

P.T.O.

- Q5) a)** Describe the steps involved in developing a sequence control strategy for a packaging or assembly process. [5]
- b)** Explain the structure of Relay Ladder Logic. Why is RLL widely used for programming PLCs? [5]

OR

- Q6) a)** Explain the structured design approach for developing sequence control logic. [5]
- b)** Describe linear, circular, and parabolic interpolation techniques used in CNC motion control. [5]

- Q7) a)** List the main components of a hydraulic system and describe their functions. [5]
- b)** Describe the difference between open-loop and closed-loop hydraulic control systems. [5]

OR

- Q8) a)** Explain how speed control of hydraulic actuators is achieved. [5]
- b)** What is sequencing in hydraulic circuits? Give examples. [5]

- Q9) a)** Explain the concept of V/f control and its significance in AC drive operation. [5]
- b)** What precautions should be taken when wiring AC drive input power, especially regarding earthing and shielding? [5]

OR

- Q10)a)** Explain the procedure for verifying the auto-tuning function of an AC drive. [5]
- b)** Explain the working principle of a DC motor drive using controlled rectifiers. [5]



Total No. of Questions : 10]

SEAT No. :

PE12018

[Total No. of Pages : 2

[6585]-524

M.E. Electrical (Electrical Engineering) (Power Systems)

PCC-501-ELE : POWER SYSTEM MODELING

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Neat diagram must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data, if necessary and clearly state.
- 5) Use of non-programmable calculator is allowed.

Q1) a) Explain the importance of modeling in power system analysis. Discuss how modeling improves planning, operation, and stability assessment of power systems. [5]

b) Classify different types of models used in power system analysis. Explain any two in detail with applications. [5]

OR

Q2) a) Describe simplified models of steam turbine and governor system with neat block diagram. Explain their relevance in dynamic studies. [5]

b) Explain the role of modeling in power system planning, analysis, and stability studies. [5]

Q3) a) Using Park's transformation, derive current and flux linkage models for dynamic simulation. [5]

b) Evaluate the significance of linearized models in dynamic stability analysis of power systems. [5]

OR

Q4) a) Compare steady-state models and dynamic models of power systems with suitable illustrations. [5]

b) Explain the development of a model for steady-state analysis. List assumptions and limitations. [5]

Q5) a) Explain the behaviour of a synchronous machine connected to an infinite bus during steady-state operation. [5]

b) Describe power-angle relationship and stability of synchronous machine connected to an infinite bus. [5]

OR

P.T.O.

- Q6)** a) Draw and explain the block diagram for transient simulation of a synchronous machine connected to an infinite bus. [5]
- b) Describe the modeling of the synchronous machine for transient performance analysis. [5]

- Q7)** a) Draw the block diagram of a basic excitation control scheme and explain components. [5]
- b) Explain how change in excitation affects system parameters like voltage, reactive power, and stability. [5]

OR

- Q8)** a) Explain how change in excitation affects system parameters like voltage, reactive power, synchronizing torque, and system stability. [5]
- b) Compare electro-mechanical voltage regulator and solid-state voltage regulator based on accuracy, response, and performance. [5]

- Q9)** a) Explain Brushless excitation system (rotating diode type) and describe its modeling aspects. [5]
- b) Describe the working, modeling, and control features of field-controlled alternator rectifier system (stationary diode type). [5]

OR

- Q10)** a) Compare self-excited and separately excited DC generator exciter systems with suitable block diagrams and modeling characteristics. [5]
- b) • Design and explain a static excitation system using. [5]
- Potential source-controlled rectifier system
 - Compound source-controlled rectifier system



Total No. of Questions :10]

SEAT No. :

PE12019

[Total No. of Pages : 2

[6585]-525

M.E. Electrical (Electrical Engg./Power Systems)

PCC-502-ELE- POS : ADVANCED POWER ELECTRONICS

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Assume suitable additional data, if necessary.*
- 5) *Use of non-programmable calculator is allowed.*

Q1) a) Describe the topology of a 3-level voltage source converter. Explain its advantages. **[5]**

b) Explain the working principle of a PWM voltage source converter. **[5]**

OR

Q2) a) Explain the PWM harmonic elimination technique. **[5]**

b) Explain how third-harmonic component used to increase the linear modulation range. **[5]**

Q3) a) Describe the operation of a line-commutated current source converter. **[5]**

b) Explain the operating principle of a matrix converter. **[5]**

OR

Q4) a) Explain why Current Source Converters require special protection schemes? **[5]**

b) Compare a 3×3 matrix converter with a traditional multi-pulse converter in terms of size, harmonic performance, power factor, and hardware complexity. **[5]**

P.T.O.

- Q5) a)** Explain the structure and operation of a diode-clamped multilevel inverter. [5]
- b) Describe the role of multilevel inverters in a back-to-back intertie system. [5]

OR

- Q6) a)** Discuss the switching device current requirements in different multilevel inverter topologies. [5]
- b) Compare flying-capacitor and cascaded multilevel converters with respect to switching device count, voltage balancing, reliability, and control complexity. [5]
- Q7) a)** Describe the role of power electronics in interfacing Flywheel energy storage system with the grid. [5]
- b) Explain the operating principle of a superconducting magnetic energy storage (SMES) system. [5]

OR

- Q8) a)** Explain the major advantages and limitations of flywheel energy storage systems. [5]
- b) Explain any one advanced electrochemical energy storage technology. [5]
- Q9) a)** Explain the working of a series resonant inverter using bidirectional switches. [5]
- b) Compare series and parallel resonant converters. [5]

OR

- Q10)a)** Explain the operation of a parallel resonant inverter. [5]
- b) Describe the operation of a Class-E resonant inverter. [5]



Total No. of Questions :10]

SEAT No. :

PE12159

[Total No. of Pages : 2

[6585]-526

M.E. Electrical (Electrical Engineering/Power Systems)
PCC-503-ELE-POS: COMPUTER APPLICATIONS IN POWER SYSTEMS
(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt any one from Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Assume suitable data if necessary.*
- 5) *Use of non-programmable calculator is allowed.*

Q1) a) What is an objective function? Explain different types of objective functions used in optimization problems. **[5]**

b) Explain the Direct Substitution Method. What are its advantages and limitations when applied to constrained optimization problems? **[5]**

OR

Q2) a) Describe the methodology of single-variable optimization. Explain any two classical techniques used for solving such problems. **[5]**

b) Explain the formulation process of a multivariable optimization problem. **[5]**

Q3) a) Differentiate between direct search methods and indirect search methods used in optimization. Give examples of each. **[5]**

b) Describe elimination methods used in one-dimensional minimization. Discuss any one method in detail. **[5]**

OR

Q4) a) Explain the concept of a descent direction. How are descent methods used in unconstrained optimization? **[5]**

b) Explain the interval halving method for one-dimensional minimization and state its advantages and drawbacks. **[5]**

P.T.O.

- Q5)** a) What is contingency evaluation in power systems? [5]
b) Compare the conventional Newton-Raphson load flow and fast decoupled load flow methods. [5]

OR

- Q6)** a) Discuss the concept of security monitoring in modern power systems. [5]
b) Describe the decoupled load flow (DLF) method. [5]
- Q7)** a) Derive the update formula used in the Gradient Method for minimizing total generation cost. [5]
b) Explain the Lambda-Iteration method used in classical Economic Dispatch. [5]

OR

- Q8)** a) Describe the application of the Newton-Raphson method in OPF. [5]
b) Write short notes on [5]
i) Penalty factors in OPF
ii) Optimality condition for ED using Lagrangian
- Q9)** a) Describe the steps involved in economic dispatch using the exact loss formula. [5]
b) Describe how Generation Shift Factors help in evaluating line flows due to generator rescheduling. [5]

OR

- Q10)** a) Explain economic dispatch considering transmission losses using the B-coefficient method. [5]
b) Write short notes on [5]
i) Power Transfer Distribution Factors
ii) Incremental cost curve and its impact on Economic Dispatch



Total No. of Questions : 10]

SEAT No. :

PE-12210

[Total No. of Pages : 2

[6585]-526-CR

M.E. (Electrical) (Electrical Engineering/Power Systems)

**PCC-503-POS : COMPUTER APPLICATIONS IN
POWER SYSTEMS**

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt any one from Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*
- 5) *Use of non-programmable calculator is allowed.*

Q1) a) Explain the general structure of an optimization problem and describe its major components. **[5]**

- b) Classify optimization problem based on **[5]**
- i) Nature of objective function
 - ii) Number of variables
 - iii) Presence of constraints
 - iv) Deterministic vs. stochastic approaches

OR

Q2) a) Discuss the general procedure for multivariable optimization with equality constraints. Give an illustrative example. **[5]**

- b) State and derive the Lagrange Multiplier method for constrained multivariable optimization. **[5]**

Q3) a) Describe steepest descent method. Explain its working principle and limitations. **[5]**

- b) What is a one-dimensional minimization method? Explain why one-dimensional search is important in multivariable optimization. **[5]**

OR

P.T.O.

Q4) a) Explain general characteristics of unconstrained optimization techniques and state its applications. [5]

b) Explain the concept of Newton's method for unconstrained optimization. [5]

Q5) a) Explain the Newton-Raphson load flow method in polar coordinates.[5]

b) Explain the functions of state estimation and real-time contingency analysis in maintaining system security. [5]

OR

Q6) a) Derive the real and reactive power mismatch equations used in the Newton-Raphson load flow method in rectangular coordinates. [5]

b) What assumptions are made in the fast decoupled load flow method?[5]

Q7) a) Discuss Economic Dispatch with generator limits. [5]

b) Write short notes on : [5]

i) Penalty factors in Optimal Power Flow

ii) Role of constraints in Optimal Power Flow feasibility

OR

Q8) a) Describe different types of inequality constraints considered in Optimal Power Flow. [5]

b) Explain the Lambda-Iteration method used in classical Economic Dispatch. [5]

Q9) a) Compare the classical Economics Dispatch method and Linear Programming based Economuc Dispatch method. [5]

b) Discuss the procedure for calculating transmission loss coefficients. State the assumptions made. [5]

OR

Q10)a) Explain the concept of Loss Sensitivity Factors. [5]

b) Write short notes on : [5]

i) Power Transfer Distribution Factors.

ii) Loss minimization using sensitivity analysis.



Total No. of Questions : 10]

SEAT No. :

PE12160

[Total No. of Pages : 2

[6585]-527

M.E. Electrical (Electrical Engineering)

PCC-504-ELE : ADVANCED TOPICS IN POWER SYSTEM

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt any one from Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) Figures to the right indicate full marks.*
- 3) Neat diagrams must be drawn wherever necessary.*
- 4) Assume suitable additional data if necessary .*
- 5) Use of non-programmable calculator is allowed.*

Q1) Explain Automatic Generation Control (AGC) of single-area and multi-area systems and its relation with Economic Dispatch. **[10]**

OR

Q2) Explain Generation Control Loops, AVR Loop and Performance & Response of control systems in power systems. **[10]**

Q3) Explain the Trapezoidal Rule of numerical integration used for transient stability analysis and discuss methods for transient stability enhancement. **[10]**

OR

Q4) Explain the Transient Stability Problem and describe the modeling of synchronous machine, load, network and excitation system. **[10]**

Q5) Explain the improvement of system damping using supplementary excitation control and give an introduction to Sub-Synchronous Resonance (SSR) and its countermeasures. **[10]**

OR

P.T.O.

- Q6)** a) Explain the Voltage Stability Problem and discuss the effect of ULTC and load characteristics on voltage stability. [5]
- b) Explain Voltage Stability Assessment using PV curves, voltage stability limits, and methods to improve voltage stability. [5]

Q7) Explain single and multiple contingency analysis in power systems, including DC contingency analysis and the system reduction techniques used in contingency evaluation. [10]

OR

Q8) Describe how supplementary excitation control improves system damping. Also, introduce the phenomenon of Sub-Synchronous Resonance (SSR) and explain the various countermeasures used to mitigate SSR effects. [10]

Q9) Explain Contingency Analysis in power systems and describe the ZBUS method used in contingency analysis. [10]

OR

Q10) Explain single and multiple contingency analysis, including DC contingency analysis and system reduction techniques. [10]



Total No. of Questions : 10]

SEAT No. :

PE12020

[Total No. of Pages : 3

[6585]-528

M.E. (Electrical) (Power Electronics and Drives)

PCC-501-PED : LINEAR SYSTEMS THEORY AND DESIGN

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Figures to the right indicate full marks.

Q1) a) Determine product of vectors x and y where $|\bar{x}| = 6$ and $|\bar{y}| = 7$ and angle between them is 45° . **[4]**

b) Determine whether following vectors are linearly dependent or independent. **[6]**

i) $V_1 = (7, -3), V_2 = (-7, 5)$

ii) $V_1 = (1, 0, 0), V_2 = (0, 1, 0), V_3 = (0, 0, 1)$

OR

Q2) a) Find eigen values and eigen vectors. **[6]**

$$A = \begin{bmatrix} 4 & -2 \\ -2 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 3 & 7 \\ -2 & 5 \end{bmatrix}$$

b) For the vectors $x = 2\bar{i} + 2\bar{j} + 2\bar{k}$ and $y = 3\bar{i} + 5\bar{j} + \bar{k}$ determine direction cosine $\overline{x \cdot y}$. **[4]**

Q3) a) Diagonalize matrix given below $A = \begin{bmatrix} 3 & 2 & 7 \\ -4 & 5 & -2 \\ 5 & 3 & 2 \end{bmatrix}$. **[6]**

b) Test matrix A for orthogonality $A = \begin{bmatrix} 3 & 2 \\ -5 & 1 \end{bmatrix}$. **[4]**

OR

P.T.O.

Q4) a) Compute determinant of following matrix $A = \begin{bmatrix} 1 & 2 & 5 \\ 0 & 0 & 4 \\ -1 & 2 & -4 \end{bmatrix}$. [6]

b) Test matrix x for skew symmetry $X = \begin{bmatrix} 4 & 6 \\ -3 & 2 \end{bmatrix}$. [4]

Q5) a) Draw and label the x and y axes. [6]

Class	99.5	104.5	109.5	114.5	124.5	129.5
Boundaries	-104.5	-109.5	-114.5	-124.5	-129.5	-134.5
Frequency	2	8	18	13	7	1

b) A sugar mill packs sugar packets of 01kg for retail marketing, packets were checked in random and their were found as under. [4]

Weight in kg	1.05	1.28	0.995	0.987	1.116	1.085	0.99	0.955
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Determine range and coefficient of range.

OR

Q6) a) For frequency table given below [6]

12 14 10 13 16 18 17 15 21 11 20 23 25

i) Determine appropriate intervals and frequencies.

ii) Construct a frequency table.

b) Draw histogram between intervals and frequency. [4]

Intervals	0-5	5-10	10-15	15-20	20-25	25-30
Frequency	2	2	5	5	3	3

Q7) a) Explain in detail chi-square test process. [6]

b) If the value of the random variable is 4, the mean is 4, and the standard deviation is 3. Find the probability density function of the Gaussian distribution. [4]

OR

Q8) a) The male population's weight data follows a normal distribution. It has a mean of 70kg and a standard deviation of 15kg. What would the mean and standard deviation of a sample of 50 persons be if a researcher looked at their records. [6]

b) Mean time taken to read a newspaper is 8.2 minutes. Suppose the standard deviation is 1 minute. take a sample size of 70. Find its mean and standard deviation. [4]

Q9) a) Explain in detail least squares of data representation and parameter estimation. [5]

b) Fit the curve of the following data by direct application of the method of least square. [5]

A	0	5	10	15	20	25
B	800	860	900	970	1020	1100

OR

Q10)a) Fit the least squares curve of given data set [6]

x	3	6	9	12	15	18
y	3.4	3.8	4.3	4.9	5.1	5.4

b) Explain in detail, method of sequential differences of data representation and parameter estimation. [4]



Total No. of Questions :10]

SEAT No. :

PE12021

[Total No. of Pages : 2

[6585]-529

**M.E. (Electrical Power Electronics and Drives)
PCC-502-PED:MODELLING AND ANALYSIS OF
ELECTRICAL MACHINES
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt any one from Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) Figures to the right indicate full marks.*
- 3) Neat diagrams must be drawn wherever necessary.*
- 4) Assume suitable additional data, if necessary.*
- 5) Use of non-programmable calculator is allowed.*

Q1) a) List out different sign conventions used in generalized machine theory. **[5]**

b) Discuss Kron's primitive machine along with related equations. **[5]**

OR

Q2) a) In case of electrical machines, write down voltage and current equation in matrix form. **[5]**

b) Describe the concept of leakage flux in machines with multiple windings. Include mathematical expression and state why speed voltage changes its peak when the moving coil is magnetically perpendicular to coil. **[5]**

Q3) a) Write a short note on Park transformation? **[5]**

b) Explain the concept of transformation. Provide details on transformations from displaced brush axis, including the respective mathematical expression. **[5]**

OR

Q4) a) What do you understand by invariance of power? **[5]**

b) Discuss the transformation from a three-phase to a stationary two-phase axis using a relevant mathematical expression. **[5]**

P.T.O.

- Q5)** a) Derive the transfer function for a separately excited motor using standard notation. [5]
- b) Develop a generalized mathematical model for a DC shunt motor and provide the corresponding equation. [5]

OR

- Q6)** a) Derive the transfer function of a DC series motor. [5]
- b) Explain the dynamics of a DC motor considering equation for loaded conditions. [5]

- Q7)** a) Develop the generalized mathematical model for a three-phase induction motor and provide the corresponding equation. [5]
- b) Derive the flux linkage equation in three phase induction motor. [5]

OR

- Q8)** a) State the advantages and limitations of the d-q model for a three-phase induction motor. [5]
- b) From the voltage equation matrix of a three-phase induction machine derive its linearized model. [5]

- Q9)** a) Write down the equation for synchronous machine modeling in per unit system and explain significance of each term. [5]
- b) What is meant by steady-state operation of a synchronous machine? [5]

OR

- Q10)** a) Discuss dq0 transformation in the context of synchronous machine. [5]
- b) Derive stator voltage equations in arbitrary and rotor reference frame variables of synchronous machine. [5]



Total No. of Questions : 10]

SEAT No. :

PE12022

[Total No. of Pages : 2

[6585]-530

M.E. (Electrical)/(Power Electronics and Drives)

PCC-503-PED : POWER CONVERTERS - I

(2025 Pattern) (Semester - I) (Theory)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of electronic calculator is allowed.*
- 4) *Assume suitable data, if necessary.*

Q1) a) Define latching current and holding current of SCR and draw the V-I characteristics of SCR. **[5]**

b) Compare IGBT and IGCT with respect to conduction loss and ruggedness. **[5]**

OR

Q2) a) Explain the thermal advantages of SiC devices. **[5]**

b) Develop a comparison chart showing performance differences among Si, SiC, and GaN switches. **[5]**

Q3) a) Explain the operation of a 3-phase fully controlled converter feeding an inductive load. **[5]**

b) Analyze overlap angle and derive its effect on output voltage for 1-phase fully controlled converter with RL load. **[5]**

OR

Q4) a) Explain the concept of freewheeling diode action in RLE loads for AC-DC converters. **[5]**

b) Propose a PFC strategy to minimize input harmonics in high-power rectifiers. **[5]**

Q5) a) Describe DCM operation of a buck converter with neat circuit diagrams and waveforms. **[5]**

b) Analyze input and output current ripple of a boost converter with waveforms. **[5]**

OR

P.T.O.

- Q6)** a) Explain transformer utilization factor for full-bridge converters. [5]
b) Design a flyback converter for 24 V output from a 230 V AC source. State assumptions. [5]

- Q7)** a) Draw voltage waveforms for 120° conduction mode of a 3-phase inverter. [5]
b) Evaluate the effect of reducing the switching frequency on inverter efficiency. [5]

OR

- Q8)** a) Explain the commutation process in a current source inverter. [5]
b) Compare the performance of CSI and VSI for motor drive applications. [5]

- Q9)** a) Explain the operation of a single-phase AC voltage controller using integral cycle control. [5]
b) Analyze performance issues when controlling an RLE load with AC voltage controllers. [5]

OR

- Q10)** a) Draw the circuit of a single-phase midpoint cycloconverter and explain its operation. [5]
b) Evaluate the harmonic performance of 3-phase bridge-type cycloconverters. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12211

[Total No. of Pages : 2

[6585]-530-CR

M.E. Electrical (Power Electronics and Drives)

PCC-503-PED : POWER CONVERTERS - I

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q 10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of electronic calculator is allowed.*
- 4) *Assume suitable data, if necessary.*

Q1) a) Explain the principle of operation for the turn-off mechanism of an IGBT. [5]

b) Analyze the switching losses of IGCT compared with MCT. [5]

OR

Q2) a) Explain why wide-bandgap materials allow higher breakdown voltage with one example. [5]

b) Evaluate the trade-offs between SiC MOSFETs and GaN HEMTs for EV chargers. [5]

Q3) a) Draw the Input and Output voltage, current waveforms of a 3-phase full-controlled rectifier with firing angle 30° . [5]

b) Analyze the discontinuous conduction mode for an RLE load in a 1-phase converter. [5]

OR

Q4) a) Define total harmonic distortion and its significance with suitable example. [5]

b) Propose a method to reduce THD in a 6-pulse rectifier system. [5]

P.T.O.

- Q5)** a) Explain the principle of operation for energy transfer in a Cuk converter. [5]
b) Design a boost converter for 12 V to 48 V at 5 A. Show steps. [5]

OR

- Q6)** a) Draw the circuit of a push-pull converter and explain its principle operation with neat circuit diagram. [5]
b) Compare flyback and full-bridge converters for high-power power control applications. [5]

- Q7)** a) Explain sinusoidal PWM technique for voltage control of an inverter. [5]
b) Analyze the impact of dead time on inverter output voltage. [5]

OR

- Q8)** a) List the advantages of using MOSFETs in high-frequency applications. [5]
b) Which switching devices are suitable for a 100-kHz inverter, justify your selection. [5]

- Q9)** a) Explain PWM-based AC voltage control. [5]
b) Analyze the performance of star-connected 3-phase AC controllers with inductive load. [5]

OR

- Q10)** a) Describe the operation of a bridge-type cycloconverter. [5]
b) Evaluate the use of cycloconverters for low-speed, high-torque drives. [5]



Total No. of Questions :10]

SEAT No. :

PE12023

[Total No. of Pages : 2

[6585]-531

M.E. (Electrical-Power Electronics and Drives)

PCC-504 - PED: SPECIAL APPLICATIONS OF POWER ELECTRONICS

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt any one from Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Assume suitable additional data, if necessary.*
- 5) *Use of non-programmable calculator is allowed.*

- Q1) a)** Explain the concept of Multi-terminal HVDC (MTDC) systems. **[5]**
- b) List out the advantages of HVDC light technology in the modern power transmission network. **[5]**

OR

- Q2) a)** Explain the constant current control method in a Multi-terminal HVDC (MTDC) network with a neat diagram. **[5]**
- b) Explain the structure and working of the Voltage Source Converter (VSC) **[5]**
- Q3) a)** Describe in detail the architecture of the Internet of Things (IoT). **[5]**
- b) Explain the role of sensors in IoT-based smart grids. **[5]**

OR

- Q4) a)** Discuss the challenges in implementing IoT for smart grids. **[5]**
- b) Explain the application of the Internet of Things (IoT) in smart grid power transmission systems. **[5]**
- Q5) a)** Explain the concept and objectives of a smart city. **[5]**
- b) What is a two-way digital communication paradigm? Explain its importance in smart systems. **[5]**

OR

P.T.O.

- Q6)** a) Discuss features, range, data rate and application of various communication technologies and prepare comparative table with examples where this technology is preferred Zigbee and Bluetooth. [5]
b) What is cloud computing? Explain its role in smart city and IoT systems. [5]

- Q7)** a) Define smart grid and explain how it differs from conventional electrical grid. [5]
b) What are major issues and challenges in the integration of Distributed Energy Resources (DERs). [5]

OR

- Q8)** a) Define Microgrid. Explain its concept and operation. [5]
b) Describe the structure, function and operation of a Phase Measurement Unit (PMU). [5]

- Q9)** a) Explain the working principle of Switched Mode Power Supplies (SMPS) [5]
b) Describe the role of Power electronics in industrial heating applications. [5]

OR

- Q10)** a) Explain the working of an Electronic Ballast with a neat diagram. [5]
b) Explain the necessity and working of an Uninterruptible Power Supply (UPS). [5]



Total No. of Questions :10]

SEAT No. :

PE12024

[Total No. of Pages : 2

[6585]-532

M.E. (Electrical) (Power Systems)

**PCC-504-POS : POWER SYSTEM ECONOMICS & MANAGEMENT
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt any one from Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Assume suitable additional data, if necessary.*
- 5) *Use of non-programmable calculator is allowed.*

Q1) a) Describe the functions of PGCIL in the Indian power sector. **[5]**

b) Explain the significance of the National Electricity Policy (NEP). **[5]**

OR

Q2) a) Discuss the role of the Ministry of Power (MoP) in policy formulation. **[5]**

b) Compare regulation and deregulation in the power sector. **[5]**

Q3) a) Explain life cycle cost analysis with reference to power projects. **[5]**

b) What are short-term and long-term marginal costs in the power sector? **[5]**

OR

Q4) a) Explain price cap and revenue cap regulation. **[5]**

b) List and explain key performance parameters used by regulatory commissions. **[5]**

Q5) a) Explain multi-year tariff (MYT) with its benefits. **[5]**

b) What are the major environmental considerations in tariff design? **[5]**

OR

P.T.O.

- Q6)** a) Differentiate between vertically integrated and deregulated power systems. [5]
b) Explain the bilateral and pool models in electricity trading. [5]

- Q7)** a) Explain spot pricing in electricity markets. [5]
b) What is ancillary services market? Explain its importance. [5]

OR

- Q8)** a) Explain the concept of zonal vs locational MCPs. [5]
b) What is market power? Explain its impact on electricity market operations. [5]

- Q9)** a) Explain the role and functions of Load Dispatch Centers (LDCs). [5]
b) Describe any two transmission pricing methods. [5]

OR

- Q10)** a) Discuss the need for transmission planning. [5]
b) What is arbitrage in electricity markets? Give an example. [5]



Total No. of Questions :10]

SEAT No. :

PE12141

[Total No. of Pages : 2

[6585]-533

M.E. (E & TC) (VLSI & Embedded Systems)

PCC-501-VLC : DIGITAL VLSI DESIGN

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8 and Q9 or Q10.*
- 2) *Each question carries 10 marks.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data if necessary.*

Q1) a) What is diffusion capacitance in a MOSFET? How does it differ from junction capacitance? **[5]**

b) Describe different types of interconnect parasitics and their modeling. **[5]**

OR

Q2) a) What is DRC? Write CMOS layout design rules with examples. **[5]**

b) Describe the CMOS fabrication process step by step. **[5]**

Q3) a) Derive the expression for dynamic power dissipation in CMOS logic and discuss methods to reduce it. **[5]**

b) Explain propagation delay in CMOS circuits. What factors affect rise time and fall time? **[5]**

OR

Q4) a) Explain crosstalk in interconnects, its causes, effects, and reduction techniques. **[5]**

b) Analyze the delay in multistage logic networks using logical effort. **[5]**

P.T.O.

- Q5)** a) Design and explain CMOS 2:1 multiplexers using Transmission gates and Static CMOS logic. [5]
 b) Compare static CMOS NAND and NOR gates. [5]

OR

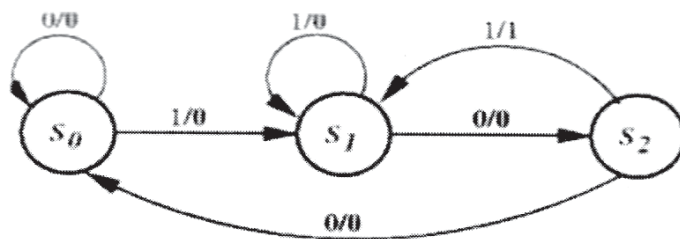
- Q6)** a) Explain CMOS NOR gate design and compare it with NAND gate in terms of Area, Speed and Power. [5]
 b) Explain the CMOS transmission gate and its advantages over pass transistor logic. [5]
- Q7)** a) Describe Cascode Voltage Switch Logic (CVSL) with circuit diagram and operation. [5]
 b) Explain BiCMOS logic circuits and their applications. [5]

OR

- Q8)** a) Explain NORA Logic and how it overcomes the limitations of domino logic. [5]
 b) Compare static CMOS and Ratioed logic. [5]
- Q9)** a) Explain hazards in digital circuits. Discuss their sources and mitigation techniques with a suitable case study. [5]
 b) Compare Mealy vs Moore FSMs. [5]

OR

- Q10)a)** Write and explain VHDL code for FSM design for Mealy FSM. [5]



- b) What is metastability window? Explain MTBF concept. [5]



Total No. of Questions : 8]

SEAT No. :

PE12161

[Total No. of Pages : 2

[6585]-534

**M.E. (E.C - VLSI & Embedded Systems/
E& TC(VLSI & Embedded Systems)**

**PCC -502 - VLC : RECONFIGURABLE COMPUTING
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer any five questions from question (Q.1 to Q.8).*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data if necessary.*
- 5) *Use of Calculator is allowed.*

Q1) a) Compare and contrast general-purpose processors and domain-specific processors. **[5]**

b) Define the terms : Specialization, reconfiguration and runtime. **[5]**

Q2) a) Explain the flow of program execution in Von Neumann architecture. **[5]**

b) Describe the role of DSP processors in domain-specific applications with examples. **[5]**

Q3) a) Draw and elaborate on the Garp's non-symmetrical RPF as a fine-grained architecture. **[5]**

b) Explain the design flow of FPGA in reconfigurable computing. **[5]**

Q4) a) Discuss non-frequently reconfigurable systems and their applications. **[5]**

b) Explain the utility of adaptive controllers in complex systems. **[5]**

P.T.O.

- Q5)** a) Describe the architecture of DPGA and its relevance in reconfigurable systems. [5]
b) Explain instruction-level parallelism and its impact on computational efficiency. [5]
- Q6)** a) Write a note on run-time reconfiguration with examples. [5]
b) Describe J-Bit reconfiguration project design approach. [5]
- Q7)** a) Elaborate on pattern matching using automation for text searching. [5]
b) Explain FPGA's role in high-performance computing with examples. [5]
- Q8)** a) Discuss software-defined radio in the context of reconfigurable computing. [5]
b) Write short notes on relocation and defragmentation. [5]

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Total No. of Questions :10]

SEAT No. :

PE12162

[Total No. of Pages : 2

[6585]-535

M.E. (E & TC (VLSI& Embedded System)

/E.C.(VLSI & Embedded System)

PCC-503-VLE/VLC: EMBEDDED SYSTEM DESIGN

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, and Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data if necessary.*

Q1) a) Which are the commonly used design metrics in an embedded system? Explain various design challenges involved in the optimization of design metrics. **[5]**

b) Define the term *Embedded system*. List the important characteristics of an embedded system and state its major applications. **[5]**

OR

Q2) a) Explain the concept of System-On-Chip (SoC) in an embedded system. **[5]**

b) Describe the features and typical applications of Arduino, Raspberry Pi, and Beagle Bone. **[5]**

Q3) a) Illustrate the architecture of the LPC1768 microcontroller with a neat block diagram. Explain the function of its major blocks. **[5]**

b) Explain the Ethernet protocol in brief. Compare it with the CAN protocol in terms of architecture and latency. **[5]**

OR

Q4) a) Discuss the improvements of ARM Cortex series over the classical ARM series. Describe the typical application of Cortex ARM processor series **[5]**

b) Explain with suitable diagram, the USB protocol with respect to LPC 1768. **[5]**

P.T.O.

- Q5)** a) Discuss an Embedded Linux boot process with reference to BIOS, Bootloader, Kernal initialization. [5]
b) Discuss the storage considerations involved in Embedded Linux systems. [5]

OR

- Q6)** a) Explain the architecture of a Real-Time Operating System (RTOS). [5]
b) Describe the following operating system functions in Real-Time Operating System (RTOS) [5]
i) Task management
ii) Interrupt handling

- Q7)** a) Explain the development process of an embedded system. [5]
b) Differentiate between host and target machines with respect to their functions and usage embedded system development. [5]

OR

- Q8)** a) Paraphrase the process of linking and locating embedded software and describe how it is loaded into the target system. [5]
b) Describe the issues in Hardware-software Design & Co-Design. [5]
- Q9)** a) Discuss the digital camera as a case study of an embedded system. [5]
b) Analyze the role of mechanical packaging, testing, reliability, and failure analysis in ensuring the performance of an embedded system. [5]

OR

- Q10)a)** Explain the various types of documents that must be prepared during the design, development, testing, and deployment of embedded real-time products. [5]
b) Discuss the smart card as a case study of an embedded system. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12212

[Total No. of Pages : 2

[6585]-535-CR

**M.E. (Electronics and Telecommunication - VLSI & Embedded Systems) E.C. (VLSI & Embedded Systems)
PCC-503-VLE/VLC : EMBEDDED SYSTEM DESIGN
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q 10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Assume suitable data, if necessary.

- Q1)** a) Define design metrics in an embedded system. Explain the different competing design metrics involved in embedded system design. [5]
b) What is a “market window”? Why is it so important for products to reach the market early in this window? [5]

OR

- Q2)** a) Describe the stages of the embedded product life cycle, highlighting the key challenges at each stage. [5]
b) Compare modern embedded system design platforms - Arduino. Raspberry Pi and Beagle Bone - with respect to hardware architecture, processing capability and typical applications. [5]

- Q3)** a) List the main features of the LPC1768 microcontroller and illustrate it's architecture. [5]
b) Explain in short USB and CAN protocols and Compare them with respect to protocol architecture and latency characteristics. [5]

OR

- Q4)** a) What are the improvements of ARM Cortex series over the classical ARM series. Describe the typical applications of ARM Cortex processor series. [5]
b) Draw and explain Cortex Microcontroller Software Interface Standard (CMSIS) structure. [5]

P.T.O.

- Q5)** a) Discuss how Kernel initialization and space initialization is carried out in an Embedded Linux. [5]
b) Discuss the storage considerations involved in Embedded Linux systems. [5]

OR

- Q6)** a) Illustrate the architecture of a Real-Time Operating System (RTOS). [5]
b) Discuss the mechanisms used for inter-task communication and interrupt handing in Real-Time Operating System. [5]

- Q7)** a) Compare BIOS and Boot Loader in terms of purpose, functionality, initialization process, hardware dependency and usage in embedded systems. [5]
b) Differentiate between host and target machines with respect to their functions and usage in embedded system development. [5]

OR

- Q8)** a) Explain the role of development tools used at various stages of embedded system design. [5]
b) Describe the file system structure used in Embedded Linux. [5]

- Q9)** a) Discuss the access control system as a case study of an embedded system. [5]
b) Explain the importance of mechanical packaging, testing, reliability and failure analysis in ensuring the performance and robustness of embedded systems. [5]

OR

- Q10)** a) Explain the various types of documents that must be prepared during the design development, testing and deployment of embedded real-time products. [5]
b) Discuss the mobile phone software for key inputs as a case study of an embedded system. [5]



Total No. of Questions :10]

SEAT No. :

PE12025

[Total No. of Pages : 2

[6585]-536

F.Y. M.E. (Electronics & Communications / E & TC all branches)

PCC-504-VLD : VLSI CHIP DESIGN & FABRICATION

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, is necessary and clearly state.*
- 5) *Use of cell phone is prohibited in the examination hall.*
- 6) *Use of electronic pocket calculator is allowed.*

- Q1)** a) What is the role of an initial block and can it be synthesized? Give an example of using initial in simulation. **[5]**
- b) How does behavioral modeling differ from gate-level modeling in Verilog? **[5]**

OR

- Q2)** a) Demonstrate the use of loops in Verilog: **[5]**
- i) An initial block that initializes an array, and
 - ii) An always block that sums bits of a vector. Explain how loops are interpreted.
- b) What can go wrong if you leave out a signal from a combinational always sensitivity list? Provide an example. **[5]**

- Q3)** a) Describe in detail the Standard Cell-Based ASIC design and its advantages over Gate Array-Based ASICs. **[5]**
- b) List & Explain any two FPGA architectures in FPGA and ASIC prototyping? **[5]**

OR

P.T.O.

- Q4)** a) Write short notes on front-end and back-end design stages in ASIC design. [5]
b) Describe physical design steps of ASICs. [5]

- Q5)** a) Explain the design-for-testability (DFT) concept and its importance in modern ASIC design. [5]
b) Explain the difference between static and dynamic timing analysis with suitable examples. [5]

OR

- Q6)** a) What is clock uncertainty? Explain its role in STA. [5]
b) Compare BIST and Boundary Scan techniques in terms of speed, cost, and fault detection efficiency. [5]

- Q7)** a) What is plasma etching? Explain its working principle with neat sketches. [5]
b) What is functional fault model? How is it different from structural fault model? [5]

OR

- Q8)** a) Compare optical, electron-beam, X-ray, and ion-beam lithography techniques. [5]
b) Explain the problems of autodoping and defect generation in epitaxial growth. How can they be minimized? [5]

- Q9)** What is metallization in IC fabrication? Explain its purpose and importance in device performance. [10]

OR

- Q10)** Explain high-energy ion implantation. What are its applications in VLSI fabrication? [10]



Total No. of Questions : 10]

SEAT No. :

PE12026

[Total No. of Pages : 2

[6585]-537

**First Year M.E. (Electronics & Communication Engineering)/
(VLSI Design)**

**PCC-501-VLD : ANALOG CMOS IC DESIGN
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) Neat diagram must be drawn wherever necessary.*
- 3) Figures to the right indicate full marks.*
- 4) Assume suitable data, if necessary and clearly state.*
- 5) Use of cell phone is prohibited in the examination hall.*
- 6) Use of electronic pocket calculator is allowed.*

- Q1)** a) Explain Layout Techniques for current mirror. [5]
b) Explain Large and Small signal models of MOS transistors. [5]

OR

- Q2)** a) Write short note on Short Channel Effect. [5]
b) Explain in detail Body Effect. [5]

- Q3)** a) Draw and describe the characteristics of a Common Gate (CG) amplifier. Mention its applications. [5]
b) What is Miller Effect? Explain in detail. [5]

OR

- Q4)** a) Explain : [5]
i) Offset Issues
ii) CMRR
b) Compare single stage amplifier and differential amplifier. [5]

- Q5)** a) Draw the circuit of a two-stage CMOS operational amplifier and explain the function of each stage. [5]
b) Explain Frequency Compensation in details. [5]

OR

P.T.O.

- Q6)** a) Draw and explain output swing and slew rate considerations. [5]
b) Explain low voltage and power op-amp design approach. [5]

- Q7)** a) Draw and explain switched capacitors circuits. [5]
b) Explain the principle of operation of an analog multiplier using MOS transistors. [5]

OR

- Q8)** a) Explain with neat diagram low noise amplifiers basics in CMOS. [5]
b) Compare Flash ADC and Pipeline ADC. [5]

- Q9)** a) Draw and explain design flow using EDA tools. [5]
b) Explain principles of analog layout in detail. [5]

OR

- Q10)** a) Explain layout optimization techniques for current mirrors to improve accuracy. [5]
b) Write a short note on matching in Analog circuits. [5]



Total No. of Questions :10]

SEAT No. :

PE12163

[Total No. of Pages : 2

[6585]-538

F.Y. M.E. (Electronics & Communication (VLSI Design))

PCC-502-VLD-: DIGITAL CMOS IC DESIGN

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8 and Q.9 or Q.10*
- 2) Neat diagram must be drawn wherever necessary.*
- 3) Figures to the right indicate full marks.*
- 4) Assume suitable data, if necessary and clearly state.*
- 5) Use of cell phone is prohibited in the examination hall.*
- 6) Use of electronic pocket calculator is allowed.*

- Q1)** a) Discuss the factors affecting propagation delay in a CMOS inverter. [5]
b) Define noise margins (NMH and NML) and explain their significance in digital circuits. [5]

OR

- Q2)** a) Explain common clocking strategies used in synchronous circuits. [5]
b) Differentiate between static and dynamic latches and flip-flops. [5]
- Q3)** a) Describe the Elmore delay model for RC networks [5]
b) How do coupling capacitance and ground capacitance affect signal integrity? [5]

OR

- Q4)** a) Explain the concept of buffer insertion for delay optimization in long interconnects [5]
b) How does buffer insertion reduce delay and what are the trade-offs involved? [5]
- Q5)** a) Explain voltage scaling and its effect on delay, dynamic power and leakage power. [5]
b) Explain the major sources of power consumption in CMOS circuits. [5]

OR

P.T.O.

- Q6)** a) Discuss the key steps involved in Physical Design and Layout for VLSI systems. [5]
b) Explain layout design rules, stick diagrams and the importance of transistor sizing and matching in analog and digital layouts. [5]

- Q7)** a) Describe the SOI CMOS technology in detail. [5]
b) Compare PD-SOI and FD-SOI devices [5]

OR

- Q8)** a) Describe reliability-aware design methodologies used to model, predict and enhance long-term circuit reliability [5]
b) How do the aging mechanisms degrade analog, digital and SRAM circuits over time? [5]

- Q9)** a) What is approximate computing? Explain its design principles and discuss how hardware-level approximations in arithmetic circuits can significantly improve energy efficiency. [5]
b) Discuss the design challenges associated with ultra-low power circuits, focusing on sub-threshold operation, leakage reduction and power management strategies. [5]

OR

- Q10)** a) Discuss the architecture and working principles of neuromorphic hardware Systems. [5]
b) Discuss different types of Physical Unclonable Functions PUF architecture. [5]



Total No. of Questions : 10]

SEAT No. :

PE12027

[Total No. of Pages : 2

[6585]-539

First Year M.E. (E.C. (VLSI Design))
PCC-503-VLD : MOS DEVICE MODELLING AND
CHARACTERIZATION
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagram must be drawn wherever necessary.*
- 4) *Assume suitable data, if necessary and clearly state.*
- 5) *Use of cell phone is prohibited in the examination hall.*
- 6) *Use of electronic pocket calculator is allowed.*

Q1) a) Derive or discuss the relationship between surface potential, oxide electric field, and gate voltage. [5]

b) Describe qualitatively the operation of an n-channel MOS transistor. [5]

OR

Q2) a) Define and explain the inversion condition in a MOS device. [5]

b) With the help of a two-terminal MOS structure, explain the concept of flat-band voltage (V_{FB}). [5]

Q3) a) Discuss carrier velocity saturation in MOSFETs. [5]

b) Explain the concept of short-channel MOSFETs. [5]

OR

Q4) a) Discuss MOSFET scaling and the effects due to thin oxides, high doping, and mobility degradation. [5]

b) What is channel length modulation? [5]

Q5) a) Discuss the importance of parameter extraction in SPICE transistor modeling. [5]

b) Explain the basic concepts of SPICE transistor modeling. [5]

OR

P.T.O.

- Q6)** a) Highlight the key differences between Level-2 and Level-3 SPICE models. [5]
b) Discuss the Level-2 SPICE MOSFET model. [5]

- Q7)** a) What are the major limitations of simple (Level-1/long-channel) MOSFET models? [5]
b) Discuss the significance of intrinsic and extrinsic capacitances in MOSFET modeling. [5]

OR

- Q8)** a) Provide a detailed comparison of basic MOSFET models and advanced MOSFET models in terms of complexity, accuracy, and applications areas. [5]
b) Describe the basic MOSFET model and its key assumptions. [5]

- Q9)** a) Provide a comparison of advanced compact models (e.g., BSIM-CMG, PSP, HiSIM) used for modern transistor technologies. [5]
b) Explain the need for advanced MOSFET models in modern circuit simulators. [5]

OR

- Q10)** a) Explain threshold voltage-based MOSFET models. [5]
b) Explain the need for advanced MOSFET models in modern circuit simulators. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12213

[Total No. of Pages : 2

[6585]-539-CR
First Year M.E. (Electronics & Communications Engineering)
(VLSI Design)
PCC-503-VLD : MOS Device Modelling and
Characterization
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8 and Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary and clearly state.*
- 5) *Use of cell phone is prohibited in the examination hall.*
- 6) *Use of electronic pocket calculator is allowed.*

Q1) a) What are contact potentials in a MOS structure? [5]

b) Define and explain the inversion condition in a MOS device. [5]

OR

Q2) a) Explain the potential balance and charge balance conditions in a MOS capacitor. [5]

b) Derive or discuss the relationship between surface potential, oxide electric field, and gate voltage. [5]

Q3) a) Describe small-dimension effects in MOSFETs. [5]

b) Discuss MOSFET scaling and the effects due to thin oxides, high doping, and mobility degradation. [5]

OR

Q4) a) Explain barrier lowering and two-dimensional charge sharing in short-channel MOSFETs. [5]

b) Discuss carrier velocity saturation in MOSFETs. [5]

P.T.O.

- Q5)** a) Describe the Level- I SPICE model for MOSFETs. [5]
b) Highlight the key differences between Level-2 and Level-3 SPICE models. [5]

OR

- Q6)** a) Explain the Level-3 SPICE MOSFET model. [5]
b) Discuss the importance of parameter extraction in SPICE transistor modeling. [5]

- Q7)** a) Explain the different capacitances associated with a MOSFET. [5]
b) Provide a detailed comparison of basic MOSFET models, and advanced MOSFET models in terms of complexity, accuracy, and application areas. [5]

OR

- Q8)** a) Explain the role of capacitance models in MOSFET circuit simulation. [5]
b) What are the major limitations of simple (Level-1/long-channel) MOSFET models? [5]

- Q9)** a) Describe the concept of surface potential–based MOSFET models.[5]
b) Explain threshold voltage–based MOSFET models. [5]

OR

- Q10)** a) What are compact MOSFET models? [5]
b) Provide a comparison of advanced compact models (e.g., BSIM-CMG, PSP, HiSIM) used for modern transistor technologies. [5]



Total No. of Questions : 10]

SEAT No. :

PE12028

[Total No. of Pages : 2

[6585]-540

M.E. (E & TC)/(Signal Processing)

PCC-501-SGP : ADVANCED DIGITAL SIGNAL PROCESSING

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Make suitable assumptions wherever necessary.*

- Q1)** a) Discuss the computational complexity of DFT and the need for FFT algorithms. [5]
b) Compare DFT and DCT in terms of energy compaction and application. [5]

OR

- Q2)** a) Explain overlap-add method for long sequences using circular convolution. [5]
b) Compute the circular convolution of two given sequences using graphical (time-domain) method. [5]

- Q3)** a) Draw and describe the magnitude responses of ideal LPF, HPF, BPF, and BRF filters. [5]
b) Write the advantages and limitations of FIR filter design using windows. [5]

OR

- Q4)** a) Explain the bilinear transformation method for IIR filter design with necessary equations. [5]
b) Discuss how the choice of window affects the transition bandwidth and stop band attenuation. [5]

- Q5)** a) Compare direct-form implementation of decimation with multistage decimation. [5]
b) Discuss the role of multi rate DSP in software-defined radio or communication systems. [5]

OR

P.T.O.

- Q6)** a) Explain the need for a single low-pass filter instead of separate filters for interpolation and decimation. [5]
- b) Explain how poly phase structure reduces computation in decimators. [5]

- Q7)** a) Derive the weight-update equation of the LMS algorithm and explain the role of step size(μ) in convergence and stability. [4]
- b) Compare LMS and RLS algorithm based on complexity, speed, and performance. [6]

OR

- Q8)** a) Explain how adaptive filters are used to remove ocular artifacts (EOG) from EEG signals. Provide a suitable block diagram. [5]
- b) Discuss the advantages, limitations and applications of the LMS algorithm in adaptive signal processing. [5]

- Q9)** a) What is the VLIW architecture? Discuss how instruction-level parallelism is achieved in modern DSP processors. [5]
- b) Define multiport memory and explain how it enables parallel processing in DSP systems. [5]

OR

- Q10)** a) Explain parallel processing in DSP architectures. How is parallelism exploited to increase speed? [5]
- b) Explain the role of the MAC unit in DSP processors. Why is it critical for real-time signal processing? [5]



Total No. of Questions :10]

SEAT No. :

PE12164

[Total No. of Pages : 2

[6585]-541

M.E. (E & TC (Signal Processing))

PCC-502-SGP : DIGITAL IMAGE AND VIDEO PROCESSING

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer any one Question out of Q.No. 1 or 2, Q. No. 3 or 4, Q5 or Q6, Q7 or Q8, and Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data if necessary.*

Q1) a) What is digital image, how it is represented and what are the advantages of digital image processing? Distinguish between Binary image, Gray scale image and True color image. **[5]**

b) How the Wavelet transform is different from DFT? Explain Wavelet transform and its use in Image Processing. **[5]**

OR

Q2) a) Explain RGB and CMY color model in detail with mathematical equations. **[5]**

b) Explain Haar Transform and write the algorithm to generate Haar Basis function. Show the Haar basis function for N=2. **[5]**

Q3) a) What is histogram? Show the histogram of Dark image, bright image, Dull image. Write the algorithm/procedure for histogram equalization. **[5]**

b) How the Averaging filter and Median filter works? which filter is suitable for removing salt and pepper noise? why, explain. **[5]**

OR

P.T.O.

- Q4)** a) Explain following filters in detail [5]
i) High boost filtering
ii) Unsharp Masking
b) What is the difference between Pseudo coloring and False coloring. Explain in detail how pseudo coloring is performed. [5]

- Q5)** a) How Image Restoration is different from Image Enhancement? With the help of block diagram, explain image restoration model. [5]
b) Explain how median filter is used for removal of noise? why it is called a non-linear filter. [5]

OR

- Q6)** a) Give mathematical expression for Wiener filter. How Wiener filter is used in image restoration process? what is its advantage over Inverse filter. [5]
b) Explain how frequency domain or transform domain image restoration is done. [5]

- Q7)** a) Explain any two types of Thresholding methods in detail. [5]
b) What are the different morphological operators used in image processing show examples of structuring elements for those operators. [5]

OR

- Q8)** a) Explain 4-directional and 8-directional chain codes in detail. [5]
b) Explain the Laplacian of Gaussian (LOG) operator for smoothing of images. [5]

- Q9)** a) What is difference between analog video and digital video? Explain in detail the structure of digital video. [5]
b) Explain any one video compression standard in detail. [5]

OR

- Q10)** a) What is the meaning of motion estimation and motion compensation? How block based motion estimation works? [5]
b) Explain the color models in video. [5]



Total No. of Questions : 10]

SEAT No. :

PE12029

[Total No. of Pages : 2

[6585]-542

M.E. (E & TC - Signal Processing)

PCC-503-SGP: LINEAR ALGEBRA, STATISTICS AND PROBABILITY

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Figures to the right indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Assume suitable data, if necessary.

Q1) a) Solve using Gauss Elimination : **[5]**

$$3x + 2y - z = 1$$

$$2x - 2y + 4z = -2$$

$$-x + \frac{1}{2}y - z = 0$$

- b) Define vector space and verify whether the set of all 2×2 upper-triangular matrices forms a vector space. **[5]**

OR

Q2) a) Find the rank of : $\begin{bmatrix} 2 & 4 & 1 \\ 0 & 2 & 3 \\ 0 & 0 & 5 \end{bmatrix}$. **[5]**

- b) Determine whether vectors (1, 2, 3), (2, 5, 8), (3, 8, 13) are linearly independent. **[5]**

Q3) a) Find eigenvalues and eigenvectors of $A = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$. **[5]**

b) Diagonalize $B = \begin{bmatrix} 2 & 0 \\ 0 & 5 \end{bmatrix}$. **[5]**

and verify $B = PDP^{-1}$.

OR

Q4) a) Prove that eigenvalues of a real symmetric matrix are real. **[5]**

b) Reduce $Q(x, y) = 4x^2 + 12xy + 9y^2$ to canonical form. **[5]**

P.T.O.

Q5) a) Find the directional derivative of $\phi = x^2 + y^2 + z^2$ at $(1, 1, 1)$ along $(1, 2, 2)$. [5]

b) Compute divergence and curl of $F = yz \mathbf{i} + zx \mathbf{j} + xy \mathbf{k}$. [5]

OR

Q6) a) Find curvature of $r(t) = t \mathbf{i} + t^2 \mathbf{j} + t^3 \mathbf{k}$. [5]

b) Show that $\nabla \cdot (\nabla \times F) = 0$ for any vector field F . [5]

Q7) a) A die is rolled twice. Find probability that sum = 8. [5]

b) Compute mean and variance for : [5]

$X : 0, 1, 2, 3; P(X) : 0.1, 0.3, 0.4, 0.2.$

OR

Q8) a) A coin is tossed 5 times. Find probability of exactly 3 heads. [5]

b) A call center receives 5 calls/hour. Find probability of exactly 3 calls in one hour (Poisson). [5]

Q9) a) Explain Type I and Type II errors with an example. [5]

b) Compare Binomial, Poisson and Normal distributions. [5]

OR

Q10)a) Explain p-value and level of significance in hypothesis testing. [5]

b) Using Hypergeometric distribution : From 12 items with 4 defective, if 3 items are selected, find probability that 2 are defective. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12214

[Total No. of Pages : 3

[6585]-542-CR

M.E. (Electronics & Telecommunication) (Signal Processing)
LINEAR ALGEBRA, STATISTICS AND PROBABILITY
(2025 Pattern) (Semester - I) (PCC-503-SGP)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer any one Question out of Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8, Q.No.9 or Q.No.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) a) $A = \begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}$

Using Gauss-Jordan method, find the inverse of matrix A. [5]

b) Consider the system :

$$\begin{cases} x + y = 5 \\ 2x + 2y = 10 \end{cases}$$

Determine whether the given system is consistent and solve it. [5]

OR

Q2) a) Let $u = (2, -1)$ and $v = (3, 4)$ be vectors in $\mathbb{R}^2$. Define the inner product as :

$$\langle u, v \rangle = x_1 x_2 + y_1 y_2$$

Verify that this function is an inner product. [5]

b) $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 1 & 1 \end{bmatrix}$

Determine rank and nullity of the matrix. [5]

P.T.O.

Q3) a) $A = \begin{bmatrix} 6 & -1 \\ 2 & 3 \end{bmatrix}$

Find eigenvalues of A. [5]

b) $B = \begin{bmatrix} 5 & 4 \\ 4 & 5 \end{bmatrix}$ [5]

Orthogonal diagonalization of B.

OR

Q4) a) Define diagonal matrix and give one example. [5]

b) Reduce the quadratic form $Q(x, y) = 4x^2 + 4xy + y^2$ to diagonal form. [5]

Q5) a) Define gradient of a scalar function. Explain with example. [5]

b) Find divergence of $\vec{F} = x^2\hat{i} + y^2\hat{j} + z^2\hat{k}$ [5]

OR

Q6) a) Define curl of a vector field. Explain with example. [5]

b) Find gradient of $\phi = x + y + z$. [5]

Q7) a) Suppose a bag contains : 3 red balls, 2 blue balls [5]

We draw 2 balls without replacement, Find the probability that both balls are red.

b) Suppose a random variable X has the following probability distribution.

$$X = | 0 | 1 | 2 | 3 |$$

$$P(X) = | 0.1 | 0.3 | 0.4 | 0.2 |$$

compute $E(X)$ and $\text{Var}(X)$ [5]

OR

Q8) a) Suppose a factory produces items with a defective probability $p = 0.1$. If we inspect $n = 5$ items, find the probability of exactly 2 defective items. [5]

b) Find Poisson probability of zero emails. [5]

Q9) a) Explain Type I and Type II errors with an example. [5]

b) Compare Binomial, Poisson and Normal distributions. [5]

OR

Q10) a) Define and Explain hypothesis testing. [5]

b) Write Steps for Chi-square Goodness of Fit Test. [5]



Total No. of Questions : 10]

SEAT No. :

PE12142

[Total No. of Pages : 2

[6585]-546

M.E. (Electronics Engineering) (Digital Systems)

PCC-501-DIS: ANALOG AND DIGITAL CMOS DESIGN

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data if necessary and clearly state.*
- 5) *Use of cell phone is prohibited in the examination hall.*
- 6) *Use of electronic pocket calculator is allowed.*

Q1) a) What do you mean by photolithography and Ion Implantation? **[5]**

b) Draw the MOSFET parasitic model due to internal capacitances. Explain how to calculate total parasitic? **[5]**

OR

Q2) a) What is SPICE? Why is it used in VLSI design? **[5]**

b) Explain the colour coding used in stick diagrams. **[5]**

Q3) a) Differentiate Logical, Electrical and Parasitic delay. **[5]**

b) Compare fan-in and fan-out effects in CMOS logic. **[5]**

OR

Q4) a) Compare static, dynamic and short-circuit power dissipation. **[5]**

b) What is RC-delay model? Illustrate it with example of any circuit. **[5]**

P.T.O.

- Q5)** a) Explain the pull-up and pull-down networks in NAND gate. [5]
b) Explain design rules for CMOS combinational logic. [5]

OR

- Q6)** a) Design a MUX using transmission gates. [5]
b) Draw and Explain Cascode Voltage Switch Logic (CVSL) gate. [5]

- Q7)** a) Explain how to use CMOS as a Diode. [5]
b) Explain the implementation of [5]
i) Diode and
ii) Current Sinks and Voltage Source.

OR

- Q8)** a) Explain the output resistance of diode-connected MOSFET. [5]
b) Explain the need for cascode configuration. Explain advantages and limitations of cascode amplifier. [5]

- Q9)** a) Explain how a CMOS inverter can be used as a linear amplifier. [5]
b) Explain the need for CMOS op-amps. [5]

OR

- Q10)**a) Draw and explain a basic MOS current mirror. [5]
b) Draw and explain the two-stage CMOS op-amp. [5]



Total No. of Questions :8]

SEAT No. :

PE12030

[Total No. of Pages : 2

[6585]-547

First Year M.E. (Electronics(Digital Systems))

**PCC-502-DIS : ADVANCED MULTIRATE SIGNAL PROCESSING
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer any five questions out of eight questions.*
- 2) Figures to the right indicate full marks.*
- 3) Assume suitable data if necessary.*
- 4) Use of scientific calculators is allowed.*

Q1) a) Construct the complete block diagram and explain each stage involved in the process for a sampling rate conversion factor L/M . **[5]**

b) Design an interpolator of a factor 32 from a sampling rate 64 KHz to get new sampling rate 2048 KHz. Signal band of interest extends from 0 to 30 KHz. Pass band deviations are 0.01 dB and stop band attenuation is 80 dB. **[5]**

Q2) a) Write the paraunitary filter banks properties. **[5]**

b) What are the conditions required for perfect reconstruction in a two-channel QMF bank? Derive mathematically. **[5]**

Q3) a) Explain the role of filter banks in subband coding of speech signals. **[5]**

b) Derive the alias cancellation condition for a two-channel filter bank and explain its significance in perfect reconstruction. **[5]**

Q4) a) List the main differences between Prony's and Shank's methods for system modeling. **[5]**

b) Explain the difference between Pade approximation technique and Least Squares techniques. **[5]**

P.T.O.

- Q5)** a) Why Least mean square algorithm is called as stochastic gradient algorithm? List the drawbacks of LMS algorithm. [5]
b) Explain the construction of the Haar scaling function and wavelet function. Discuss why Haar wavelets are useful for piecewise constant signal representation? [5]
- Q6)** a) What is wavelet transform? How is it used for image processing? [5]
b) Explain the terms mother wavelet, scaling function and wavelet basis. Also discuss their roles in multiresolution analysis. [5]
- Q7)** a) How multirate systems used in CD player application to change sampling rate. Draw block diagram of Digital to analogue conversion for a CD player. [5]
b) Discuss the use of multirate signal processing techniques in Video signal processing. [5]
- Q8)** a) Explain the design of delta-sigma (DS) analog-to-digital converters. [5]
b) Explain the working principle of the Discrete Cosine Transform (DCT). Discuss how DCT achieves energy compaction and how this property is used in image compression applications such as JPEG? [5]



Total No. of Questions : 8]

SEAT No. :

[Total No. of Pages : 2

PE12031

[6585]-548

First Year M.E. Electronics(Digital Systems)

PCC-503-DIS : IMAGE PROCESSING & COMPUTER VISION

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer any five questions out of eight questions.*
- 2) Figures to the right indicate full marks.*
- 3) Assume Suitable data if necessary.*
- 4) Use of scientific calculators is allowed.*

Q1) a) What is of binary image processing operation? Explain any one in detail. [5]

b) Explain the Haar Transformation. [5]

Q2) a) Write a short note on Hough Transform. [5]

b) Explain the concept of DCT image transform. [5]

Q3) a) Define the terms Hue, Saturation and Intensity. [5]

b) Explain the term noise in color images. [5]

Q4) a) Explain the HIS color model in detail. [5]

b) Write a short Pseudo color Image Processing. [5]

Q5) a) Explain Head and hat algorithm. [5]

b) Write a short note on Image Registration. [5]

P.T.O.

- Q6)** a) Explain the Weighted geometrical feature algorithm. [5]
b) Give the classification of Image registration methods in brief. [5]
- Q7)** a) Write a short note on 3D surface reconstruction. [5]
b) Explain Epipolar geometry in detail. [5]
- Q8)** a) Explain Range data merging with respect 3D reconstruction. [5]
b) Write a short note on 3D photography. [5]



Total No. of Questions : 8]

SEAT No. :

PE-12215

[Total No. of Pages : 2

[6585]-548-CR

First Year M.E. (Electronics) (Digital Systems)

**PCC-503-DIS : IMAGE PROCESSING AND COMPUTER
VISION**

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer any five questions out of eight questions.*
- 2) *Figures to the right indicate full marks.*
- 3) *Assume suitable data, if necessary.*
- 4) *Use of scientific calculators is allowed.*

- Q1)** a) Explain in brief what is Histogram Equalization in image enhancement with suitable example. [5]
- b) Write a short note on Hough Transform in image processing. [5]
- Q2)** a) What does color image smoothing and sharpening meaning? Explain them in short. [5]
- b) Explain concept of segmentation in RGB Vector space. [5]
- Q3)** a) Describe the classification of image registration methods. [5]
- b) Explain Head and Hat algorithm and explain its use in image registration. [5]
- Q4)** a) Explain local methods in stereo vision. [5]
- b) Write a short note on sub-pixel disparity estimation. [5]

P.T.O.

- Q5)** a) Discuss the application of 3D reconstruction in digital heritage. [5]
b) Write a short note on surface interpolation. [5]
- Q6)** a) Explain model-based reconstruction. [5]
b) Explain the Weighted geometrical feature algorithm. [5]
- Q7)** a) Explain stereo-based head tracking. [5]
b) Explain Epipolar geometry in detail. [5]
- Q8)** a) Explain Range data merging with respect to 3D reconstruction. [5]
b) Write a short note on histogram equalization for color images. [5]



Total No. of Questions : 8]

SEAT No. :

PE12032

[Total No. of Pages : 2

[6585]-549

M.E. (E & TC Engineering) (Communication Network)
PCC-501-CMN : ADVANCE MODELING AND SIMULATION OF
COMMUNICATION NETWORK
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) The question paper consists of a total of eight questions.*
- 2) Answer any five questions.*
- 3) Figures to the right indicate full marks.*
- 4) Draw neat and well-labelled diagrams wherever necessary.*
- 5) Assume suitable data, if necessary.*

- Q1)** a) Explain the various aspects of simulation methodology used in communication system design. Illustrate with suitable examples. [4]
- b) Design a simulation flow for a 5G MIMO-OFDM transceiver, including all key stages from signal generation to performance evaluation. [4]
- c) What is the difference between linear and nonlinear system modeling?[2]
- Q2)** a) Define and explain random signal processing. How are random signals used in the performance testing of communication systems? [4]
- b) Explain the Kolmogorov-Smirnov (KS) test. Compare its advantages over the Chi-square test for testing random number generators. [4]
- c) What is a PN (Pseudo-Noise) sequence? Mention its key characteristics. [2]
- Q3)** a) Explain the principles of Monte Carlo integration and its application in performance estimation of wireless communication systems. [4]
- b) Describe the role of semi-analytic techniques in 5G channel modeling. How do they improve modeling accuracy compared to purely statistical methods? [4]
- c) How is Reinforcement Learning used for AI-enhanced adaptive network simulation? [2]

P.T.O.

- Q4)** a) Explain the Tapped Delay Line (TDL) model for a multipath fading channel. Illustrate how it represents channel impulse response over time. [4]
 b) Describe how the Markov model is used to represent discrete channels with memory. [4]
 c) Briefly explain the different types of nonlinearities encountered in communication systems. [2]
- Q5)** a) Explain the role of sampling methods in Digital Twin simulation frameworks for IoT and Industry 4.0. [4]
 b) With reference to 5G networks, explain the simulation of bursty IoT traffic and network slicing using Mininet and NS-3. [4]
 c) What is meant by bursty IoT traffic? Why is it important to model it in 5G simulation? [2]
- Q6)** a) With the help of suitable diagrams, explain the generation and correlation properties of PN sequences used in spread spectrum systems. [4]
 b) What is the purpose of testing random number generators? What are the main steps involved in Chi-square testing of a random number generator? [4]
 c) Write the expression for the probability density function (PDF) of a Gaussian random variable. [2]
- Q7)** a) Explain how time-varying and nonlinear systems are modeled in communication system simulations. Give examples of each. [4]
 b) Explain the low-pass equivalent model for OFDM and NR signals. How does it simplify system-level simulation? [4]
 c) Mention two key advantages of using low-pass equivalent models for OFDM/NR signals. [2]
- Q8)** a) Explain queuing theory models M/M/1 and M/G/1. Compare their assumptions, characteristics, and applications in communication networks. [4]
 b) Discuss network traffic modeling in communication systems. Explain Poisson and Non-Poissonian traffic models, including self-similar traffic characteristics. [4]
 c) Briefly explain the mapping of a uniform random variable to an arbitrary probability density function (PDF). [2]



Total No. of Questions :10]

SEAT No. :

PE12033

[Total No. of Pages : 2

[6585]-550

M.E. (E & TC (Communication Networks))

**PCC-502-CMN : HIGH SPEED COMMUNICATION NETWORKS
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt all questions.*
- 2) All questions carry equal marks.*
- 3) Neat labeled diagrams must be drawn wherever necessary.*
- 4) Figures to the right indicate full marks.*

Q1) a) Describe the goals and challenges of high-speed communication networks in your own words. **[5]**

b) Describe different types of switching techniques used in networks. **[5]**

OR

Q2) a) Explain protocol architecture of high-speed network. **[5]**

b) Compare OSI and TCP/IP models with respect to high-speed networking **[5]**

Q3) a) Explain ATM reference model with neat diagram. **[5]**

b) Explain signaling in ATM networks. **[5]**

OR

Q4) a) Describe ATM virtual paths and virtual channels. **[5]**

b) Analyze traffic descriptors used in ATM. **[5]**

P.T.O.

- Q5)** a) Explain flow control mechanisms in high-speed networks. [5]
b) Describe congestion avoidance techniques. [5]

OR

- Q6)** a) Explain admission control in ATM networks. [5]
b) Analyze different policing mechanisms used in ATM. [5]
- Q7)** a) Explain video streaming architecture. [5]
b) Explain Little's theorem and its application in queuing systems. [5]

OR

- Q8)** a) Describe working of HTTP streaming. [5]
b) Analyze performance metrics of a queuing system. [5]

- Q9)** Evaluate WDM technology and its impact on network capacity. [10]

OR

- Q10)** Evaluate the advantages and limitations of optical packet switching. [10]



Total No. of Questions : 8]

SEAT No. :

PE12034

[Total No. of Pages : 2

[6585]-551

M.E. (E & TC(Communication Networks))

PCC-503-CMN : NETWORK & CYBER SECURITY

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Assume suitable data if necessary.*

Q1) a) Explain network security concepts and discuss security threats and vulnerabilities in modern communication networks. **[6]**

b) Explain the RSA algorithm with key generation, encryption and decryption steps. **[6]**

OR

Q2) a) Describe information security concepts and explain the CIA triad with suitable examples. **[6]**

b) Explain the Diffie-Hellman key exchange algorithm and discuss its security issues. **[6]**

Q3) a) Explain conventional encryption techniques. Discuss cipher block modes of operation with neat diagrams. **[7]**

b) Explain secure hash functions and the working of HMAC with applications. **[6]**

OR

Q4) a) Explain security attacks in computer networks and classify them as passive and active attacks. **[7]**

b) Explain digital signatures and discuss their role in authentication and non-repudiation. **[6]**

P.T.O.

Q5) a) Explain secure software design principles and network security architecture. [6]

b) Explain IP Security (IPSec) architecture. Describe AH and ESP in detail. [6]

OR

Q6) a) Explain access control mechanisms and intrusion detection systems (IDS). [6]

b) Explain SSL/TLS protocol and describe the handshake process. [6]

Q7) a) Explain Intrusion Prevention Systems (IPS) and Unified Threat Management (UTM) with neat block diagrams. [7]

b) Explain email security mechanisms using PGP and S/MIME. [6]

OR

Q8) a) Explain operating system security and discuss security management practices and standards. [7]

b) Write a detailed note on Cybersecurity challenges in IoT systems and their defences. [6]



Total No. of Questions : 8]

SEAT No. :

PE12222

[Total No. of Pages : 2

[6585]-551CR

M.E. (E & TC) (Communication Networks)

PCC -503 - CMN : NETWORK AND CYBER SECURITY

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data if necessary.

Q1) a) Draw and explain network security model in detail. **[6]**

b) Which are the steps required to provide security to the operating system?**[6]**

OR

Q2) a) What are different types of security attacks on the network? Explain release of message contents and traffic analysis attack. **[6]**

b) Explain various security technologies and protocols in detail. **[6]**

Q3) a) Which basic steps are performed in one round of operation in DES? Explain in detail. **[7]**

b) Specify any 3 laws and standards of network security. **[6]**

OR

Q4) a) How does an authentication application such as 'Kerberos' work? Explain in detail. **[7]**

b) Which are the different steps in secure software design? **[6]**

P.T.O.

Q5) a) Explain the concept of PGP in email security. What are the services provided by PGP? **[6]**

b) Write a short note on 'Cyber security for Smart Grids'. **[6]**

OR

Q6) a) Write a short note on 'encapsulating security payload. **[6]**

b) How to do the analysis of attack vectors in IoT devices and their corresponding defences? **[6]**

Q7) a) What is the need of SSL? Explain all phases of SSL handshake protocol. **[7]**

b) What are the emerging security challenges in Next-Gen networks? **[6]**

OR

Q8) a) How does the use of security tokens and biometrics work in two-factor authentication systems? **[7]**

b) Explain the concept of 'Zero Trust Architecture (ZTA)' in detail. **[6]**

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Total No. of Questions : 5]

SEAT No. :

PE12035

[Total No. of Pages : 2

[6585]-552

M.E. (Information Technology)

PCC-501-ITT : APPLIED PROBABILITY & STATISTICS

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Solve any two questions of each section given in the following :

Q1) a) Find the eigenvalues and eigenvectors of the matrix : $A = \begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$. [5]

b) If X is a random variable with PDF $f(x) = 2x$, for $0 < x < 1$, find $E[X]$. [5]

c) Calculate mean and variance of the following data set : 3, 5, 7, 9, 11. [5]

Q2) a) Solve : If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, find its eigenvalues. [5]

b) If $x + 2y = 3$ and $2x + y = 4$, solve for x and y using matrix method. [5]

c) If a fair coin is tossed 3 times, what is the probability of getting exactly two heads? [5]

Q3) a) Given dataset: 2, 6, 4, 5, 7, calculate mean and standard deviation. [5]

b) Solve for x, y, z : [5]

$$\begin{matrix} x + y + z = 6 \\ x + 2y + 3z = 14 \\ x - y + z = 2. \end{matrix}$$

c) Find the eigenvalues and eigenvectors for $A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$. [5]

P.T.O.

- Q4)** a) If the probability distribution of X is given by $P(X = 0) = 0.4$, $P(X = 1) = 0.3$, $P(X = 2) = 0.3$, find $E(X)$ and $\text{Var}(X)$. [5]
- b) Find the mean, median and mode of the following values : 5, 7, 9, 12, 14, 14, 15. [5]
- c) 100 families were classified by income (High, Low) and housing (Own, Rent). [5]

	Own	Rent	Total
High	36	14	50
Low	24	26	50
Total	60	40	100

Test independence between income and housing

- Q5)** a) For 100 tosses of a coin, 60 heads observed. Test if the coin is fair. [5]
- b) Two independent samples from normal populations have sizes 20 and 15, sample means 56 and 52, sample variances 9 and 16. Test whether population means are equal. [5]
- c) For two production lines, line A : 150 defective in 2500, line B : 100 in 2200. Is there a significant difference? [5]



Total No. of Questions :5]

SEAT No. :

PE12036

[Total No. of Pages : 2

[6585]-553

M.E. (Information Technology)

**PCC-502-ITT : INFORMATION QUALITY AND BUSINESS RULES
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) Solve any Two

- a) Analyse how Business Intelligence enables organizations to transform raw data into strategic insights. **[5]**
- b) Describe the essential components of BI system architecture. **[5]**
- c) Analyse how organizational culture impacts the adoption of BI initiatives. **[5]**

Q2) Solve any Two

- a) Discuss the components of a strong business case for information management. **[5]**
- b) Analyse the relevance of information flow models in digital enterprises. **[5]**
- c) Explain dimensional modelling techniques such as star schema and snowflake schema. **[5]**

Q3) Solve any Two

- a) Discuss the components of a business case for business rule implementation. **[5]**
- b) Describe the architecture and components of a business rule management system (BRMS). **[5]**
- c) Explain key profiling activities such as data model inference attribute analysis, and relationship analysis. **[5]**

P.T.O.

Q4) Solve any Two

- a) Describe key EAI patterns and technologies. [5]
- b) Analyse the challenges in consolidating heterogeneous records across systems. [5]
- c) Explain the concept of web behaviour intelligence [5]

Q5) Solve any Two

- a) Compare incremental and batch data enhancement approaches. [5]
- b) Explain the relationship between data mining and data warehouses. [5]
- c) Evaluate approaches for processing semi-structured data. [5]



Total No. of Questions : 10]

SEAT No. :

PE12037

[Total No. of Pages : 2

[6585]-554

M.E. (Information Technology)

PCC-503-ITT : APPLIED MACHINE LEARNING

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) Draw neat labelled diagram wherever necessary.*
- 3) Figures to the right indicates full marks.*
- 4) Assume suitable data, if necessary.*

Q1) a) What is bias-variance decomposition? Explain with a diagram. **[5]**

b) Discuss Bayes classifier and its decision boundary. **[5]**

OR

Q2) a) Explain linear regression and discuss the role of cost function. **[5]**

b) Explain emission and transition probabilities in HMM. **[5]**

Q3) a) Discuss eigen decomposition and its role in dimensionality reduction. **[5]**

b) Explain Markov Decision Processes (MDPs). Discuss concepts of reward, policy, value functions and Bellman equations. **[5]**

OR

Q4) a) Explain the importance of dimensionality reduction in ML. **[5]**

b) Discuss different types of kernel functions. **[5]**

Q5) a) What is the concept of convolution and pooling as an “infinitely strong prior”? **[5]**

b) Describe the role of feature maps in deep feature extraction. **[5]**

OR

Q6) a) Discuss the architecture and advancements of modern CNN models. **[5]**

b) Describe the neuroscientific inspiration behind CNNs. **[5]**

P.T.O.

- Q7)** a) What is the role of gates in gated RNNs? [5]
b) Explain Backpropagation Through Time (BPTT). [5]

OR

- Q8)** a) Discuss optimization techniques used during RNN training. [5]
b) Describe the Encoder-Decoder architecture with a neat diagram. [5]

- Q9)** a) Discuss a complete pipeline for credit card fraud detection using ensemble learning. [5]
b) Discuss ensemble learning. Explain bagging, boosting and stacking in detail. [5]

OR

- Q10)** a) Explain how dimensionality reduction improves performance and reduces overfitting. [5]
b) Describe how CNNs are used for medical image diagnosis. [5]



Total No. of Questions : 10]

SEAT No. :

PE12220

[Total No. of Pages : 2

[6585]-554CR

M.E. (Information Technology)

PCC-503-ITT : APPLIED MACHINE LEARNING

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Figures to the right indicate full marks.
- 3) Draw neat labelled diagram whenever necessary.
- 4) Assume suitable data, if necessary.

- Q1)** a) Explain the concept of pattern representation in pattern recognition. How does it help in building intelligent systems? [5]
b) Explain the working of Linear Regression. How are model parameters estimated using the least squares approach? [5]

OR

- Q2)** a) Discuss Support Vector Machines (SVMs). Explain the concept of margin and the role of kernels in SVM classification. [5]
b) Describe the K-Nearest Neighbor (K-NN) algorithm. What are its advantages and limitations in classification task? [5]

- Q3)** a) Explain the concept of kernel methods. How do kernels enable non-linear classification in machine learning? [5]
b) Compare PCA with linear regression. How do their objectives and techniques differ? [5]

OR

- Q4)** a) Explain the architecture of a Hidden Markov Model (HMM). Describe its components and state the significance of each. [5]
b) Compare parametric and nonparametric density estimation techniques with suitable examples. [5]

- Q5)** a) Explain the basic architecture of a convolutional Neural Network (CNN). Describe the role of convolution, pooling and fully connected layers. [5]
b) Explain how CNNs perform automatic feature extraction. How does random or unsupervised feature learning work in CNNs? [5]

OR

P.T.O.

Q6) a) Describe the use of CNNs in image classification. Provide an example of a well-known CNN architecture. [5]

b) Describe different types of pooling operations. How do they help in reducing the dimensionality of feature maps? [5]

Q7) a) Explain the concept of deep recurrent networks. How do they improve sequence modeling? [5]

b) Explain the basic architecture of a recurrent Neural Network (RNN). How does it differ from a feed forward neural network? [5]

OR

Q8) a) Explain the Encoder-Decoder architecture. How is it useful in sequence-to-sequence tasks? [5]

b) Discuss the role of RNNs in speech recognition. How do they process sequential audio data? [5]

Q9) a) Explain the working principle of Support Vector Machines (SVM). How is the optimal hyperplane selected? [5]

b) Explain how machine learning is used in fraud detection. Describe the modeling steps with an example. [5]

OR

Q10) a) Discuss Random Forest as an ensemble method. How does it overcome the limitations of a single decision tree? [5]

b) Explain a medical diagnosis application where CNNs or deep learning models were used to identify abnormalities in medical images. [5]



Total No. of Questions :5]

SEAT No. :

PE12038

[Total No. of Pages : 2

[6585]-555

M.E. (Information Technology)

**PCC-504-ITT: ADVANCE SOFTWARE ENGINEERING AND
PROJECT MANAGEMENT
(2025 Pattern) (Semester-I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) Solve any Two

- a) Explain the difference between Prescriptive and Specialized Software Process Models with suitable examples. **[5]**
- b) Write short notes on Finite State Machines (FSM) are used in operational specifications of software systems. **[5]**
- c) Explain the role of Petri Nets in modelling concurrent systems with an example. **[5]**

Q2) Solve any Two

- a) Explain the importance of the Design Process in software engineering. **[5]**
- b) Differentiate between architectural design and component-level design. **[5]**
- c) Define Software Product Lines and explain their benefits. **[5]**

Q3) Solve any Two

- a) What are the advantages of Agile development techniques over traditional methods? **[5]**
- b) Explain the key features of the SCRUM process model. **[5]**
- c) What is Lean Software Development (LSD)? **[5]**

P.T.O.

Q4) Solve any Two

- a) Explain the use of PERT in project scheduling. [5]
- b) Differentiate between process metrics and product metrics. [5]
- c) What are the key principles of Agile Planning? [5]

Q5) Solve any Two

- a) Explain the importance of a Software Measurement Framework in project management. [5]
- b) Write short notes on process patterns and their significance. [5]
- c) Differentiate between product attributes and process attributes. [5]



Total No. of Questions : 10]

SEAT No. :

PE12039

[Total No. of Pages : 2

[6585]-556

M.E. (Instrumentation & Control) (Process Instrumentation)

PCC-501-PRI : TRANSDUCER DESIGN

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer any five questions.*
- 2) *Neat diagram must be drawn whenever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logarithmic tables slide rule, mollier charts, electronic pocket calculator and steam table is allowed.*
- 5) *Assume suitable data, if necessary.*

- Q1)** a) Select appropriate transducer for pressure measurement and justify the selection with example. [5]
- b) Elaborate with neat sketch measurement of displacement and justify the selection with example. [5]

OR

- Q2)** a) Select appropriate transducer for the measurement of chemical parameter and justify the selection with example. [5]
- b) Design Signal conditioning circuit for J-type thermocouple with cold junction compensation for following specification. [5]
- i) Input range 0-1000C
 - ii) Reference room temperature
 - iii) LM 35 : 20mv/0C
 - iv) Thermocouple sensitivity : 100μv/0Ci.e.2mv/0C

- Q3)** a) Select a suitable transducer for measuring displacement in a robotic arm and justify your selection. [5]
- b) A sensor is used in a noisy environment. What types of errors may occur? Suggest remedial measures. [5]

OR

- Q4)** a) Elaborate various methods of signal level and bias changes. [5]
- b) A strain-gauge bridge shows an imbalance voltage of 20 mV for a load change. If the amplifier gain is 100, find the output signal. [5]

P.T.O.

- Q5) a)** Explain with a neat sketch the design and operation of optical gas sensors with suitable examples. [5]
- b) Select gas sensor which is best suited for detecting flammable gases? Justify your answer. [5]

OR

- Q6) a)** Describe in detail the MEMS fabrication process. [5]
- b) Explain the material properties of silicon that make it suitable for MEMS applications. [5]

- Q7) a)** Explain the working principle of a piezoelectric accelerometer. [5]
- b) Differentiate between piezoelectric and capacitive accelerometers. [5]

OR

- Q8) a)** Explain applications of accelerometers in vibration monitoring and automotive systems. [5]
- b) Analyze the use of accelerometers in earthquake monitoring systems. [5]

- Q9) a)** Describe chemical sensors used for blood glucose measurement. [5]
- b) Explain the role of electrodes in electrical biomedical sensors. [5]

OR

- Q10)a)** Explain the working principle of optical biomedical sensors with suitable examples. [5]
- b) Which type of biomedical sensor would you use to measure dissolved gases in blood? Write proper justification. [5]



Total No. of Questions :10]

SEAT No. :

PE12040

[Total No. of Pages : 2

[6585]-557

M.E. (Instrumentation & Control (Process Instrumentation))

PCC-502-PRI: INDUSTRIAL AUTOMATION

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of Calculator is allowed.*
- 5) *Assume Suitable data if necessary.*

Q1) Write a Structured Text (ST) program for implementing ON-delay timer logic and explain each step. **[10]**

OR

Q2) Develop programmable ladder diagram for after five flashes it should go off. **[10]**

Q3) Differentiate between PROFIBUS, PROFINET, and EtherCAT in terms of architecture, data rate, and application suitability. **[10]**

OR

Q4) What is FOUNDATION Fieldbus? Explain its Fieldbus communication model and advantages in process industries. **[10]**

Q5) Develop a DCS control strategy using function blocks for a temperature control loop in a chemical reactor. **[10]**

OR

Q6) Comment on Advanced Process Control (APC) tools used in modern DCS systems. **[10]**

P.T.O.

Q7) Elaborate Data Logging and Report Generation in SCADA with examples. **[10]**

OR

Q8) Discuss the key steps involved in developing an HMI for suitable example using touch screen technology. **[10]**

Q9) Describe the role of Digital Twin Technology in predictive maintenance and process optimization. **[10]**

OR

Q10) Compare cybersecurity threats in traditional OT systems versus modern IT/OT integrated systems. **[10]**



Total No. of Questions : 10]

SEAT No. :

PE12041

[Total No. of Pages : 2

[6585]-558

M.E. (Instrumentation & Control(Process Instrumentation))
PCC-503-PRI : PROCESS MODELLING AND OPTIMIZATION
(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right indicates full marks.*
- 4) Use of logarithmic tables slide rule, mollier charts, electronic pocket calculator and steam table is allowed.*
- 5) Assume Suitable data, if necessary.*

- Q1)** a) State the purpose of modeling a control system and illustrate the importance of modeling in the design of control systems. [5]
- b) List the different types of models used in process control and differentiate between empirical and theoretical modeling approaches. [5]

OR

- Q2)** a) Draw and explain the block diagram of a general second-order electrical system. [5]
- b) Explain the significance of damping ratio (ζ) in second-order systems with suitable example. [5]

- Q3)** a) Define dynamic model of a process and state the assumptions made in the modeling of a CSTR. [5]
- b) Derive the mass balance equation for a single CSTR with first-order reaction. [5]

OR

- Q4)** a) Explain single-effect and multiple-effect evaporators in brief. [5]
- b) Compare performance of tray dryer and spray dryer. [5]

P.T.O.

- Q5)** a) Find the real roots of the equation $x^4 - x - 10 = 0$ correct to three decimal places by Newton-Raphson's method. [5]
- b) List the types of process reactors used in industries and illustrate how heat transfer affects evaporator performance. [5]

OR

- Q6)** a) Define constrained and unconstrained optimization. List the types of constraints commonly found in optimization problems. [5]
- b) Formulate the state-space model using a subspace identification algorithm. [5]

- Q7)** a) Define optimization in the context of engineering processes and specify types of optimization problems encountered in process industries. [5]
- b) Illustrate convex and concave functions influence the nature of solutions in detail. [5]

OR

- Q8)** a) Determine the continuity of the function $f(x)=1/x$ at $x = 0$. [5]
- b) Define process identification and state the conditions for a function to be continuous. [5]

- Q9)** a) Summarize the differences between Euler and Runge-Kutta methods. [5]
- b) Examine whether the function $f(x, y) = x^2 - y^2$ has minima, maxima, or saddle points (unconstrained). [5]

OR

- Q10)** a) Analyze the advantages and limitations of gradient-based optimization methods. [5]
- b) Distinguish between global minima and local minima in unconstrained optimization. [5]



Total No. of Questions : 10]

SEAT No. :

PE12223

[Total No. of Pages : 2

[6585]-558CR

M.E. (Instrumentation & Control) (Process Instrumentation)
PCC-503-PRI : PROCESS MODELLING AND OPTIMIZATION
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of logarithmic tables slide rule, mollier charts, electronic pocket calculator and steam table is allowed.
- 5) Assume suitable data, if necessary.

- Q1)** a) Define a model in the context of process control systems and state the purpose of modeling a control system. [5]
- b) Enlist the different types of models used in process control and specify significance of modeling in the design of control systems. [5]

OR

- Q2)** a) Examine the relationships among mass, damper, and spring constants in mechanical models. [5]
- b) Compare time-domain and frequency-domain modeling approaches. [5]
- Q3)** a) Enlist the types of process reactors used in industries and state the assumptions made in the modelling of a CSTR. [5]
- b) Derive the mass balance equation for a single CSTR with first-order reaction. [5]

OR

- Q4)** a) Analyze effect of flow disturbances on outlet temperature. [5]
- b) Evaluate factors affecting dryer efficiency. [5]

P.T.O.

- Q5)** a) Define numerical methods and their significance and enlist the steps involved in the Newton-Raphson method. [5]
b) Find the real roots of the equation $x^2 - 5x + 2 = 0$ by Newton-Raphson's method. [5]

OR

- Q6)** a) Design a flowchart for Euler method implementation. [5]
b) Compare Euler method with modified Euler method. [5]

- Q7)** a) Define process identification and state the difference between off-line and on-line identification. [5]
b) Enlist the types of process identification methods and state the significance of process identification in automatic control. [5]

OR

- Q8)** a) Define optimization in the context of engineering process and specify types of optimization problems encountered in process industries. [5]
b) Illustrate convex and concave functions influences the nature of solutions in detail. [5]

- Q9)** a) Justify the use of subspace state-space identification for multivariable systems. [5]
b) Examine the limitations of ATV method for non-linear processes. [5]

OR

- Q10)** a) State the difference between direct and indirect methods of optimization in detail. [5]
b) Compare single-variable and multivariable optimization approaches. [5]

x x x

Total No. of Questions : 10]

SEAT No. :

PE12042

[Total No. of Pages : 3

[6585]-559

M.E. (Instrumentation & Control-Process Instrumentation)

PCC-504-PRI : MATHEMATICAL METHODS IN

INSTRUMENTATION

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Figures to the right indicates full marks.
- 3) Use of calculator is allowed.
- 4) Assume Suitable data if necessary.

- Q1)** a) Determine basis and dimension of vectors $(3, 8, -3, -5)$, $(1, -2, 5, -3)$, $(2, 3, 1, -4)$ in a vector space $V = \mathbb{R}^4$. [4]
- b) Show that the vectors $(1, 1, 1)$, $(1, 1, 0)$, $(1, 0, 0)$ is linearly independent in $\mathbb{R}^3$. [4]
- c) Define linear combination of vector with suitable examples. [2]

OR

- Q2)** a) Let $\mathbb{R}^4$ have a Euclidean inner product, Find the cosine of angle between the vectors $\vec{u} = (-1, 2, 3, 4)$ and $\vec{v} = (4, 1, 2, 1)$. [5]
- b) Show that the set of vectors $u = (1, 3, 5)$, $v = (2, -1, -2)$, $w = (3, 2, 3)$ are linearly dependent and find relation between them. [5]

- Q3)** a) Let $\vec{v}_1 = \left(\frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}} \right)$ $\vec{v}_2 = \left(-\frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}} \right)$ be an orthonormal set of vectors in $\mathbb{R}^3$, if $\vec{u} = (1, 2, 3)$ find orthogonal projection $\vec{u}$ on W and orthogonal component of $\vec{u}$ to W. [5]
- b) Use Gram-Schmidt process to transform the basis $\{(1, 1, 1), (0, 1, 1), (1, 2, 3)\}$ for $\mathbb{R}^3$ into an orthogonal basis for $\mathbb{R}^3$. [5]

OR

P.T.O.

- Q4)** a) Define linear combination of vector with suitable examples. [5]
 b) Find singular value decomposition of the matrix. [5]

$$A = \begin{bmatrix} 2 & -1 \\ 2 & 2 \end{bmatrix}$$

- Q5)** a) Find square root of 18 by Newton Raphson method. [3]
 b) Solve by Gauss-Seidal iteration method [5]

$$20x_1 + x_2 - 2x_3 = 17,$$

$$3x_1 + 20x_2 - x_3 = -18,$$

$$2x_1 - 3x_2 + 20x_3 = 25.$$

- c) Explain role of Numerical method in Process Instrumentation. [2]

OR

- Q6)** a) Determine the value of y when $x = 0.1$, by euler modified method given that $\frac{dy}{dx} = 1 + xy, y(0) = 1$ and $h = 0.1$. [5]
 b) Explain Gauss Jordan method to solve linear algebraic equations. [5]

- Q7)** a) Explain skewness and kurtosis of with suitable examples. [5]
 b) Between 2 p.m. and 3 p.m. the average number of phone call per minute coming into company are 3. Find the probability that during one particular minute, there will be 2 or less calls. [5]

OR

- Q8)** a) Assume that the mean height of soldiers to be 68.22 inches with variance 10.8 inches. How many soldiers in a regiment of 10,000 would you expect to be over 6 feet tall? Area at $(z = 1.15) = 0.3749$. [5]
 b) Define addition and multiplication theorems of probability. [5]

Q9) a) Let X be a random variable define by a density function [5]

$$f(x) = e^{-x}, x \geq 0. \text{ and } f(x) = 0, \text{ otherwise.}$$

Find:

- i) $E(X)$
 - ii) $E(X^2)$
- b) Explain the terms. [5]
- i) Moments
 - ii) Moments Generating Function

OR

Q10)a) A joint PDF of two continuous random variable X and Y is

$$f(x, y) = c(2x + y), 0 < x < 1, 0 < y < 2. \text{ and } f(x, y) = 0, \text{ otherwise. [6]}$$

- i) Find the value of constant C
 - ii) Find $p\left[X > \frac{1}{2}, Y < \frac{3}{2}\right]$.
- b) The probability that a bomb dropped from a plane will strike the target is $\frac{1}{5}$. If six bombs are dropped, find the probability that exactly two will strike the target. [4]



Total No. of Questions : 10]

SEAT No. :

PE12043

[Total No. of Pages : 2

[6585]-560

M.E. (Mechanical)/(Computer Aided, Design, Manufacture & Engineering)

PCC-501-CME : ADVANCE MACHINE DESIGN

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Figures to the right indicate full marks.
- 3) Use of calculator is allowed.
- 4) Assume suitable data if necessary.

- Q1)** a) Explain the example of plane stress and plane strain conditions. [5]
b) State the three static equilibrium equations for a planar (2D) rigid body and explain their physical meaning. [5]

OR

- Q2)** a) Derive the compatibility equations in Cartesian coordinate system. [5]
b) Explain Mohr's theory of failure in detail. [5]

- Q3)** a) Explain Galerkin's method with its important characteristics. [5]
b) Explain Castigliano's theorems with its application. [5]

OR

- Q4)** a) State and explain theory of virtual work. [5]
b) Explain the expressions for strain energy stored in a body subjected to (i) axial load, and (ii) bending load. Discuss what each term in the expressions represents. [5]

- Q5)** a) What is cumulative fatigue damage? How the life of component subjected to different values of fluctuating stresses in cycle, is estimated by using Miner's equation. [5]
b) Describe the influence of super imposed static stress in fatigue. [5]

OR

P.T.O.

- Q6)** a) Explain the concept of energy balance during the crack growth. [5]
b) Describe brittle fracture mechanics. [5]

- Q7)** a) Describe transverse shear effect in composite laminates. [5]
b) Explain Elastic stress analysis of composite material. [5]

OR

- Q8)** a) Explain how the combination of material enhances properties compared to individual material and describe potential applications. [5]
b) What are the causes of cut-out stress concentration in composite structures? [5]

- Q9)** a) Explain the four elements of Maxwell-Kelvin model. [5]
b) How does viscoelasticity affect the stress-strain response of materials? [5]

OR

- Q10)** a) What are the Von Mises and Tresca yield criteria, and how do they predict material yielding? [5]
b) What is plastic flow and how plastic flow relevant to stress-strain behavior in materials. [5]



Total No. of Questions :10]

SEAT No. :

PE12044

[Total No. of Pages : 2

[6585]-561

M.E. (Mechanical (CAD, Manufacture & Engg.))

PCC-502-CME : COMPUTER AIDED DESIGN

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Solve any 1 questions from Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Assume suitable data, if necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of electronic pocket calculator is allowed.*

- Q1)** a) What are the evaluation criteria for selecting CAD software? [5]
b) Compare Bezier curves and B-Spline curves. [5]

OR

- Q2)** a) Explain the concept of CAD/CAM systems with benefits. [5]
b) Explain Hermite cubic spline with its properties. [5]

- Q3)** a) Explain the mathematical representation of a plane surface. [5]
b) What are coordinate systems in CAD? Explain types. [5]

OR

- Q4)** a) Explain Boundary Representation (B-rep) for solid modeling. [5]
b) Explain solid modeling advantages over surface modeling. [5]

- Q5)** a) Explain Hermite Bicubic surface with its mathematical representation. [5]
b) Describe sculptured surfaces and their use in CAD. [5]

OR

P.T.O.

- Q6)** a) What is a Coons surface? [5]
b) Explain surface segmentation in CAD. [5]

- Q7)** a) Explain the important drafting features available in modern CAD [5]
b) Explain associative modeling with an example. [5]

OR

- Q8)** a) What is customization in drafting? Explain its benefits. [5]
b) Explain shading, rendering, and the role of AI in CAD. [5]

- Q9)** a) Define collaborative engineering and explain its importance. [5]
b) What is ACIS? Explain its role in CAD. [5]

OR

- Q10)**a) What is Product Data Management (PDM)? [5]
b) Explain the process of implementing a data exchange workflow. [5]



Total No. of Questions : 10]

SEAT No. :

PE12045

[Total No. of Pages : 1

[6585]-562

M.E. (Mechanical (Computer Aided Design, Manufacture & Engineering))

PCC-503-CME : AUTOMATED MANUFACTURING SYSTEM

MODELING

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer any five questions.*
- 2) *Answers in one answer books.*
- 3) *Figures to the right indicates full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) Explain the principles and strategies of automation in modern production systems. **[10]**

OR

Q2) Discuss the various levels of automation and illustrate their role in improving productivity. **[10]**

Q3) Compare manufacturing cells and flexible manufacturing systems (FMS). **[10]**

OR

Q4) Explain the working of transfer mechanisms in automated flow lines. **[10]**

Q5) Design a pneumatic circuit for an automatic die casting machine using Boolean logic. **[10]**

OR

Q6) Discuss pneumatic sensors, jet devices, and Schmitt triggers. **[10]**

Q7) Develop a mathematical model of a manufacturing plant. **[10]**

OR

Q8) Explain ANN and fuzzy logic in manufacturing automation. **[10]**

Q9) Explain automated inspection systems. **[10]**

OR

Q10) Describe the role of IoT in manufacturing support systems. **[10]**



Total No. of Questions : 10]

SEAT No. :

[Total No. of Pages : 1

PE12221

[6585]-562CR

M.E. Mechanical (Computer Aided Design, Manufacture & Engineering)

PCC-503-CME : AUTOMATED MANUFACTURING SYSTEM

MODELING

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer any five questions.*
- 2) Answers in one answer book.*
- 3) Figures to the right indicate full marks.*
- 4) Assume suitable data, if necessary.*

Q1) Discuss advanced automation functions. [10]

OR

Q2) Describe PLC ladder logic with examples. [10]

Q3) Explain planning and implementation of FMS. [10]

OR

Q4) Describe product design considerations for automatic assembly. [10]

Q5) Prepare pneumatic circuit using AND/OR logic. [10]

OR

Q6) Explain Schmitt trigger characteristics. [10]

Q7) Develop an NN model for tool-wear prediction. [10]

OR

Q8) Explain system modeling and types. [10]

Q9) Compare inspection strategies in CNC systems. [10]

OR

Q10) Explain IoT architecture for CIM. [10]



Total No. of Questions : 10]

SEAT No. :

PE12046

[Total No. of Pages : 2

[6585]-563

M.E. (Mechanical) (Computer Aided Design, Manufacture & Engineering)

PCC-504-CME : FINITE ELEMENT METHOD

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

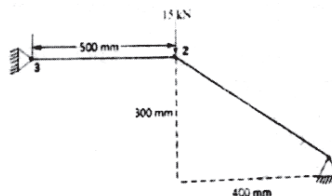
- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Figures to the right indicate full marks.
- 3) Assume suitable data, if necessary.
- 4) Use of non programmable calculator is allowed.

- Q1) a) What are the different steps of FEA? Explain each of them briefly. [5]
b) Explain the properties of stiffness matrix. [5]

OR

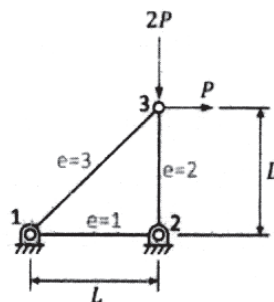
- Q2) a) Explain the concept of FEM briefly and outline the procedure. [5]
b) Derive element stiffness matrix for two noded (linear) bar element using Principle of Minimum Potential Energy Method. [5]

- Q3) For the two-bar truss shown in figure below, determine the displacement of node 2 and stresses in the element. All the elements have $E = 70 \text{ GPa}$ and $A = 200 \text{ mm}^2$. [10]



OR

- Q4) Solve the following truss problem. Find the deflection of the nodes and determine the forces and stresses in each member. E and A values are the same for each member. [10]



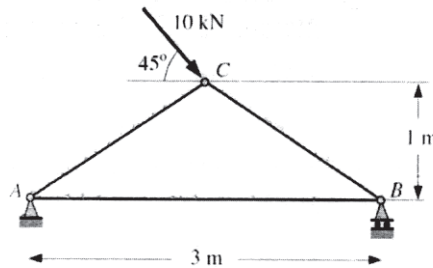
- Q5) Derive shape function for Nine Noded Quadratic Quadrilateral element Nine Noded Quadratic Quadrilateral element. [10]

OR

P.T.O.

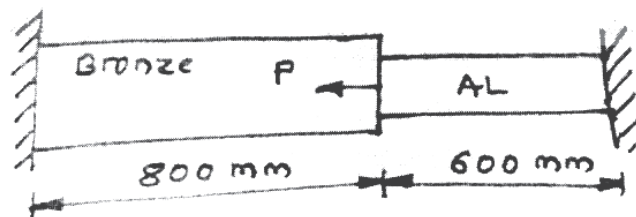
- Q6)** a) State and explain the three basic laws on which isoparametric concept is developed. [5]
 b) Evaluate the following integrals. Use three point Gaussian quadrature method $\int_{-1}^1 (2 + x + x^2) dx$ [5]

- Q7)** a) Derive the stiffness matrix formulation for one-dimensional steady-state heat conduction problems. [5]
 b) Determine the forces in the members in the following truss. [5]



OR

- Q8)** a) What is the role of mass and damping matrices in dynamic analysis? [5]
 b) Describe the steps involved in performing a response spectrum analysis for a multi-degree-of-freedom (MDOF) system. [5]
- Q9)** a) The structure shown in Figure is subjected to an increase in temperature of 80°C. Determine nodal displacement. Bronze: Area = 2400 mm², E = 83 GPa, $\alpha = 18.9 \times 10^{-6}$ per °C. AL : Area = 1200 mm², E = 70 GPa, $\alpha = 23 \times 10^{-6}$ per °C, P = 60 kN. [5]



- b) Discuss about 2D heat conduction in composite slabs using FEA. [5]

OR

- Q10)** a) Write down governing equation of steady state heat transfer and also write down elemental stiffness matrix and compare with bar element. [5]
 b) What are the main challenges in modeling plane, incompressible, rotational FSI? [5]



Total No. of Questions : 7]

SEAT No. :

PE12047

[Total No. of Pages : 2

[6585]-564

M.E. (Mechanical) (Design Engineering)
PCC-501-MDE : ADVANCED STRESS ANALYSIS
(2025 Pattern) (Semester - I)

Time : 2 Hours]

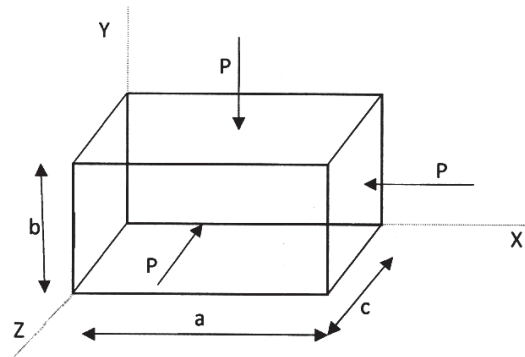
[Max. Marks : 50

Instructions to the candidates:

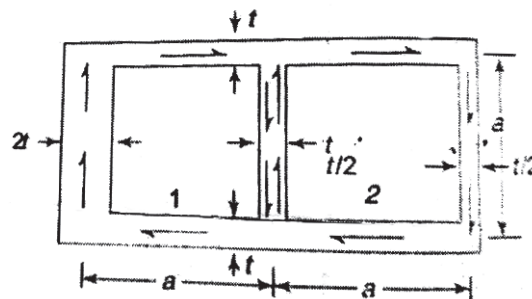
- 1) Answer any five questions.
- 2) Figures to the right indicate full marks.
- 3) Assume suitable data if necessary.

Q1) Describe the concept of plane stress and plane strain, and provide an appropriate example. [10]

Q2) A rectangular 3D solid body has the dimensions shown in figure, acted on by a uniform hydrostatic pressure P . The three negative faces are attached to the fixed coordinate system. Find the stresses, strain, displacements and support reactions of the body if there are no body forces present. [10]



Q3) Figure shows a two cell tubular section whose wall thickness are shown. If the member is subjected to a torque T , find the shear flows and angle of twist of the member per unit length. [10]



P.T.O.

Q4) a) Explain in brief concept of shear center in symmetrical and unsymmetrical bending. [5]

b) Explain Prandtl's membrane analogy, with a suitable example. [5]

Q5) Derive Winkler Bach formula for curved beam. [10]

Q6) Two carbon steel ball, each 25 mm in diameter are pressed together by a force $F = 18\text{N}$. At the center of the area of contact, find the values of the principal stresses, maximum shear stress, and the octahedral shear stress. $E = 207\text{GP}$, $\mu = 0.292$. [10]

Q7) a) Explain construction and working of circular polariscope. [5]

b) What are strain rosettes? Explain rosettes with suitable example. [5]



[6585]-565

First Year M.E. (Mechanical (Design Engineering))

PCC-502-MDE : ADVANCED MECHANICAL
VIBRATIONS

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Solve any five Questions.
- 2) Draw Neat diagrams wherever necessary.
- 3) Use of scientific calculator is allowed.
- 4) Assume suitable data wherever necessary.
- 5) Figures to the right indicate full marks.

- Q1)** Three rail bogies are connected by two springs of stiffness 40×10^5 N/m each as shown in figure 1. The mass of each bogie is 20×10^3 Kg. Determine the frequencies of vibration by any method. Neglect friction between the wheels and rails. [10]

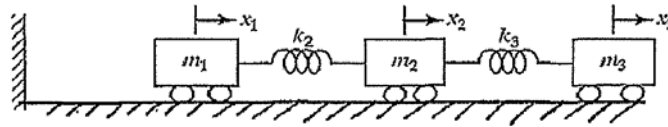


Fig.1

- Q2)** Using matrix method, determine natural frequencies of the system in figure 2. [10]

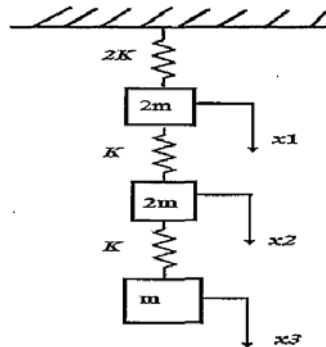


Fig. 2

P.T.O.

Q3) Derive the frequency equation of longitudinal vibrations for a free-free beam with zero displacement. **[10]**

Q4) In the vibration testing of a structure, an impact hammer with a load cell to measure the impact force is used to cause excitation, as shown in figure 3. Assuming $m = 5 \text{ Kg}$, $K = 2000 \text{ N/m}$, $c = 10 \text{ N-s/m}$ and $F = 20 \text{ N-s}$, Find the response of system. **[10]**

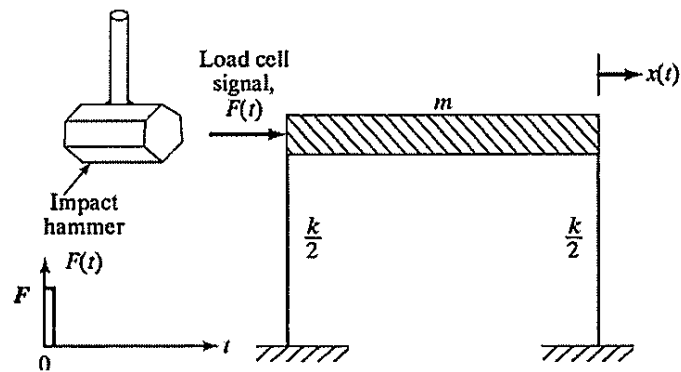


Fig.3

Q5) a) What is active vibration isolation? **[6]**

b) What is the difference between a vibration isolator and a vibration absorber? **[4]**

Q6) a) Give two examples of a mechanical vibration exciter. **[6]**

b) Explain, What is the purpose of experimental modal analysis? **[4]**

Q7) Write Short note on any three : **[10]**

- a) Analysis of narrow band system
- b) In-situ balancing of rotors
- c) Power Spectral Density
- d) FFT Analyzer



Total No. of Questions :7]

SEAT No. :

PE12165

[Total No. of Pages : 2

[6585]-566

First Year M.E. (Mechanical(Design Engineering))
PCC-503-MDE : MATERIAL SCIENCE AND MECHANICAL
BEHAVIOR OF MATERIALS
(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Solve any five Questions.*
- 2) *Draw Neat diagrams wherver necessary.*
- 3) *Use of scientific calculator is allowed.*
- 4) *Assume suitable data wherever necessary.*
- 5) *Figures to the right indicate full marks.*

- Q1) a)** What are the Smart Materials? Explain their applications by considering functional attributes. **[5]**
- b) For single-phase metals, explain strengthening by grain size reduction, solid-solution alloying, and strain hardening. **[5]**

- Q2) a)** The state of stress at a point in a body is given by
$$\begin{bmatrix} 20 & -40 & 0 \\ -40 & -40 & 0 \\ 0 & 0 & 100 \end{bmatrix}.$$

Determine the following: **[5]**

- i) Octahedral normal stress.
 - ii) Octahedral shear stress.
 - iii) Maximum shear stress.
- b) Consider an isotropic material loaded so that the principal stresses coincide with the x, y and z axes. Assume the Von Misses yield criterion applies, make a plot of σ_y versus σ_x yield locus with $\sigma_z = 0$. Assume at yielding, $\sigma_1 = Y$ and $\sigma_2 = \sigma_3 = 0$. **[5]**

P.T.O.

- Q3)** a) A 13 mm-diameter tensile specimen has a 50 mm gage length. The load corresponding to the 0.2 percent offset is 6800 kg and the maximum load is 8400 kg. Fracture occurs at 7300 kg. The diameter after fracture is 8mm and the gage length at fracture is 65 mm. Calculate the standard properties of the material from the tension test. [5]
- b) Explain with neat sketch the Biaxial Tension (Hydraulic Bulge) Test. [5]
- Q4)** a) A tensile specimen with a 12 mm initial diameter and 50 mm gauge length reaches maximum load at 90 kN and fractures at 70 kN. The minimum diameter at fracture is 10mm. Determine the engineering stress at maximum load and true fracture stress. [5]
- b) Explain Bridgman correction and Bauschinger's effect. Is it desirable phenomenon? Justify. [5]
- Q5)** a) Write a short note on: [5]
- i) Isotropic Hardening Model
- ii) Kinematic Hardening Model
- b) Two points on a true stress-strain curve for aluminum alloy are $\sigma = 222$ MPa at $\varepsilon = 0.05$ and $\sigma = 303$ MPa at $\varepsilon = 0.15$. Find the values of σ_0 and A using saturation model suggested by Voce i.e. $\sigma = \sigma_0[1 - \exp(-A\varepsilon)]$, that best fit the data. Then using these values of σ_0 and A, predict the true stress at a strain of $\varepsilon = 0.30$. [5]
- Q6)** a) Explain the Deformation Theory of Plasticity. [5]
- b) Find shake down region for a circular rod of radius a with a tensile force P and a twisting moment M. [5]
- Q7)** a) What is viscoelasticity? Explain Maxwell's model and the Voigt Model for viscoelastic material with a neat sketch. [5]
- b) A piece of metal is subjected to a cyclic stress of 80 MPa. If the phase angle $\delta = 0.1^\circ$ and no heat is transferred to the surroundings, what will be the temperature rise after 1,00,000 cycles? Data: $E=80$ GPa, $C=800$ J/kgK, and $\rho = 4.2$ Mg/m³. [5]



Total No. of Questions : 7]

SEAT No. :

PE12224

[Total No. of Pages : 2

[6585]-566CR

First Year M.E. (Mechanical) (Design Engineering)

**PCC-503-MDE : MATERIAL SCIENCE AND MECHANICAL
BEHAVIOR OF MATERIALS
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Solve any five questions.*
- 2) Draw neat diagrams wherever necessary.*
- 3) Use of scientific calculator is allowed.*
- 4) Assume suitable data, if necessary.*
- 5) Figures to the right indicate full marks.*

Q1) a) Explain the constituents of composite materials in detail. **[5]**

b) Explain any four properties of Nano materials and it's industrial application. **[5]**

Q2) a) The state of stress at a point in a body is given by
$$\begin{bmatrix} 10 & 0 & 3 \\ 0 & 3 & 0 \\ 3 & 0 & 2 \end{bmatrix}$$
 Determine the following : **[5]**

- i) Octahedral normal stress
 - ii) Octahedral shear stress
 - iii) Maximum shear stress
- b) Explain Von Mises's Criteria of Yielding and draw its Yield Locus. **[5]**

Q3) a) A tensile specimen with a 12 mm initial diameter and 50mm gauge length reaches maximum load at 90kN and fractures at 70kN. The minimum diameter at fracture is 10mm. Determine the engineering stress at maximum load and true fracture stress. **[5]**

b) Describe the phenomenon of Bauschinger's effect in mild steel. **[5]**

P.T.O.

Q4) a) A 13 mm diameter tensile specimen has a 50 mm gage length. The load corresponding to the 0.2 percent offset is 6800 kg and the maximum load is 8400 kg. Fracture occurs at 7300kg. The diameter after fracture is 8mm and the gage length at fracture is 65mm. Calculate the standard properties of the material from the tension test. [5]

b) Explain Three Point Bend Test with neat sketch. [5]

Q5) An element of J2-material (deformation theory of plasticity) is subjected to a proportional loading path with stress ratio $\frac{\sigma}{\tau} = 2$. The material obeys Hook's law up to elastic limit. Post-yield behaviour during simple tension of the material is given by $\epsilon = \frac{\sigma}{E} + \frac{\sigma - \sigma_y}{m}$. With Young's modulus $E = 207 \text{ GPa}$, yield stress $\sigma_y = 207 \text{ MPa}$, constant $m = 25 \text{ GPa}$ Poisson's ratio = 0.3. Find all the components of normal and shear strains for stress state of $\sigma = 180 \text{ MPa}$ and $\tau = 90 \text{ MPa}$. [10]

Q6) What is viscoelasticity? Explain Maxwell Model, Voigt Model and Maxwell-Voigt Model for rheological properties of viscoelastic material with neat sketch. [10]

Q7) a) The amplitude of a vibrating member decreases so that the amplitude on the 100th cycle is 13% of the amplitude on the 1st cycle. Determine natural Decay. [5]

b) Explain isotropic and kinematic hardening models with neat sketch. [5]



Total No. of Questions : 7]

SEAT No. :

PE-12203

[Total No. of Pages : 2

[6585]-567

M.E. (Mechanical) (Design Engineering)

PCC - 504 - MDE : OPTIMIZATION TECHNIQUES

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer any five questions from the following.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of electronic pocket calculator is allowed.
- 5) Assume suitable data, if necessary.

- Q1) a) Explain the characteristics mathematical models. [5]
b) Discuss in brief classification of optimization problems. [5]

- Q2) Minimize the following function with simple simplex method. [10]

$$\text{Minimize } Z = 25 X_1 + 30 X_2$$

$$\text{Subject to, } 4X_1 + 3X_2 \geq 60$$

$$2X_1 + 3X_2 \geq 36$$

$$X_1, X_2 \geq 0$$

- Q3) Explain in brief (Any 2) [10]

- a) Artificial Neural Network
- b) Teaching Learning based optimization
- c) Particle Swarm Optimization

- Q4) Use golden section method to find the maximum of $\sin x + (x^2/20)$ with the interval 0 and 4. [10]

- Q5) a) What is topology optimization? Explain with suitable example. [5]
b) Write a short note on Bi-Directional evolutionary optimization. [5]

P.T.O.

Q6) Explain with suitable example Neural-Network-based optimization technique. **[10]**

- Q7)** a) Write short note on optimization as design tool Topology. **[5]**
b) List the different solution methods in topology optimization and explain one of them in detail. **[5]**



Total No. of Questions : 7]

SEAT No. :

PE-12049

[Total No. of Pages : 1

[6585]-568

M.E. (Mechanical Engineering) (Robotics & Automation)

PCC-501-RAU : MACHINE VISION SYSTEM

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer any five questions from the following.***
- 2) Neat diagrams must be drawn wherever necessary.***
- 3) Figures to the right indicate full marks.***
- 4) Assume suitable data if necessary.***

Q1) Explain the terms : [10]

- a) Template based activity recognition.***
- b) Human Recognition Using Gait.***

Q2) What is Image Acquisition? Explain Image Processing in Spatial and Frequency Domain? [10]

Q3) What is Image processing? Explain in detail Point Operation and Thresholding. [10]

Q4) Write Machine vision applications in metrology and gauging, Vision guided robotics, Field and Service Applications, and Bio medical field. [10]

Q5) Explain how Industrial machine vision is used in production and services. Explain with an example. [10]

Q6) Define Object Detection. Explain in detail Silhouette-Based Method for Object Classification and Viola Jones object detection framework. [10]

Q7) What is Machine vision? Write about types and Selection process for Machine Vision Lenses and Optical Filters. [10]



Total No. of Questions : 7]

SEAT No. :

PE-12050

[Total No. of Pages : 2

[6585]-569

M.E. (Mechanical (Robotics & Automation))

PCC-502-RAU - TOTAL INTEGRATED AUTOMATION INDUSTRY

4.0 (2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer any five questions from the following.*
- 2) Figures to the right side indicate full marks.*
- 3) Assume suitable data if necessary.*

Q1) Explain the concept of production economics. Discuss the costs in manufacturing and unit cost of production. **[10]**

Q2) What is Computer Simulation of Automated Flow Lines? Explain its importance in system design. **[10]**

Q3) Describe the construction and working of an Automated Storage and Retrieval System (AS/RS). Explain its performance measures. **[10]**

Q4) Explain Automated Guided Vehicle (AGV) systems. Discuss their routing and control methods. **[10]**

Q5) Describe the design considerations for automated assembly systems. Explain part-feeding devices. **[10]**

P.T.O.

Q6) Explain continuous and discrete control systems. Compare their characteristics with examples. **[10]**

Q7) Describe SCADA architecture. Explain the role of RTU and analog/digital I/O modules. **[10]**



Total No. of Questions : 7]

SEAT No. :

PE-12051

[Total No. of Pages : 2

[6585]-570

M.E. (Mechanical (Robotics & Automation))

PCC-503-RAV - ROBOTICS APPLICATION

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer any five questions from the following.*
- 2) Figures to the right side indicate full marks.*
- 3) Assume suitable data if necessary.*

Q1) Discuss the basic components of a robotic system and explain their functions with a neat block diagram. **[10]**

Q2) Explain in detail the different types of sensors used in robots such as tactile, proximity and vision sensors. **[10]**

Q3) Explain forward and inverse kinematics of a three-degree-of-freedom robotic manipulator. **[10]**

Q4) Describe the construction, types and characteristics of manipulators used in robotic systems. **[10]**

Q5) Explain the concepts of path planning and obstacle avoidance in robotic motion control. **[10]**

P.T.O.

Q6) Describe various feedback devices used in robot control systems such as encoder, resolver and LVDT. **[10]**

Q7) Discuss the role of computer control and robot programming languages in modern robotic systems. **[10]**



Total No. of Questions : 7]

SEAT No. :

PE-12225

[Total No. of Pages : 1

[6585]-570-CR

M.E. (Mechanical Engineering) (Robotics & Automation)

PCC-503-RAU : ROBOTICS APPLICATIONS

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer any five questions from the following.*
- 2) Figures to the right indicate full marks.*
- 3) Assume suitable data if necessary.*

Q1) Trace the history and evolution of robots. Explain the present status and future trends in robotics. **[10]**

Q2) Compare hydraulic, pneumatic, and electric drive systems used in robotic applications. **[10]**

Q3) Explain homogeneous transformations and their use in multiple-link robotic kinematics. **[10]**

Q4) Discuss gripper design, gripper force analysis, and different drive systems used for grippers. **[10]**

Q5) Explain path and trajectory planning methods used for joint-integrated and straight-line robot motions. **[10]**

Q6) Explain different types of robot control actions and motion interpolation techniques. **[10]**

Q7) Discuss various robot applications in material handling, machine loading/unloading, welding and spray painting. **[10]**



Total No. of Questions : 7]

SEAT No. :

PE-12052

[Total No. of Page : 1

[6585]-571

M.E. (Mechanical Engineering) (Robotics & Automation)

PCC-504-RAU: Robotic Operating System

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer any five questions from the following.*
- 2) Figures to the right side indicate full marks.*
- 3) Use of electronic pocket calculator is allowed.*
- 4) Assume suitable data if necessary.*

Q1) Describe the history of robotics and explain any robot drive mechanism with examples. **[10]**

Q2) Explain mathematical modeling of a robot and derive the Denavit – Hartenberg (DH) representation. **[10]**

Q3) Explain the specifications and hardware design considerations of ChefBot in detail. **[10]**

Q4) Explain interfacing Dynamixel actuators and encoders with Tiva C Launchpad. **[10]**

Q5) Describe the working of ultrasonic, IR, and IMU sensors used in mobile robots. **[10]**

Q6) Explain point cloud processing using Kinect, OpenNI, ROS, and PCL. **[10]**

Q7) Describe the different types of ROS nodes and launch files used for ChefBot testing. **[10]**



Total No. of Questions : 10]

SEAT No. :

PE-12053

[Total No. of Pages : 3

[6585]-572

M.E. (Automation & Robotics)/(Mechanical)
ADVANCE COMPUTATIONAL & NUMERICAL
METHODS
(2025 Pattern) (Semester - I) (PCC-501-AUR)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagram must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary and clearly state.*
- 5) *Use of cell phone is prohibited in the examination hall.*
- 6) *Use of electronic pocket calculator is allowed.*

Q1) In a cam follower mechanism, the displacement d of the follower tip in term of angle of rotation θ is given by

$$d = \theta + \sin(\theta) \quad 0 \leq \theta \leq 2\pi$$

Determine value of θ which produces displacement $d = 1$ cm. Check convergence and solve up to 4 decimal place accuracy using Newton Raphson's method. Take initial guess as ZERO [10]

OR

Q2) Solve the following equations by Gauss-Sedidal method. Solve up to 6 iterations [10]

$$8x + 2y - 2z = 8$$

$$x - 8y + 3z = -4$$

$$2x + y + 9z = 12$$

Q3) Fit a second order polynomial to the data represented below. Also evaluate R^2 value and standard error. [10]

x	0	1	2	3	4	5
y	2.1	7.7	13.6	27.2	40.9	61.1

P.T.O.

OR

Q4) By means of Newton's divided difference formula find the value of $f(8)$ and $f(15)$ [10]

x	4	5	7	10	11	13
$f(x)$	48	100	294	900	1210	2028

Q5) Find $f'(10)$ from the following data : [10]

x	3	5	11	27	34
$f(x)$	-13	23	899	17315	35606

OR

Q6) Determine the largest Eigen value and the corresponding Eigen vector of the matrix [10]

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

Q7) Using Runge-Kutta method of fourth order Solve [10]

$$\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2} \text{ with } y(0) = 1 \text{ at } x = 0.2 \text{ and } x = 0.4$$

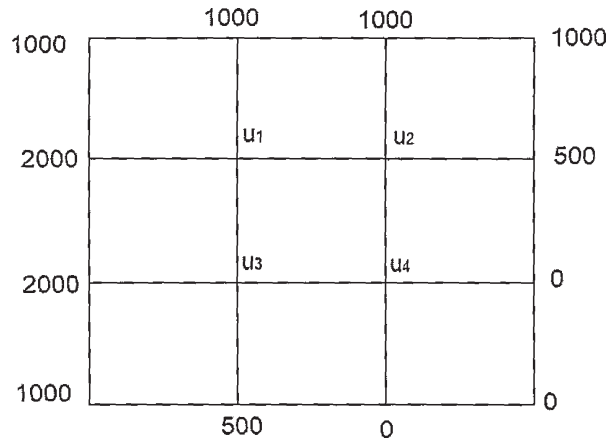
OR

Q8) Using Adam's method find $y(0.4)$, Given that [10]

$$\frac{dy}{dx} = \frac{1}{2}xy$$

x	0	0.1	0.2	0.3	0.4
y	1	1.01	1.022	1.023	?

Q9) Given the value of $u(x, y)$ on the boundary of the square in the figure below, evaluate the function $u(x, y)$ satisfying the Laplace's equation $\nabla^2 u = 0$ at the pivotal points of the figure by Jacobi's method. Perform 4 iterations only [10]



OR

Q10) Find the values of $u(x, t)$ satisfying the parabolic equation [10]

$$\frac{\partial u}{\partial t} = 4 \frac{\partial^2 u}{\partial x^2}$$

And the boundary conditions are

$$u(0, t) = 0 = u(8, t)$$

$$\text{and } u(x, 0) = 4x - \frac{1}{2}x^2$$

at the point $x = i; i = 0, 1, 2, \dots, 7$ and $t = \frac{1}{8}j; j = 0, 1, 2, \dots, 5$



Total No. of Questions : 10]

SEAT No. :

PE-12054

[Total No. of Pages : 2

[6585]-573

M.E. (Mechanical (Automation and Robotics))

(PCC-502-AUR) : MECHATRONICS

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Solve any 1 question from Q1 or Q2, Q3 or Q4, or Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Assume suitable data, if necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of electronic pocket calculator is allowed.*

Q1) Explain the elements of a Mechatronic system with a block diagram. Discuss advantages and give four practical examples. Explain working principle and application of optical encoders and capacitive level sensors. **[10]**

OR

Q2) Classify sensors used in mechatronic systems. Describe construction, working and application of proximity sensors. Compare contact vs non-contact sensing. **[10]**

Q3) Define signal conditioning. Explain ADC and DAC types, opto-isolators and protection devices used in signal chains. **[10]**

OR

Q4) Explain types of electronic signals (analog/digital, single-ended/differential). Describe relays, contactors and typical display units. Outline a typical data acquisition chain (sensor → display). **[10]**

Q5) Compare AC motors, DC motors, servomotors and stepper motors with construction, Control Characteristics and applications. **[10]**

OR

Q6) Explain working principle, construction and applications of linear motors. Distinguish stepper vs servo drives (control, advantages, typical uses). **[10]**

P.T.O.

Q7) Explain On/Off, P.I.D control actions. Derive PID controller law and show how PI, PD and PID affect steady state error, overshoot and settling time.[10]

OR

Q8) Consider an electro-mechanical plant $G(s)=K/(\tau s+1)$. Derive closed-loop transfer function with proportional controller and show effect of increasing K_p on steady-state error and time constant. [10]

Q9) Draw and explain the architecture of the 8051 microcontroller. Explain functions of ports, timers, serial port and interrupts. [10]

OR

Q10) Compare 8051 with modern microcontrollers. Explain how microcontrollers interface with sensors and actuators using ADC, PWM, UART, SPI, I2C.[10]



Total No. of Questions : 10]

SEAT No. :

PE-12055

[Total No. of Pages : 2

[6585]-574

M.E. (Mechanical Engineering) (Automation and Robotics)

PCC - 503 - AUR : ROBOTICS APPLICATION

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data, if necessary.

- Q1)** a) Compare hydraulic, pneumatic and electric drive systems used in robots.[6]
b) Write short notes on the present status and future trends in robotics.[4]

OR

- Q2)** a) What are the basic components of a robotic system? State the main function of each component. [5]
b) Explain the working of a slider-crank mechanical gripper with a neat diagram. [5]

- Q3)** a) Explain the forward kinematics of a 3-DOF manipulator with a neat explanation. [5]
b) Discuss the relationship between forward and inverse kinematics in robot motion control. [5]

OR

- Q4)** a) Discuss the challenges associated with solving inverse kinematics for 3-DOF robot arms. [4]
b) Write short notes on scaling rotation and translation operations in robotic kinematics. [6]

- Q5)** a) Differentiate between grippers and tools as end effectors. [5]
b) Explain the constructional features of robotic manipulators. [5]

OR

- Q6)** a) Discuss the characteristics required for an end effector used in industrial environments. [5]
b) Explain the construction and applications of tool-type end effectors.[5]

P.T.O.

- Q7)** a) Explain the computer control architecture used in industrial robot systems with a neat sketch. [5]
b) Explain the role of obstacle avoidance in robotic path planning. [5]

OR

- Q8)** a) Explain straight-line motion and joint-interpolated motion in robot manipulators. [4]
b) Explain the difference between joint-integrated motion and straight-line motion with an example. [6]

- Q9)** a) Explain point-to-point (PTP) control in robots. Discuss its working, advantages and limitations. [5]
b) Explain robot applications in material handling with neat sketches. [5]

OR

- Q10)** a) Compare online and offline robotic programming with suitable examples. [5]
b) Explain the working of an LVDT and its role in robotic control systems. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12226

[Total No. of Pages : 2

[6585]-574-CR

M.E. (Mechanical Engineering) (Automation and Robotics)

PCC-503-AUR : ROBOTICS APPLICATION

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8 and Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) a) Explain the working of a slider-crank mechanical gripper with a neat diagram. **[5]**

b) Explain the working principle and applications of tactile sensors in robots. **[5]**

OR

Q2) a) Write a short note on light sensors and pressure sensors used in robotic systems. **[5]**

b) Compare magnetic grippers and vacuum grippers in terms of working principle, advantages and limitations. **[5]**

Q3) a) Explain the procedure for computing the homogeneous transformation matrix of a 3-link manipulator. **[5]**

b) Discuss the relationship between forward and inverse kinematics in robot motion control. **[5]**

OR

Q4) a) Discuss the challenges associated with solving inverse kinematics for 3-DOF robot arms. **[5]**

b) Write short notes on scaling, rotation and translation operations in robotics kinematics. **[5]**

P.T.O.

- Q5)** a) Explain the constructional features of robotics manipulators. [5]
b) Discuss the characteristics required for an end effector used in industrial environments. [5]

OR

- Q6)** a) Explain the construction and principle of vacuum grippers. [5]
b) Differentiate between electronic manipulators and pneumatic manipulators with suitable examples. [5]

- Q7)** a) Explain robot software and its role in real-time robot control. [5]
b) Explain the role of obstacle avoidance in robotic path planning. [5]

OR

- Q8)** a) Explain straight-line motion and joint-interpolated motion in robot manipulators. [4]
b) Explain the computer control architecture used in industrial robot systems with a neat sketch. [6]

- Q9)** a) Explain the structure and working of a robotic control system with a neat block diagram. [5]
b) Compare online and offline robotic programming with suitable examples. [5]

OR

- Q10)** a) Explain the concept of an intelligent robot with suitable features and examples. [5]
b) Explain Point-To-Point (PTP) control in robots. Discuss its working, advantages and limitations. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12056

[Total No. of Pages : 2

[6585]-575

M.E (Mechanical) (Automation and Robotics)

PCC-504-AUR : ROBOT PROGRAMMING

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Solve any 1 question from Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Assume suitable data, if necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of electronic pocket calculator is allowed.*

Q1) a) Explain the functions and features of a Flex Pendant used in industrial robots. [5]

b) Explain the concept of robot programming and its significance in industrial automation. [5]

OR

Q2) a) Discuss different robot coordinate systems: World, Base, Tool, and Joint coordinates. [5]

b) Explain the importance of Tool Center Point (TCP) in robot programming. [5]

Q3) a) Discuss the use of MOVE and path control commands in robotic welding. [5]

b) Explain the motion control commands MOVE, MOVES, and MOVE in VAL language. [5]

OR

Q4) a) Discuss the role of key RAPID commands such as MoveJ, MoveL, SetDO, and WaitTime. [5]

b) Explain the use of OPEN, CLOSE, and GRIP commands in VAL with examples. [5]

P.T.O.

- Q5)** a) Compare low level, high-level and task-level robot programming languages [6]
b) Discuss the importance of speed, zone data, and accuracy in RAPID motion instructions. [4]

OR

- Q6)** a) Explain the syntax of basic motion commands in Movemaster with examples. [6]
b) Explain the sequence of steps required to write a RAPID program for a pick-and-place operation. [4]
- Q7)** a) Explain the procedure for robot cycle time analysis with an example.[5]
b) Explain the steps involved in jogging a robot in a virtual environment.[5]

OR

- Q8)** a) Write an AML program for a simple pick-and-place operation. [5]
b) Write a simple VAL-II program for a pick-and-place operation. [5]
- Q9)** a) Explain the steps involved in robot programming synthesis with an example. [6]
b) Describe the role of robots in CAM environments and their benefits.[4]

OR

- Q10)** a) Explain how robots are integrated with CAD systems for automated manufacturing. [6]
b) Discuss different methods used for collision-free motion planning in robots. [4]



Total No. of Questions : 5]

SEAT No. :

PE12143

[Total No. of Pages : 3

[6585]-576

M.E. (Mechanical Engineering) (Heat Power Engineering)
PCC-501-HPO : ADVANCED NUMERICAL METHODS FOR
THERMAL & FLUID ENGINEERING
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *All questions carry equal marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Use of electronic pocket calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

Q1) Attempt any two of the following :

[10]

- a) Solve the following system of equations using Gauss elimination method. **[5]**

$$10x_1 - 7x_2 + 3x_3 + 5x_4 = 6$$

$$-6x_1 + 8x_2 - x_3 - 4x_4 = 5$$

$$3x_1 + x_2 + 4x_3 + 11x_4 = 2$$

$$5x_1 - 9x_2 - 2x_3 + 4x_4 = 7$$

- b) Solve the equations by LU decomposition method. **[5]**

$$2x + 3y + z = 9$$

$$x + 2y + 3z = 6$$

$$3x + y + 2z = 8$$

- c) Obtain the roots of the equation $x^3 - 4x - 9 = 0$ correct to four decimal places by using Newton-Raphson method. **[5]**
- d) Find the roots of the equation $x^4 - 1.8x^3 + 6x^2 - 18x - 13.9 = 0$ by regula-falsi method correct upto two decimal places. **[5]**

P.T.O.

Q2) Attempt any two of the following : [10]

- a) Using Newton's forward difference formula, find the value of y at $x = 3.5$ for the following data : [5]

x	2	3	4	5	6	7	8	9
y	19	48	99	178	291	444	643	894

- b) By using Trapezoidal rule, evaluate $\int_0^1 x e^{x^2} dx$, taking $h = 0.1$. [5]

- c) By Lagrange's cubic spline find $f(2.5)$ for the data : [5]

x	1	2	3	4
y	3	2	5	10

- d) Use Simpson's $\frac{1}{3}$ rule with two and four intervals to evaluate $\int_1^2 \frac{1}{x} dx$. [5]

Q3) Solve any two of the following : [10]

- a) Using modified Euler's method, find $y(0.2)$ $\frac{dy}{dx} = y + e^x$, $y(0) = 0$, $h = 0.2$ (only 3 iterations). [5]

- b) Apply Rung-Kutta fourth order method to find an approximate value of y when $x = 0.2$ given that $\frac{dy}{dx} = x + y$ & $y = 1$ when $x = 0$ & $h = 0.2$. [5]

- c) Given $\frac{dy}{dx} = x^2(1 + y)$ and $y(1) = 1$, $y(1.1) = 1.233$, $y(1.2) = 1.548$, $y(1.3) = 1.979$, Evaluate $y(1.4)$ by Adams - Bashforth method. [5]

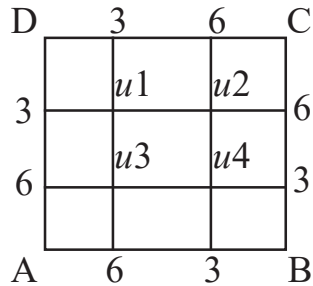
- d) Solve the equation $y'' = x + y$ with the boundary conditions $y(0) = y(1) = 0$ using finite difference method. [5]

Q4) Solve any two of the following : [10]

- a) Solve the equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over the square with sides $x = 0 = y$, $x = 3 = y$ with $u = 0$ on the boundary and $h = 1$. [5]

- b) Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ in $0 < x < 5$, $t \geq 0$ given that $u(x, 0) = 20$, $u(0, t) = 0$, $u(5, t) = 100$. Compute u for the time-step with $h = 1$ by Crank-Nicholsor method. [5]

- c) Solve $y_{tt} = y_{xx}$ upto $t = 0.5$ with a spacing of 0.1 subject to $y(0, t) = 0$, $y(1, t) = 0$, $y_t(x, 0) = 0$ and $y(x, 0) = 10 + x(1-x)$. [5]
- d) Solve $u_{xx} + u_{yy} = 0$ numerically for the following mesh with uniform spacing and with boundary conditions as shown in the following figure. [5]



Q5) Solve any two : [10]

- a) Find the least square polynomial approximation of degree two of the data. [5]

x	0	1	2	3	4
y	-4	-1	4	11	20

- b) Find the least square straight line to the data. [5]

x	-2	-1	0	1
y	6	3	2	2

- c) Solve the following linear programming problem graphically. [5]

Minimize and maximize : $z = x + 2y$

Subject to constraints $x + 2y \geq 100$

$$2x - y \leq 0$$

$$2x + y \leq 200; x, y \geq 0$$

- d) Solve the following LPP by simplex method $z = x_1 - 3x_2 + 3x_3$ [5]

$$\text{Subject to : } 3x_1 - x_2 + 2x_3 \leq 7; \quad 2x_1 + 4x_2 \geq -12;$$

$$-4x_1 + 3x_2 + 8x_3 \leq 10; \quad x_1, x_2, x_3 \geq 0$$



Total No. of Questions : 10]

SEAT No. :

PE12166

[Total No. of Pages : 2

[6585]-577

M.E. (Mechanical-Heat Power)

PCC-502-HPO : ADVANCED THERMODYNAMICS

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right of each question indicate full marks.
- 4) Assume suitable data wherever necessary and mention the same clearly.
- 5) Use of steam tables, mollier chart and calculator is allowed.

Q1) a) Define the compressibility factor and describe the generalized compressibility chart. **[5]**

b) Explain P-T diagram for a pure substance. **[5]**

OR

Q2) a) Define the reduced pressure and reduced temperature and explain the principle of corresponding states. **[5]**

b) On Mollier diagram, why do the isobars diverge from one another. **[5]**

Q3) a) State and explain Third law thermodynamics. **[4]**

b) One kg of ice at -5°C is exposed to the atmosphere which is at 20°C . The ice melts and comes into thermal equilibrium with the atmosphere. **[6]**

i) Determine the entropy increase of the universe.

ii) What is the minimum amount of work necessary to convert the water back into ice at -5°C , C_p of ice is 2.093 kJ/kg K and the latent heat of fusion of ice is 333.3 kJ/kg .

OR

Q4) a) State and explain Nerst heat theorem. **[4]**

b) One kg of water at 273 K is brought into contact with a heat reservoir at 373 K . When the water has reached 373 K , find the entropy change of the water, of the heat reservoir, and of the universe.

If water is heated from 273 K to 373 K by first bringing it in contact with a reservoir at 323 K and then with a reservoir at 373 K , what will the entropy change of the universe. **[6]**

P.T.O.

- Q5)** a) What is the second law efficiency? How does it differ from the first-law efficiency? [4]
b) Derive the Clapeyron equation. [6]

OR

- Q6)** a) Explain the term Dead State. [4]
b) What is Joule-Thomson coefficient? Describe the inversion line and the maximum inversion temperature. [6]

- Q7)** a) Discuss Amagat's law. [4]
b) What do you understand by the term enthalpy of formation and enthalpy of combustion? [6]

OR

- Q8)** a) State and explain Gibb's phase rule. [4]
b) Write three different K_p (equilibrium constant) relations for reacting ideal gas mixtures, and state when each relation should be used. [6]

- Q9)** a) Explain thermodynamics of nutrition and exercise. [5]
b) Explain Fermi-Dirac statistics. [5]

OR

- Q10)** a) Explain the thermodynamics of biological cells. [5]
b) Explain Bose Einstein statistics. [5]



Total No. of Questions :6]

SEAT No. :

PE12167

[Total No. of Pages : 2

[6585]-578

M.E. (Mechanical-Heat Power)

PCC-503-HPO : ADVANCED FLUID MECHANICS

(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt any five questions*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data wherever necessary and mention the same clearly.*
- 5) *Use of steam tables, Mollier chart and calculator is allowed.*

Q1) a) Discuss Reynolds transport theorem. Explain Relationship between material derivative and RTT. **[5]**

b) Elaborate concept of Vorticity and irrotationality. **[5]**

Q2) Consider steady, incompressible, laminar flow of a Newtonian fluid in an infinitely long round pipe of diameter D or radius $R=D/2$. You can ignore the effects of gravity. A constant pressure gradient $\partial p / \partial x$ is applied in the x-direction, **[10]**

Applied pressure gradient: $\frac{\partial P}{\partial X} = \frac{P_2 - P_1}{X_2 - X_1} = \text{constant}$

Where x_1 and x_2 are two arbitrary locations along the x-axis, and P_1 and P_2 are the pressures at those two locations. Note that we adopt a modified cylindrical coordinate system here with x instead of z for the axial component, namely, (r, θ, x) and (u_r, u_θ, u) . Derive an expression for the velocity field inside the pipe and estimate the viscous shear force per unit surface area acting on the pipe wall.

Q3) a) Discuss different types of free turbulent flow? Why turbulence modeling is required? **[5]**

b) Explain the concept of Vortex Lines, Doublet **[5]**

P.T.O.

- Q4)** a) Discuss concept of Magnus effect with application [5]
 b) Discuss concept of Displacement thickness, momentum thickness. [5]
- Q5)** a) Elaborate normal and oblique shocks with diagram [5]
 b) Air enters a converging-diverging nozzle at 1.0 MPa and 800 K with a negligible velocity. The flow is steady, one-dimensional, and isentropic with $k = 1.4$. For an exit Mach number of $Ma=2$ and a throat area of 20 cm^2 , determine (i) the throat conditions, (ii) the exit plane conditions, including the exit area, and (iii) the mass flow rate through the nozzle. [5]
- Q6)** Write Note on following. [10]
 a) Kutta-Joukowski lift theorem
 b) Fanno and Rayleigh curve

Table 1

One-dimensional isentropic compressible flow functions for an ideal gas with $k = 1.4$					
Ma	Ma*	A/A^*	P/P_0	ρ/ρ_0	T/T_0
0	0	∞	1.0000	1.0000	1.0000
0.1	0.1094	5.8218	0.9930	0.9950	0.9980
0.2	0.2182	2.9635	0.9725	0.9803	0.9921
0.3	0.3257	2.0351	0.9395	0.9564	0.9823
0.4	0.4313	1.5901	0.8956	0.9243	0.9690
0.5	0.5345	1.3398	0.8430	0.8852	0.9524
0.6	0.6348	1.1882	0.7840	0.8405	0.9328
0.7	0.7318	1.0944	0.7209	0.7916	0.9107
0.8	0.8251	1.0382	0.6560	0.7400	0.8865
0.9	0.9146	1.0089	0.5913	0.6870	0.8606
1.0	1.0000	1.0000	0.5283	0.6339	0.8333
1.2	1.1583	1.0304	0.4124	0.5311	0.7764
1.4	1.2999	1.1149	0.3142	0.4374	0.7184
1.6	1.4254	1.2502	0.2353	0.3557	0.6614



Total No. of Questions : 6]

SEAT No. :

PE-12227

[Total No. of Pages : 3

[6585]-578-CR
M.E. (Mechanical-Heat Power)
PCC - 503 - HPO : ADVANCED FLUID MECHANICS
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Attempt any five questions.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data wherever necessary and mention the same clearly.*
- 5) *Use of steam tables, Mollier chart and calculator is allowed.*

Q1) Derive conservation of mass equation with differential analysis and deduce the same for following cases in Cartesian as well as polar coordinate system.[10]

- a) Steady Compressible Flow
- b) Incompressible Flow

Q2) a) Discuss concept of Couette flow. [5]

b) What do you mean by Creeping Flow? State expressions for the same.[5]

Q3) a) Discuss different types of free turbulent flow? Why turbulence modeling is required? [5]

b) Discuss following with simple diagrams. [5]

i) Wake

ii) Large Eddy Simulations

Q4) a) Explain concept of Velocity profile over a flat plate and in pipes for turbulent flow. [5]

b) Compare flow separation for a laminar versus turbulent boundary layer. Specifically, which case is more resistant to flow separation? Why? Based on your answer, explain why golf balls have dimples. [5]

P.T.O.

Q5) a) Air enters a nozzle at 0.2 MPa, 350 K and a velocity of 150 m/s. Assuming isentropic flow, determine the pressure and temperature of air at a location where the air velocity equals the speed of sound. What is the ratio of the area at this location to the entrance area? **[5]**

b) Elaborate normal and oblique shocks with diagram. **[5]**

Q6) Write Note on following. **[10]**

a) Significance of Drag, lift

b) Pressure and Velocity variation in Converging-diverging nozzle.



Table 1

One-dimensional isentropic compressible flow functions for an ideal gas with $k = 1.4$

Ma	Ma*	A/A^*	P/P_0	ρ/ρ_0	T/T_0
0	0	∞	1.0000	1.0000	1.0000
0.1	0.1094	5.8218	0.9930	0.9950	0.9980
0.2	0.2182	2.9635	0.9725	0.9803	0.9921
0.3	0.3257	2.0351	0.9395	0.9564	0.9823
0.4	0.4313	1.5901	0.8956	0.9243	0.9690
0.5	0.5345	1.3398	0.8430	0.8852	0.9524
0.6	0.6348	1.1882	0.7840	0.8405	0.9328
0.7	0.7318	1.0944	0.7209	0.7916	0.9107
0.8	0.8251	1.0382	0.6560	0.7400	0.8865
0.9	0.9146	1.0089	0.5913	0.6870	0.8606
1.0	1.0000	1.0000	0.5283	0.6339	0.8333
1.2	1.1583	1.0304	0.4124	0.5311	0.7764
1.4	1.2999	1.1149	0.3142	0.4374	0.7184
1.6	1.4254	1.2502	0.2353	0.3557	0.6614

Total No. of Questions : 7]

SEAT No. :

PE12168

[Total No. of Pages : 2

[6585]-579

M.E. Mechanical Engineering (Heat Power Engineering)
PCC-504-HPO : ADVANCED REFRIGERATION TECHNOLOGY
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer any FIVE questions.*
- 2) Use of thermodynamics tables permitted.*
- 3) Figures to the right indicate full marks.*
- 4) All questions carry equal marks.*
- 5) Assume suitable data, if necessary*

Q1) a) Explain the Linde-Hampson cycle for air liquefaction with a T-s diagram. **[5]**

b) Discuss the challenges in selecting materials for cryogenic applications.**[5]**

Q2) a) Compare the thermodynamic and environmental properties of R-1234yf and R-134a. **[5]**

b) Explain the working and calibration of an Electronic Expansion Valve (EEV). **[5]**

Q3) a) Explain the working of a triple-effect LiBr-Water absorption refrigeration system with a neat flow diagram. **[5]**

b) Describe the role of the rectifier and analyzer in an ammonia-water absorption system. **[5]**

Q4) a) Describe the working principle of an ejector refrigeration system. **[5]**

b) Explain the Peltier effect and its application in thermoelectric cooling.**[5]**

P.T.O.

Q5) a) Draw a schematic and P-h diagram for a multi- evaporator system with a single compressor. [4]

b) Derive the expression for the total mass flow rate of the multi-evaporator system with a single compressor. [6]

Q6) a) Explain the procedure for cooling load estimation of a commercial cold storage facility. [5]

b) Discuss the concept and significance of Dry Air Rated Temperature (DART) used in aircraft refrigeration. [5]

Q7) a) Define ODP and GWP. [5]

b) Discuss the phase-out of HCFCs as per the Montreal protocol. [5]



Total No. of Questions : 8]

SEAT No. :

PE-12057

[Total No. of Pages : 2

[6585]-580

M.E. (Mechatronics)

**PCC-501 MTX : SYSTEM MODELLING,
IDENTIFICATION AND SIMULATION
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer any five questions.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of Calculator is allowed.*
- 5) *Assume suitable data if necessary.*

Q1) a) Define a system. Classify systems based on linearity and time-variance with examples. **[4]**

b) Derive the mathematical model for a mass-spring-damper system. State assumptions. **[6]**

Q2) a) Explain the Force-Voltage (F-V) analogy. **[4]**

b) Represent $\ddot{y} + 4\dot{y} + 3y = 5x$ in block diagram form. **[6]**

Q3) a) What is a mechatronic system? Explain with an example. **[4]**

b) Derive the state-space model of an armature-controlled DC motor. **[6]**

Q4) a) Explain time-domain system identification. When is it preferred? **[4]**

b) Derive the least squares estimator for $y = ax + b$. **[6]**

P.T.O.

- Q5)** a) What is simulation? Why is it used? [4]
b) Explain MATLAB/Simulink-based simulation of dynamic systems. [6]
- Q6)** a) What is a digital twin? Give one application. [4]
b) Develop a modelling and simulation study of a servo control system. [6]
- Q7)** a) Differentiate between lumped and distributed parameter systems. [4]
b) Explain numerical integration methods: Euler and Runge-Kutta. [6]
- Q8)** a) What is recursive least squares? Why is it important? [4]
b) Explain Hardware-In-The-Loop (HIL) simulation architecture. [6]



Total No. of Questions : 8]

SEAT No. :

PE-12058

[Total No. of Pages : 2

[6585]-581

ME. (Mechatronics Engineering)

PCC-502-MTX - INTELLIGENT CONTROL SYSTEMS

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer any five questions.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of Calculator is allowed.*
- 5) *Assume suitable data if necessary.*

Q1) a) Explain the fundamental concepts of control systems and discuss the need for intelligent control. **[4]**

b) Discuss soft computing and its components. **[6]**

Q2) a) Explain the fundamental concepts of fuzzy sets and fuzzy logic. **[4]**

b) Describe defuzzification techniques and compare any three. **[6]**

Q3) a) Explain the basic structure of an artificial neural network. **[4]**

b) Explain backpropagation algorithm steps. **[6]**

Q4) a) Explain the basic idea of genetic algorithms. **[4]**

b) Explain fitness function design and significance. **[6]**

P.T.O.

- Q5)** a) Explain the role of intelligent control in process automation. [4]
b) Discuss challenges in real-time intelligent control. [6]
- Q6)** a) Describe neural network—based system identification. [4]
b) Explain a case study of neural control in robotics. [6]
- Q7)** a) Compare fuzzy PID and conventional PID. [4]
b) Explain adaptive fuzzy control with applications. [6]
- Q8)** a) Explain evolutionary strategies and differences from GA. [4]
b) Discuss hybrid neuro-genetic system applications. [6]



Total No. of Questions : 8]

SEAT No. :

PE-12059

[Total No. of Pages : 2

[6585]-582

M.E. (Mechanical-Mechatronics)

PCC-503-MTX : SMART SENSORS & IOT

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer any five questions.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of calculator is allowed.*
- 5) *Assume suitable data if necessary.*

Q1) a) Explain the Chi-Square test with suitable example. **[4]**

b) Draw a neat block diagram of analog CRO & explain function of each block. State applications of CRO. **[6]**

Q2) a) Explain working of magnetic flow meter. **[4]**

b) What is thermocouple? Explain the need of compensation in thermocouple using neat diagram. **[6]**

Q3) a) Draw a neat block diagram of data acquisition system & explain function of each block. **[4]**

b) Explain working of **[6]**

i) Flash type A - to - D converter.

ii) R-2R ladder n/w based D - to - A converter

P.T.O.

- Q4)** a) Enlist important features/characteristics of ADC. [4]
- b) Explain the different types of displays used in data acquisition system. [6]
- Q5)** a) What are the different types of smart sensor? Using neat diagram explain working of smart sensor. [4]
- b) What is firmware? Discuss the main role of firmware. [6]
- Q6)** a) Discuss the various standards for smart sensor interface. [4]
- b) Write notes on : [6]
- i) Smart motion sensor
 - ii) Smart water leak sensor
- Q7)** a) What is the Internet of Things (IoT)? Explain architecture of IoT. [4]
- b) Explain the IoT based application for vibration monitoring of mechatronics system. State & explain the design consideration & selection criterion for components. [6]
- Q8)** a) Explain the different types of cloud services. [4]
- b) Write notes on : [6]
- i) Thing Speak
 - ii) Wi - Fi



Total No. of Questions : 8]

SEAT No. :

PE-12228

[Total No. of Pages : 2

[6585]-582-CR
M.E. (Mechanical - Mechatronics)
PCC-503-MTX : SMART SENSORS & IoT
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer any Five questions.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of non-programmable calculator is allowed.*
- 5) *Assume suitable data if necessary.*

- Q1)** a) What are the causes of experimental errors? Discuss the ways to reduce these errors. **[4]**
- b) For the set of following measurements calculate mean deviation, standard deviation & variance.
50.51, 50.50, 50.19, 50.27, 50.48, 50.92, 50.63, 50.72, 50.32, 50.42.
Comment on your result. **[6]**
- Q2)** a) What is LVDT? Explain operation of LVDT using neat diagram. **[4]**
- b) State the different pressure measurement gauges & explain operation of any one pressure gauge with the help of neat diagram. **[6]**
- Q3)** a) What is the data acquisition system? State the various objectives of DAS. **[4]**
- b) What is ADC? State various types of ADC & explain operation of Flash type ADC. **[6]**
- Q4)** a) What is the need of signal conditioner? State the different signal conditioning circuits used in data acquisition system. **[4]**
- b) Write short notes on- **[6]**
- i) Microcontroller based DAS
 - ii) Displays

P.T.O.

- Q5) a)** What is smart sensor? Explain the difference between traditional sensor & smart sensor. **[4]**
- b)** State the applications of smart sensor & explain any one application in detail. **[6]**
- Q6) a)** Explain briefly the different types of embedded systems. **[4]**
- b)** Explain operation of following smart sensors using neat diagram. **[6]**
- i)** Smart light sensor
- ii)** Smart temperature sensor
- Q7) a)** Define Internet of Things (IoT). Discuss the four types of IoT. **[4]**
- b)** Explain cloud based data logging using neat diagram. **[6]**
- Q8) a)** What is protocol? Discuss IoT protocols briefly. **[4]**
- b)** Explain operation/working of IoT based remote temperature monitoring. **[6]**



Total No. of Questions : 8]

SEAT No. :

PE-12060

[Total No. of Pages : 2

[6585]-583

M.E. (Mechatronics)

PCC-504-MTX: Artificial Intelligence and Machine Learning
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer any five questions.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Use of Calculator is allowed.
- 5) Assume Suitable data if necessary.

Q1) a) Define Artificial Intelligence and explain its scope in modern engineering systems. [5]

b) Define Machine Learning. Explain how ML differs from traditional programming. [5]

Q2) a) Describe the historical development of AI and mention any major milestones. [5]

b) Explain the concept of backpropagation and why it is important for training neural networks. [5]

Q3) a) Explain the working principle of the k-Nearest Neighbors (k-NN) algorithm with an example. [5]

b) Explain how AI is used in mobile robots for navigation and obstacle avoidance. [5]

P.T.O.

- Q4)** a) Explain any three applications of AI in Mechatronics, Robotics, and Automation. [5]
- b) Describe any two applications of AI in industrial automation. [5]
- Q5)** a) What are Decision Trees? Explain how they are used for classification. [5]
- b) What are the three main types of Machine Learning? Explain each with examples. [5]
- Q6)** a) Differentiate between shallow neural networks and deep neural networks. [5]
- b) Describe the Naive Bayes algorithm. Why is it called 'naive'? [5]
- Q7)** a) Explain the concept of supervised learning. Give examples of regression and classification tasks. [5]
- b) How do smart sensors use AI for embedded decision-making? Give examples. [5]
- Q8)** a) What are Artificial Neural Networks (ANN)? Explain their basic structure. [5]
- b) Explain how AI can be integrated with PLC and SCADA systems. [5]



Total No. of Questions : 8]

SEAT No. :

PE-12061

[Total No. of Pages : 2

[6585]-585

M.E. Production (Robotics and Automation)
PCC-502-ROA : ROBOT CONTROL SYSTEMS
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logarithmic table, slide rule is electronic pocket calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

- Q1)** a) Describe the elements and fundamental quantities of electrical systems. How are these elements analogous to mechanical components? Illustrate with examples. **[6]**
- b) What are non-potential and dissipative forces? Discuss how these forces affect energy flow and stability in electromechanical systems. **[6]**

OR

- Q2)** a) Describe the concept of dynamics in electromechanical systems. How is coupling achieved between electrical and mechanical domains? Provide suitable examples. **[6]**
- b) Define stability of a control system. Compare Lyapunov stability, BIBO stability, and asymptotic stability with suitable examples. **[6]**
- Q3)** a) Explain the concept of state-space representation. Derive the canonical form of a linear time-invariant system and explain the advantages over transfer-function based representation. **[6]**
- b) Discuss disturbance estimation in modern control systems. How can observers be designed for simultaneous estimation of system states and disturbances? **[6]**

OR

P.T.O.

- Q4)** a) Discuss the structure and design procedure of disturbance-model-based observers. How is the disturbance dynamic model incorporated into state estimation? [6]
- b) Explain interactions in functionally related systems. How do dynamic coupling and shared task objectives influence stability and control architecture? [6]

- Q5)** a) Explain the difference between internal force observers and external force observers. Provide examples of electromechanical systems that use each. [6]
- b) Describe the concept of equivalent force and equivalent acceleration estimation using disturbance observers. Derive the related estimation equations. [7]

OR

- Q6)** a) Differentiate between lossless and lossy environments in interaction control. How do these conditions influence force tracking and system stability? [6]
- b) Explain the principle of modifying the reference signal for interaction control. How does this modification affect system behavior during environment contact? [7]

- Q7)** a) Explain impedance control in detail. Compare it with admittance control and discuss its role in safe human-robot interaction. [6]
- b) Describe bilateral control without scaling. Derive the control law and discuss the conditions required for stable bilateral interaction. [7]

OR

- Q8)** a) Define bilateral control in the acceleration dimension. Compare acceleration-based bilateral control with force- and position-based bilateral control. [6]
- b) Explain how observers influence closed-loop behavior in bilateral control systems. How can observers enhance estimation and improve transparency? [7]



Total No. of Questions : 8]

SEAT No. :

PE-12062

[Total No. of Pages : 2

[6585]-588

M.E. (Chemical - Environmental Engineering)

PCC-501-ENV - ENVIRONMENTAL MANAGEMENT

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer any 5 questions.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logarithmic tables slide rule, Mollier charts, and electronic pocket calculator and steam table is allowed.*
- 5) *Assume suitable data, if necessary.*

Q1) a) Discuss the various national standards for Environmental Management [5]

b) Explain the concept Green funding and taxes. [5]

Q2) a) Explain EIA evaluation in India. [5]

b) Discuss trade and environmental management. [5]

Q3) a) What are the features of the directive principles of state policy? [5]

b) What are the impact of Social sub-systems of environment on Business? [5]

P.T.O.

Q4) Discuss the various Environmental Policies of the Government of India for Industrial Location with respect to Ecology. **[10]**

Q5) a) Write short note on Safety Related rules in Chemical Industry. **[5]**

b) Explain fundamental rights and duties of Indian citizens. **[5]**

Q6) a) Write short note on Safety Related rules in Chemical Industry. **[5]**

b) Explain the Effectiveness of international environmental regimes. **[5]**

Q7) a) Write short note on Kyoto protocol. **[5]**

b) Explain the role of Central Pollution Control Board for sustainable growth. **[5]**

Q8) a) Discuss general features of annual report of Ministry of Environment for current year. **[5]**

b) Explain the Environmental Policies of the Government of India for conservation forest. **[5]**



Total No. of Questions : 10]

SEAT No. :

PE-12063

[Total No. of Pages : 2

[6585]-589

M.E. Chemical (Environmental Engineering)

PCC-502-ENV: ENVIRONMENTAL CHEMISTRY

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logarithmic tables slide rule, Mollier charts, and electronic pocket calculator and steam table is allowed.*
- 5) *Assume suitable data if necessary.*

Q1) What are Colloids? Explain the use of colloids in Environmental Engineering with suitable example. **[10]**

OR

Q2) What is the role of Chemical kinetics in Environmental Engineering? Explain it in detail. **[10]**

Q3) Explain the Fate of chemicals in aquatic environment. **[10]**

OR

Q4) What is COD? Explain its environmental significance and determination technique. **[10]**

P.T.O.

Q5) Discuss greenhouse gases and global warming. **[10]**

OR

Q6) Explain the formation of photochemical smog? In which region of India it is been observed and why? **[10]**

Q7) How to do the Reclamation of oily soil? **[10]**

OR

Q8) What is the cause of contaminated soils? How to treat the contaminated soils? **[10]**

Q9) What is Nano material? Explain its use in Environmental Engineering. **[10]**

OR

Q10) Explain principle of Green Chemistry? **[10]**



Total No. of Questions :10]

SEAT No. :

PE12169

[Total No. of Pages : 2

[6585]-590

M.E. Chemical (Environmental Engineering)
PCC-503-ENV : WASTEWATER TREATMENT
TECHNOLOGY & DESIGN
(2025 Pattern) (Semester-I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data if necessary.

Q1) Explain the various types of reactions involved in design of process. **[10]**

OR

Q2) Explain Coagulation processes in detail. **[10]**

Q3) Write down the various types of clarifier **[10]**

OR

Q4) a) Discuss general features of conventional rapid granular medium depth filters. **[5]**

b) What is backwash hydraulics. **[5]**

Q5) a) How activated carbons are prepared and explain carbon regeneration and reactivation. **[5]**

b) Explain the concept of uptake capacity. **[5]**

OR

Q6) Explain the applications of ion exchange for hardness and TDS removal. **[10]**

P.T.O.

Q7) Determine the capacity of a chlorinator for a treatment plant with an average wastewater flow of 1000 m³/d. The peak daily factor for the treatment plant is 3.0 and the maximum required chlorine dosage is to be 20 mg/L. **[10]**

OR

Q8) Discuss the UV disinfection in detail. **[10]**

Q9) Explain activated sludge process. **[10]**

OR

Q10) Discuss the general design consideration for anaerobic treatment process. **[10]**



Total No. of Questions : 10]

SEAT No. :

PE-12229

[Total No. of Pages : 2

[6585]-590-CR
M.E. Chemical (Environmental Engineering)
PCC-503-ENV : WASTEWATER TREATMENT
TECHNOLOGY & DESIGN
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q 10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) Explain the various principles of ideal reactor design. **[10]**

OR

Q2) Describe two film theory in detail. **[10]**

Q3) a) Explain PSA in the process of adsorption. **[5]**

b) Explain the design of GAC contractors. **[5]**

OR

Q4) Explain adsorption equilibria and development of adsorption isotherms. **[10]**

Q5) a) How activated carbons are prepared and explain carbon regeneration and reactivation. **[5]**

b) Explain the concept of uptake capacity. **[5]**

OR

Q6) Discuss process design consideration for Rotating Biological Contactors (RBC). **[10]**

P.T.O.

Q7) Determine the capacity of a chlorinator for a treatment plant with an average wastewater flow of 1000 m³/d. The peak daily factor for the treatment plant is 3.0 and the maximum required chlorine dosage is to be 20 mg/L. **[10]**

OR

Q8) Explain Principle and working of Chlorination Chemistry. **[10]**

Q9) Explain activated sludge process. **[10]**

OR

Q10) Discuss the general design consideration for anaerobic treatment process. **[10]**



Total No. of Questions : 10]

SEAT No. :

PE-12064

[Total No. of Pages : 2

[6585]-591

M.E. (Chemical) (Environmental Engineering)
PCC - 504 - ENV : MEMBRANE TECHNOLOGY IN
ENVIRONMENTAL ENGINEERING
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Neat diagram must be drawn wherever necessary.*
- 2) *Figures to the right side indicate full marks.*
- 3) *Assume suitable data, if necessary.*

Q1) Construct an appropriate diagram and explain the various membrane module configurations and their uses. **[10]**

OR

Q2) Describe the washing/cleaning procedures used in membrane systems with a suitable diagram. **[10]**

Q3) Give the design considerations and operational challenges in membrane separation systems. Assume suitable case study. **[10]**

OR

Q4) Discuss advanced membrane materials and recent developments in membrane technologies. Draw a suitable diagrams. **[10]**

Q5) What are composite membranes? Explain their preparation techniques and advantages over asymmetric membranes. **[10]**

OR

Q6) Analyse the difficulties in membrane preparation procedures and propose potential solutions or optimization techniques using an appropriate casestudy. **[10]**

Q7) Clarify how nonporous (dense) membranes are characterized. Describe permeability, diffusion coefficient, and solubility measurement methods. **[10]**

OR

Q8) Compare porous, ionic, and nonporous membrane characterization. Highlight major differences in techniques and performance indicators. **[10]**

P.T.O.

Q9) Give the details of construction and working mechanism of Capillary and Hollow Fiber membrane modules. Compare their structural features. **[10]**

OR

Q10) Compare different membrane module configurations-plate-and-frame, spiral-wound, tubular, capillary, and hollow fibre based on design, packing density, fouling tendency, and applications. **[10]**



Total No. of Questions : 10]

SEAT No. :

PE-12065

[Total No. of Pages : 2

[6585]-592

M.E (Master of Computer Data Science Artificial Intelligence)

PCC-501- AI/DS : MATHEMATICAL FOUNDATIONS

(2005 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of nonprogrammable calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

- Q1)** a) Define scalars, vectors, matrices, and tensors. Explain their role in Artificial Intelligence applications. [5]
- b) Explain matrix operations (addition and multiplication) with suitable examples. [5]

OR

- Q2)** a) What are eigenvalues and eigenvectors? Explain their significance in PCA and dimensionality reduction. [5]
- b) Explain Singular Value Decomposition (SVD) and its application in recommender systems. [5]

- Q3)** a) Define gradient vector and explain its geometrical interpretation. [5]
- b) Explain directional derivatives and tangent planes with suitable examples [5]

OR

- Q4)** a) What are critical points? Explain maxima, minima, and saddle points using the second derivative test (Hessian) [5]
- b) Explain constrained optimization using Lagrange multipliers with an example. [5]

P.T.O.

- Q5)** a) Define Probability Mass Function (PMF), Probability Density Function (PDF), and cumulative distribution function (CDF). [5]
b) Explain expectation, variance, and conditional expectation with suitable examples. [5]

OR

- Q6)** a) State and explain the Central Limit Theorem and its importance. [5]
b) State and explain Bayes' Theorem and Markov chains with suitable examples. [5]
- Q7)** a) Explain mean, median, mode, variance, and standard deviation with examples. [5]
b) Explain skewness and kurtosis and their significance in data analysis. [5]

OR

- Q8)** a) What is hypothesis testing? Explain point estimation and interval estimation. [5]
b) Explain Chi-square goodness-of-fit test and contingency tables. [5]
- Q9)** a) Explain sets, relations, and functions with suitable examples. [5]
b) Explain permutations and combinations with and without repetition. [5]

OR

- Q10)** a) Explain graph isomorphism, planar graphs, and graph coloring. [5]
b) Explain Euler cycles and Hamiltonian circuits with suitable examples. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12066

[Total No. of Pages : 2

[6585]-593

M.E. (Computer - Artificial Intelligence / Data Science)

PCC-502-AI / PCC-503-DS : MACHINE LEARNING

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Numeric figures in brackets [] indicates full marks.
- 4) Use of electronic pocket calculator is allowed.
- 5) Assume suitable data, if necessary.

- Q1)** a) What is Linear Discriminant Analysis (LDA)? Explain LDA with suitable example. [5]
- b) What is hypothesis space in machine learning? Explain the concept of inductive bias. [5]

OR

- Q2)** a) Explain the difference between feature selection and feature extraction. [5]
- b) Discuss in detail the various steps involved in data pre-processing. [5]

- Q3)** a) How does logistic regression differ from Linear regression. [5]
- b) Define and compare Accuracy, Precision, Recall, F1-score, ROC curve and AVC. [5]

OR

- Q4)** a) Describe L1 and L2 regularization in detail. [5]
- b) Explain the roles of training, validation and test sets in machine learning. [5]

- Q5)** a) Explain the FP-Growth algorithm with the help of a suitable example. [5]
- b) Describe how Adjusted Rand Index (ARI) works for comparing clustering outcomes. [5]

OR

P.T.O.

- Q6)** a) Compare Agglomerative and Divisive hierarchical clustering. [5]
b) Explain the working of the k-means clustering algorithm in detail. [5]

- Q7)** a) Explain the concept of Bagging, Boosting and Stacking in detail. [5]
b) Describe the complete workflow of building a bagging ensemble model, using Random forest. [5]

OR

- Q8)** a) Explain the Cat Boost algorithm in detail. [5]
b) Discuss the challenges of training large-scale ensemble models (like XG Boost or LGBM) on massive datasets. [5]

- Q9)** a) Explain the working of LIME (Local Interpretable Model-Agnostic Explanations) [5]
b) Explain the concept of SHAP (Shapley Additive explanations). [5]

OR

- Q10)** a) Describe an end-to-end AutoML workflow for a classification problem with imbalance data. [5]
b) Explain the concept of Meta-Learning (learning to learn). [5]



Total No. of Questions : 10]

SEAT No. :

PE-12067

[Total No. of Pages : 2

[6585]-594

M.E. (Computer-Data Science)

PCC-502-DS : BIG DATA TECHNOLOGIES

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Numeric Figures in square brackets [] indicate full marks.
- 3) Use of electronic pocket calculator is allowed.
- 4) Assume suitable data, if necessary.
- 5) Neat diagrams must be drawn wherever necessary.

- Q1)** a) Differentiate between Big Data and traditional data with suitable examples. [5]
- b) Describe the features of S3 and BigQuery that support large-scale data analytics. [5]

OR

- Q2)** a) Describe the five key characteristics of Big Data and highlight their impact on storage and analytics. [5]
- b) Describe how cloud computing helps in managing and analysing Big Data in healthcare applications. [5]

- Q3)** a) Demonstrate how to store and process a dataset using HDFS and MapReduce. [5]
- b) List the basic configuration requirements for setting up a Hadoop cluster. [5]

OR

- Q4)** a) State the purpose of Pig, Hive, HBase, Sqoop and ZooKeeper in the Hadoop ecosystem. [5]
- b) Describe the steps involved in moving data from a relational database into HDFS with Sqoop. [5]

P.T.O.

- Q5)** a) Differentiate between batch processing and real-time processing with examples. [5]
b) List and describe the use cases of real-time analytics in industries with streaming platforms. [5]

OR

- Q6)** a) Compare Apache Spark and Flink in terms of their features and usage. [5]
b) Describe how Kafka integrates with Spark or Flink for handling streaming data. [5]

- Q7)** a) State the key distinctions between Spark DataFrames and Datasets. [5]
b) State the advantages of using Spark DataFrames over traditional RDDs. [5]

OR

- Q8)** a) State the purpose of HiveQL and how it is used for querying large datasets. [5]
b) List ways to integrate Spark or Flink with BI tools for reporting and visualization. [5]

- Q9)** a) State the main security and privacy considerations in large-scale data systems. [5]
b) List examples of Big Data as a Service (BDaaS) and describe its purpose. [5]

OR

- Q10)** a) Describe the key aspects of data governance by showing how data quality, data lineage and data cataloging contribute to effective data management. [5]
b) Illustrate how cloud-based services like EMR and Dataproc support scalable Big Data solutions. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12230

[Total No. of Pages : 2

[6585]-594-CR
M.E. Computer (Data Science)
PCC-502-DS : BIG DATA TECHNOLOGIES
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q 10.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right indicate full marks.*
- 4) Assume suitable data, if necessary.*
- 5) Use of electronic pocket calculator is allowed.*

Q1) a) Describe the characteristics of Big Data (5 Vs). **[5]**

b) Write short notes on : **[5]**

i) Data Lake

ii) Data Warehouse

OR

Q2) a) Describe applications of Big Data in Finance and IoT. **[5]**

b) Describe cloud-based storage solutions for Big Data with S3 and Big Query architecture. **[5]**

Q3) a) Write short note on the Hadoop ecosystem with its major components. **[5]**

b) Write a short note on HBase architecture. **[5]**

OR

Q4) a) What is YARN? Describe its main components. **[5]**

b) Describe Pig. Hive with their internal architecture. **[5]**

P.T.O.

- Q5)** a) Describe the working of Apache Storm. [5]
b) Compare batch vs real-time processing. [5]

OR

- Q6)** a) Compare Apache Spark and Apache Flink with architecture and advantages. [5]
b) What is AWS Kinesis? Give applications. [5]

- Q7)** a) What are Data frames, Datasets and their use in Spark analytics. [5]
b) Describe HiveQL query processing with examples. [5]

OR

- Q8)** a) Write short notes on : [5]
i) Star Schema
ii) Snowflake Schema
b) Describe Spark SQL, architecture with Catalyst optimizer and Tungsten engine. [5]

- Q9)** a) What is Big Data as a Service (BDaaS) with EMR, Dataproc. [5]
b) Write IAM roles and permissions for Big Data systems. [5]

OR

- Q10)** a) Write cloud-based Big Data architectures with examples. [5]
b) What is data cataloging? Explain with AWS Glue example. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12067

[Total No. of Pages : 2

[6585]-594

M.E. (Computer) (Data Science)

PCC-502-DS : BIG DATA TECHNOLOGIES

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Numeric Figures in square brackets [] indicate full marks.
- 3) Use of electronic pocket calculator is allowed.
- 4) Assume suitable data, if necessary.
- 5) Neat diagrams must be drawn wherever necessary.

- Q1)** a) Differentiate between Big Data and traditional data with suitable examples. [5]
- b) Describe the features of S3 and BigQuery that support large-scale data analytics. [5]

OR

- Q2)** a) Describe the five key characteristics of Big Data and highlight their impact on storage and analytics. [5]
- b) Describe how cloud computing helps in managing and analysing Big Data in healthcare applications. [5]

- Q3)** a) Demonstrate how to store and process a dataset using HDFS and MapReduce. [5]
- b) List the basic configuration requirements for setting up a Hadoop cluster. [5]

OR

- Q4)** a) State the purpose of Pig, Hive, HBase, Sqoop and ZooKeeper in the Hadoop ecosystem. [5]
- b) Describe the steps involved in moving data from a relational database into HDFS with Sqoop. [5]

P.T.O.

- Q5)** a) Differentiate between batch processing and real-time processing with examples. [5]
b) List and describe the use cases of real-time analytics in industries with streaming platforms. [5]

OR

- Q6)** a) Compare Apache Spark and Flink in terms of their features and usage. [5]
b) Describe how Kafka integrates with Spark or Flink for handling streaming data. [5]

- Q7)** a) State the key distinctions between Spark DataFrames and Datasets. [5]
b) State the advantages of using Spark DataFrames over traditional RDDs. [5]

OR

- Q8)** a) State the purpose of HiveQL and how it is used for querying large datasets. [5]
b) List ways to integrate Spark or Flink with BI tools for reporting and visualization. [5]

- Q9)** a) State the main security and privacy considerations in large-scale data systems. [5]
b) List examples of Big Data as a Service (BDaaS) and describe its purpose. [5]

OR

- Q10)** a) Describe the key aspects of data governance by showing how data quality, data lineage and data cataloging contribute to effective data management. [5]
b) Illustrate how cloud-based services like EMR and Dataproc support scalable Big Data solutions. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12068

[Total No. of Pages : 3

[6585]-595

M.E. (Computer) (Data Science)

PCC-504-DS : Advanced Data Analysis and Visualization
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data, if necessary.

Q1) a) Define Data Visualization. Explain its importance in the field of Data Science and Engineering with suitable examples. [5]

b) Explain preattentive attributes and discuss their role in effective visual design. Provide suitable examples. [5]

OR

Q2) a) Discuss the evolution and role of Data Visualization in modern analytics and decision-making processes. [5]

b) What are the Gestalt Principles of Visual Perception? Explain how they guide the design of meaningful and coherent visualizations. [5]

Q3) a) Discuss the differences, advantages, and limitations of histograms, box plots, and violin plots for data distribution analysis. [6]

b) Differentiate between choropleth maps and symbol maps. Discuss their design considerations and potential pitfalls. [4]

P.T.O.

OR

- Q4)** a) Compare bar charts, line charts, and scatter plots in terms of their effectiveness for representing relationships and trends. [6]
- b) Discuss the industry applications of static visualizations and their role in decision-making, reporting, and data-driven insights. [4]
- Q5)** a) Explain the core differences between Matplotlib, Seaborn, Plotly, and Bokeh in terms of visualization style, interactivity, and use cases. [5]
- b) Describe how Seaborn enhances statistical visualization. Give examples of at least three plot types that Seaborn simplifies. [5]

OR

- Q6)** a) Explain the major steps in data preparation, including cleaning, aggregation, and transformation, before using data for visualization. [5]
- b) What are the advantages of using Plotly for interactive visualizations? Explain with an example of a dashboard component. [5]
- Q7)** a) Explain the Dashboard Design Principles and discuss how UX/UI considerations influence the effectiveness of data storytelling. [5]
- b) Using Tableau or Power BI, describe how you would design a dashboard that supports multi-level navigation, drill-downs, and cross-filtering. [5]

OR

- Q8)** a) Describe how Tableau and Power BI connect to relational databases for building interactive, data-driven dashboards. [5]
- b) What is A/B Testing for dashboard efficacy? Describe how A/B testing can be integrated into the dashboard design lifecycle to enhance user engagement. [5]

- Q9)** a) Explain the concept of data storytelling and discuss how it differs from conventional data reporting. [5]
- b) How can presenters integrate data, narrative, and visuals to create compelling and persuasive data stories? [5]

OR

- Q10)** a) Explain the importance of ethical considerations in data science and AI, particularly when presenting results to non-technical audiences. [5]
- b) Discuss the role of responsible communication in the context of data-driven insights. How can data practitioners avoid causing social or cultural harm? [5]



[6585]-596

M.E. Computer (AI & DS)

PCC-501-AID : Mathematics for Data Science

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8 and Q.9 or Q.10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of electronic pocket calculator is allowed.
- 5) Assume suitable data, if necessary.

Q1) a) What is dimensionality reduction? Explain dimensionality reduction techniques. [5]

b) Find the inverse of the given matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$. [5]

OR

Q2) a) Prove that $A = \frac{1}{7} \begin{bmatrix} 3 & 2 & 6 \\ -6 & 3 & 2 \\ 2 & 6 & -3 \end{bmatrix}$ is an orthogonal matrix of order 3 and

hence find its inverse. [5]

b) Explain the properties and operation of matrix. [5]

Q3) a) Given the $f(x) = \int_0^x t dt$ Find the value of $f(4)$. [5]

b) Evaluate $y = \log \sin x^2$. [5]

OR

Q4) a) Calculate the value of given function $x = 2$, $g(x) = f(x) + f(-x)$ where

$$f(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt \quad [5]$$

b) Find the derivative of $y = e^{x \sin x}$ [5]

P.T.O.

Q5) a) The mean age of cigarette smokers is 35 years. Suppose the standard deviation is 10 years. The sample size is 39. Find the mean and standard deviation of the sample. [5]

b) Explain the random variable and its type with suitable example. [5]

OR

Q6) a) Explain Bayes' Theorem with an example. [5]

b) Application of Binomial probability distribution. [5]

Q7) a) Explain mean, mode, median and variance with suitable example. [5]

b) Compare the null hypothesis and alternative hypothesis. [5]

OR

Q8) a) Find the (i) mean (ii) median (iii) mode for each of the following data sets : [5]

a) 12, 17, 20, 24, 25, 30, 40

b) 8, 8, 8, 10, 11, 11, 12, 12, 16, 20, 20, 24

b) Explain ANOVA test in brief and explain its type with the help of suitable example. [5]

Q9) a) Explain the regularization with its any two types. Give the benefits of regularization. [5]

b) Compare the constrained and unconstrained optimization. [5]

OR

Q10) a) What is neural network? Explain its architecture. [5]

b) Prove that the set of all points (x, y) such that $x^2 + y^2 \leq 1$ is a convex set. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12069

[Total No. of Pages : 2

[6585]-597

M.E. (AI & DS)

PCC-502-AID - Natural Language Understanding

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Assume suitable data, if necessary.*

- Q1)** a) Explain the different linguistic levels involved in Natural Language Processing with suitable examples. [5]
- b) Define morphology and explain its role in Natural Language Processing. [5]

OR

- Q2)** a) Explain the purpose and structure of corpus creation. [5]
- b) Explain the need and process of POS tagging in NLP. [5]
- Q3)** a) Explain context-free grammars (CFGs) and compare top-down vs bottom-up parsing with a suitable example. [5]
- b) Describe the process of unification in feature-based grammars. Explain with example. [5]

OR

- Q4)** a) Explain POS tagging using HMM and CRF models. Compare their advantages in real- world NLU tasks. [5]
- b) Write short notes on statistical parsing and chunking. Explain their importance in downstream ML applications. [5]

P.T.O.

- Q5)** a) Explain lexical semantics with relevant example. [6]
b) Differentiate between lexical semantics and distributional semantics with examples. [4]

OR

- Q6)** a) Describe vector semantics and compare TF-IDF, Word2Vec, and GloVe models for text representation. [6]
b) Define semantic role labelling (SRL) and mention its key components. [4]

- Q7)** a) Explain the structure and working of an LSTM network. [5]
b) Discuss the encoder – decoder architecture and its relevance in sequence modelling. [5]

OR

- Q8)** a) Explain the concept of attention mechanism and its importance in deep learning. [5]
b) Explain the role of Hugging Face Transformers library in building NLU pipelines. Describe its key features. [5]

- Q9)** a) Explain the architecture of a dialogue system with emphasis on intent detection and slot filling. [6]
b) Discuss the importance of explainability in NLU applications with at least one example. [4]

OR

- Q10)** a) Design a high-level pipeline for a question-answering system using BERT/GPT models. [6]
b) Analyze how gender bias can occur in NLP datasets. Provide two methods to mitigate such bias. [4]



Total No. of Questions : 10]

SEAT No. :

PE-12070

[Total No. of Pages : 3

[6585]-598

M.E. (Computer(AIDS))

PCC-503-AID : Machine Learning Techniques

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Assume Suitable data if necessary.*

Q1) a) Compare AdaBoost, XGBoost and LightGBM in terms of training strategy, handling of errors, and computational efficiency. **[5]**

b) Explain the working principle of Bagging and discuss how Random Forests reduce variance in prediction. **[5]**

OR

Q2) a) What are Semi-supervised GANs? Explain their working and describe their applications in Computer Vision. **[5]**

b) Describe Graph based Semi-supervised learning methods with suitable examples. **[5]**

Q3) a) Explain any two unsupervised anomaly detection techniques and describe scenarios where they are effective. **[5]**

b) What are Auto-Encoders? Explain their architecture and role in unsupervised representation learning for dimensionality reduction. **[5]**

OR

P.T.O.

- Q4)** a) Explain how the Expectation – Maximization (EM) algorithm is used to estimate the parameters of a Gaussian Mixture Model (GMM) for model-based clustering. Describe how cluster assignments are obtained from the model. [5]
- b) Compare DBSCAN and HDBSCAN in terms of cluster shape handling, noise detection, and parameter sensitivity. [5]
- Q5)** a) Discuss how Graph Neural Networks (GNNs) aggregate information from neighboring nodes to learn useful representations. [5]
- b) What is Doc2Vec? Explain its working and how it represents documents in a vector space. [5]

OR

- Q6)** a) Describe the key idea behind GloVe embeddings. How do global co-occurrence statistics contribute to vector learning? [5]
- b) Explain the concept of node embeddings and their role in Graph Neural Networks (GNNs). How do GNNs use message passing to learn node representations? Illustrate with a simple example. [5]
- Q7)** a) What is Label Studio used for? Elaborate with an example? Name two annotation tasks supported by it. [5]
- b) Explain Monte Carlo Dropout with a diagram showing uncertainty estimation. [5]

OR

- Q8)** a) Describe the features of modal and explain how it supports modular active learning workflows in Python. [5]
- b) Discuss the role of human experts in the active learning loop. Why is human – machine collaboration important for label quality? [5]

- Q9) a)** Describe the role of Transfer Learning in Computer Vision with suitable examples. [5]
- b) Analyze the concept of zero-shot learning. How do vision – language models like CLIP achieve this capability? [5]

OR

- Q10)a)** What is Task Similarity in Multi-task Learning? Why is it important for successful training? [5]
- b) Explain how BERT uses transfer learning for NLP tasks such as text classification or question answering. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12070

[Total No. of Pages : 3

[6585]-598

M.E. (Computer) (AIDS)

PCC-503-AID : Machine Learning Techniques

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Assume Suitable data if necessary.

Q1) a) Compare AdaBoost, XGBoost and LightGBM in terms of training strategy, handling of errors, and computational efficiency. [5]

b) Explain the working principle of Bagging and discuss how Random Forests reduce variance in prediction. [5]

OR

Q2) a) What are Semi-supervised GANs? Explain their working and describe their applications in Computer Vision. [5]

b) Describe Graph based Semi-supervised learning methods with suitable examples. [5]

Q3) a) Explain any two unsupervised anomaly detection techniques and describe scenarios where they are effective. [5]

b) What are Auto-Encoders? Explain their architecture and role in unsupervised representation learning for dimensionality reduction. [5]

OR

P.T.O.

- Q4)** a) Explain how the Expectation – Maximization (EM) algorithm is used to estimate the parameters of a Gaussian Mixture Model (GMM) for model-based clustering. Describe how cluster assignments are obtained from the model. [5]
- b) Compare DBSCAN and HDBSCAN in terms of cluster shape handling, noise detection, and parameter sensitivity. [5]
- Q5)** a) Discuss how Graph Neural Networks (GNNs) aggregate information from neighboring nodes to learn useful representations. [5]
- b) What is Doc2Vec? Explain its working and how it represents documents in a vector space. [5]

OR

- Q6)** a) Describe the key idea behind GloVe embeddings. How do global co-occurrence statistics contribute to vector learning? [5]
- b) Explain the concept of node embeddings and their role in Graph Neural Networks (GNNs). How do GNNs use message passing to learn node representations? Illustrate with a simple example. [5]
- Q7)** a) What is Label Studio used for? Elaborate with an example? Name two annotation tasks supported by it. [5]
- b) Explain Monte Carlo Dropout with a diagram showing uncertainty estimation. [5]

OR

- Q8)** a) Describe the features of modal and explain how it supports modular active learning workflows in Python. [5]
- b) Discuss the role of human experts in the active learning loop. Why is human – machine collaboration important for label quality? [5]

- Q9) a)** Describe the role of Transfer Learning in Computer Vision with suitable examples. [5]
- b) Analyze the concept of zero-shot learning. How do vision – language models like CLIP achieve this capability? [5]

OR

- Q10)a)** What is Task Similarity in Multi-task Learning? Why is it important for successful training? [5]
- b) Explain how BERT uses transfer learning for NLP tasks such as text classification or question answering. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12231

[Total No. of Pages : 2

[6585]-598-CR

M.E. (Computer) (AI&DS Engineering)

PCC-503-AID : MACHINE LEARNING TECHNIQUES
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data if necessary.

Q1) a) Explain Bagging technique and illustrate its workflow with an example. [5]

b) Explain the working of LightGBM. Discuss the concepts of GOSS and EFB that make LightGBM faster than XGBoost. [5]

OR

Q2) a) What are Semi-supervised GANs? Explain their working and describe their applications in NLP. [5]

b) Explain Semi-Supervised Learning. Describe Self-training and Co-training approaches with suitable examples. [5]

Q3) a) Explain how the Expectation-Maximization (EM) algorithm is used to estimate the parameters of a Gaussian Mixture Model (GMM) for model-based clustering. Describe how cluster assignments are obtained from the model. [5]

b) What are Auto-encoders? Explain their architecture and role in unsupervised representation learning for dimensionality reduction. [5]

OR

Q4) a) What is Anomaly Detection? Explain any two techniques used for detecting anomalies. [5]

b) Write a short note on : [5]

Density - based

Hierarchical clustering methods.

P.T.O.

- Q5)** a) What challenges arise in learning graph representation? How do GNNs address these challenges? [5]
b) Difference between contextual and non-contextual embeddings with examples. [5]

OR

- Q6)** a) What is Doc2Vec? Explain its working and how it represents documents in a vector space. [5]
b) Explain the concept of Momentum Contrast (MoCo). How does MoCo improve representation learning using a momentum encoder? [5]
- Q7)** a) Describe Pool-Based Sampling strategy in Active Learning with suitable examples. [5]
b) Explain Monte Carlo Dropout with a diagram showing uncertainty estimation. [5]

OR

- Q8)** a) What is Human-in-the-loop learning? Explain the role of human experts in the Active Learning process with an application example. [5]
b) Explain how PyTorch or TensorFlow can be used for implementing Active Learning Models. Mention any typical workflow steps. [5]
- Q9)** a) What is Feature-based Transfer Learning? Explain how learned features from a pre-trained model can be extracted and reused for a new task. [5]
b) Difference between Domain Adaptation and Domain Generalization. [5]

OR

- Q10)** a) What is Task Similarity in Multi-task Learning? Why is it important for successful training? [5]
b) Describe the role of Transfer Learning in Computer Vision with suitable examples. [5]



Total No. of Questions : 10]

SEAT No. :

PE12170

[Total No. of Pages : 2

[6585]-599

M.E. (Computer) (AIDS Engineering)

PCC-504-AID : GENERATIVE ARTIFICIAL INTELLIGENCE

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right indicate full marks.*
- 4) Assume suitable data if necessary.*

Q1) a) Explain the evolution of generative models from rule-based AI to deep generative models. **[5]**

b) Describe Autoregressive models with suitable examples. **[5]**

OR

Q2) a) Differentiate between Autoencoders and Variational Autoencoders. **[5]**

b) Discuss Generative Adversarial Networks (GANs) and their training process. **[5]**

Q3) a) Explain the Transformer architecture with a neat diagram. **[5]**

b) Describe the Self-Attention mechanism used in Transformers. **[5]**

OR

Q4) a) What are Large Language Models (LLMs)? Explain their applications. **[5]**

b) Explain multimodal generative AI models such as DALL·E and CLIP. **[5]**

P.T.O.

- Q5)** a) Explain text generation using autoregressive models. [5]
b) Explain image generation using StyleGAN or Stable Diffusion. [5]

OR

- Q6)** a) What is AI Art? Explain DeepDream with an example. [5]
b) Describe evaluation metrics used in Generative AI such as Perplexity, BLEU and FID score. [5]

- Q7)** a) Explain the role of Generative AI in software development with GitHub Copilot. [5]
b) Explain Hugging Face framework for generative AI applications. [5]

OR

- Q8)** a) Explain fine-tuning and custom model development in Generative AI. [5]
b) Discuss AI-generated content such as deepfakes and virtual influencers. [5]

- Q9)** a) Discuss the role of Generative AI in finance and risk analysis. [5]
b) Explain the concept of Explainable AI in generative systems. [5]

OR

- Q10)** a) Discuss future trends such as Federated Learning and Edge AI. [5]
b) Explain synthetic data generation and its importance. [5]



Total No. of Questions : 5]

SEAT No. :

PE-12071

[Total No. of Pages : 2

[6585]-600

M.E. (Computer) (Artificial Intelligence)
PCC-503-AI : AI SYSTEMS ENGINEERING
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) Explain the following questions (Any Two)

- a) Explain the lifecycle of an AI application from ideation to deployment with a neat block diagram. **[5]**
- b) Discuss the differences between AI research and AI engineering. How do systems design principles such as modularity and observability influence AI systems? **[5]**
- c) Describe the key components of an AI system (data, models, infrastructure, and business logic) with suitable examples. **[5]**

Q2) Explain the following questions (Any Two)

- a) Explain the role of version control in DevOps. Discuss branching strategies used in collaborative development. **[5]**
- b) What is CI/CD? Explain the stages of a typical CI/CD pipeline used in software deployment. **[5]**
- c) Discuss the importance of environment management and reproducibility in modern software engineering. **[5]**

P.T.O.

Q3) Explain the following questions (Any Two)

- a) Differentiate between DevOps and MLOps. Why is MLOps necessary for modern AI systems? [5]
- b) Explain experiment tracking and model reproducibility. Discuss how MLflow or Weights & Biases supports these tasks. [5]
- c) Discuss data pipelines for ingestion and pre-processing. Mention the role of scheduling tools such as Airflow or Prefect. [5]

Q4) Explain the following questions (Any Two)

- a) Compare Tensor Flow Serving, Torch Serve, and Triton Inference Server in terms of features and use cases. [5]
- b) Explain auto scaling and A/B testing in AI model deployment. Provide a practical scenario where both are required. [5]
- c) Discuss model monitoring using Prometheus and Grafana. How are latency and throughput metrics visualized? [5]

Q5) Explain the following questions (Any Two)

- a) Explain model explainability. Compare SHAP and LIME with suitable examples. [5]
- b) What are adversarial attacks? Describe any two attack methods and techniques to secure model APIs. [5]
- c) Discuss GDPR compliance and data anonymization techniques used in AI system development. [5]



Total No. of Questions : 5]

SEAT No. :

PE-12232

[Total No. of Pages : 2

[6585]-600CR

M.E. Computer (Artificial Intelligence) (AI)
PCC-503-AI : AI SYSTEMS ENGINEERING
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) Explain the following questions (Any Two)

- a) Explain observability in AI systems through logs, metrics and traces.[5]
- b) Discuss the need for modularity and abstraction when designing AI systems. [5]
- c) Explain with examples the role of data quality and data governance in AI lifecycle. [5]

Q2) Explain the following questions (Any Two)

- a) Describe the workflow of CI using GitHub Actions or Jenkins. [5]
- b) Explain virtual environments (venv/conda) and dependency management. [5]
- c) Discuss types of deployment strategies : rolling update, blue-green, canary deployment. [5]

Q3) Explain the following questions (Any Two)

- a) Explain the role of DVC (Data Version Control) in ML pipelines. [5]
- b) Discuss the importance of reproducibility in AI experiments. Explain steps to ensure reproducibility. [5]
- c) Explain the components of an end-to-end ML pipeline from data ingestion to monitoring. [5]

P.T.O.

Q4) Explain the following questions (Any Two)

- a) Compare online serving vs batch serving using Triton Inference Server. [5]
- b) Explain autoscaling policies (horizontal, vertical) with an example.[5]
- c) Describe latency optimization techniques in AI model deployment.[5]

Q5) Explain the following questions (Any Two)

- a) Explain different types of adversarial attacks : FGSM, PGD, poisoning attacks. [5]
- b) Explain anonymization techniques such as k-anonymity, pseudonymization and masking. [5]
- c) Explain SHAP values and plot interpretation for a sample model. [5]



Total No. of Questions : 5]

SEAT No. :

PE-12072

[Total No. of Pages : 2

[6585]-601

M.E. Computer (Artificial Intelligence)
PCC-504-AI : OPTIMIZATION TECHNIQUES
(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*

Q1) Explain the following questions (any Two)

- a) Explain different optimization techniques commonly used in data science. Give suitable examples. [5]
- b) Explain the characteristics of convex functions and discuss why convexity is important in optimization. [5]
- c) Discuss why non-convex optimization is challenging, especially in machine learning. [5]

Q2) Explain the following questions (any Two)

- a) Explain Stochastic Gradient Descent (SGD) and its importance in large-scale machine learning. [5]
- b) Explain Accelerated Gradient Descent (Nesterov Momentum). Provide an example. [5]
- c) Write the steps involved in training a neural network using gradient-based optimization. [5]

P.T.O.

Q3) Explain the following questions (Any Two)

- a) Explain Newton's Method with mathematical formulation. [5]
- b) Explain Coordinate Descent with a sample problem. [5]
- c) How does PGD differ from Proximal Gradient Descent? [5]

Q4) Explain the following questions (Any Two)

- a) Explain Quadratic Programming (QP) with an example. [5]
- b) What is Random Search? Provide a solved example. [5]
- c) Analyse Lagrangian Duality Theory and explain with example. [5]

Q5) Explain the following questions (Any Two)

- a) Explain Bayesian Optimization and demonstrate with a simple example. [5]
- b) Explain Covariance Matrix Adaptation Evolution Strategy (CMA-ES). [5]
- c) Explain Particle Swarm Optimization (PSO) and give a numerical example. [5]



Total No. of Questions : 10]

SEAT No. :

PE-12145

[Total No. of Pages : 2

[6585]-602

M.E. (IoT)

**PCC-501-IOT : PRINCIPLES OF INTERNET OF THINGS
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.*
- 2) *Neat diagram must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*
- 5) *Use of scientific calculator is allowed.*

Q1) a) Define IoT and explain any four major characteristics of IoT with suitable examples. **[5]**

b) Write a short note on IoT enabling technologies. Discuss any three enabling technologies. **[5]**

OR

Q2) a) Identify and explain the main security and privacy issues faced by IoT systems in real-world applications. **[5]**

b) Explain the key technological elements that form the foundation of IoT architectures, supported by examples. **[5]**

Q3) a) What are essential components used in an RFID system and explain the role of any two. **[5]**

b) Explain the important features of the COAP. Discuss any one of its message types. **[5]**

OR

Q4) a) Explain Bluetooth Low Energy (BLE) and its advantages for IoT applications. **[5]**

b) Write short note on Explain AMPQ and MQTT. **[5]**

P.T.O.

- Q5) a)** What is Raspberry Pi? Explain the OS installation procedure for the board. [5]
- b) Explain the pin configuration and key features of a Raspberry Pi board. [5]

OR

- Q6) a)** Explain how sensors and actuators contribute to an IoT architecture, supported by a labeled diagram. [5]
- b) Explain the working principle and applications of DHT11 and PIR sensors. [5]

- Q7) a)** Describe the procedure to create a web server using Raspberry Pi. [5]
- b) Explain Python programming concepts used in Raspberry Pi-based IoT applications. [5]

OR

- Q8) a)** Explain basic Linux commands used in Raspberry Pi environment. [5]
- b) Write a Python program to interface an ultrasonic sensor with Raspberry Pi. [5]

- Q9) a)** Explain the use of remote monitoring and resource mapping in smart agriculture. [5]
- b) Explain the concept of home automation using IoT. Describe hardware, Software and communication technologies involved. [5]

OR

- Q10) a)** Describe sensor-based smart irrigation system with block diagram. [5]
- b) Discuss e-health applications based on IoT. Mention challenges in implementation. [5]



Total No. of Questions : 8]

SEAT No. :

PE-12073

[Total No. of Pages : 2

[6585]-603

M.E (E & TC (IoT))

**PCC - 502 - IOT : EMBEDDED PHYSICAL DESIGN OF IoT
(2025 Pattern) (Semester - I)**

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Answer any five questions out of eight questions.*
- 2) Figures to the right indicate full marks.*
- 3) Assume suitable data, if necessary.*
- 4) Use of scientific calculator is allowed.*

- Q1)** a) Analyse how trade-offs in power, performance, and area affect embedded physical design in IoT systems. [5]
- b) Evaluate the impact of form-factor reduction on thermal reliability, routing complexity and manufacturability in IoT hardware. [5]
- Q2)** a) Construct a physical design workflow for a battery-operated IoT module and justify each stage in sequence. [5]
- b) Examine power, packaging, and connectivity constraints in an IoT-based smart agriculture node and recommend optimisation strategies. [5]
- Q3)** a) Investigate challenges in integrating multi-sensor arrays on a single PCB in terms of interference, crosstalk and analog-digital domain isolation. [5]
- b) Compare I2C, SPI, UART and select the most suitable protocol for a long-range low-power IoT sensor, with justification. [5]
- Q4)** a) Analyse the causes of EMI, ground bounce and signal reflections in dense IoT boards and propose routing-level mitigation techniques. [5]
- b) Demonstrate the importance of skew control, trace symmetry and clock tree balancing in high-speed MCU-based designs. [5]

P.T.O.

- Q5)** a) Formulate PCB rules for RF IoT design including impedance control, antenna zone isolation and return-path optimization. [5]
- b) Critically compare dynamic power reduction and leakage reduction methods used in IoT-grade SoC fabrication at deep submicron technology nodes. [5]
- Q6)** a) Recommend and justify a compact antenna topology (chip, PIFA, PCB trace, patch) for a wearable IoT device working at 2.4 GHz. [5]
- b) Assess practical EMC compliance methods for IoT boards and suggest filtering & shielding approaches to improve RF coexistence. [5]
- Q7)** a) Examine environmental ruggedization requirements (shock, vibration, corrosion, humidity) for industrial IoT hardware and justify material selection. [5]
- b) Evaluate power-density, heat dissipation and safety constraints in implantable healthcare IoT and recommend design alternatives. [5]
- Q8)** a) Analyse the suitability of solar, RF-harvested and piezoelectric energy sources for autonomous IoT nodes under varying deployment conditions [5]
- b) Design and describe an end-to-end physical architecture for a LoRa-enabled environmental monitoring device including SoC selection, RF stage, layout, and power block. [5]



Total No. of Questions : 8]

SEAT No. :

PE-12074

[Total No. of Pages : 2

[6585]-604

M.E. (Internet of Things) (E & TC)

PCC-503-IoT : Computational and Optimization Methods for IoT
Systems

(2025 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Answer any five questions out of eight questions.
- 2) Figures to the right indicate full marks.
- 3) Assume suitable data if necessary.
- 4) Use of scientific calculator is allowed.

- Q1)** a) Explain the concept of matrix operations and their applications in sensor data processing. [5]
- b) Describe the concept of stochastic processes and their application in modeling random phenomena. [5]
- Q2)** a) What are the Karush-Kuhn-Tucker (KKT) conditions, and how are they used in constrained optimization? [5]
- b) Explain the principle of optimality and its role in dynamic programming. [5]
- Q3)** a) Differentiate between edge computing and fog computing. [5]
- b) Explain Dijkstras variant algorithm for energy-efficient routing in wireless sensor networks and its advantages. [5]
- Q4)** a) Describe the application of machine learning and optimization in predictive maintenance of IoT devices? [5]
- b) Explain the concept of exploration-exploitation trade-off in RL and its significance in IoT applications? [5]

P.T.O.

- Q5)** a) Describe the implementation of machine learning models on resource-constrained devices like Raspberry Pi or ESP32 using Tensor Flow Lite. [5]
- b) Explain the optimization challenges in designing an agricultural sensor network and how they can be addressed. [5]
- Q6)** a) Explain the application of Reinforcement Learning in autonomous vehicles and its challenges. [5]
- b) Elaborate the optimization techniques used for cryptographic key distribution in IoT networks and their advantages. [5]
- Q7)** a) Describe the use of RL in self-configuring smart homes and its benefits. [5]
- b) What is Bayesian inference, and how is it used in updating probabilities based on new data? [5]
- Q8)** a) Describe the Simulated Annealing algorithm and its use in complex routing problems. [5]
- b) Describe the method of Lagrange multipliers for solving optimization problems with equality constraints. [5]



Total No. of Questions : 8]

SEAT No. :

PE-12233

[Total No. of Pages : 2

[6585]-604-CR
M.E. (Internet of Things)
COMPUTATIONAL AND OPTIMIZATION METHODS
FOR IOT SYSTEMS
(2025 Pattern) (Semester - I) (PCC-503-IOT)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer any five questions out of eight questions.*
- 2) *Figures to the right indicate full marks.*
- 3) *Assume suitable data if necessary.*
- 4) *Use of scientific calculator is allowed.*

- Q1)** a) Explain the concept of Singular Value Decomposition (SVD) and its application in data reduction? **[5]**
- b) Explain the basics of queuing theory and its use in analyzing systems with random arrivals and service times? **[5]**
- Q2)** a) What are the Karush-Kuhn-Tucker (KKT) conditions and how are they used in constrained optimization? **[5]**
- b) Explain the principle of optimality and its role in dynamic programming. **[5]**
- Q3)** a) Explain Dijkstra's variant algorithm for energy-efficient routing in wireless sensor networks and its advantages? **[5]**
- b) How can data aggregation and fusion techniques be used to reduce energy consumption in wireless sensor networks? **[5]**
- Q4)** a) What is Particle Swarm Optimization (PSO) and how is it used in optimizing IoT network configurations? **[5]**
- b) Explain the application of RL frameworks in self-configuring smart home. **[5]**

P.T.O.

- Q5)** a) State the benefits of NS-3 or GNS3 for network simulation in IoT.[4]
b) For a healthcare monitoring system, apply data privacy optimization techniques to securely aggregate patient data from multiple devices. Explain how your method balances privacy, latency and computational constraints. [6]
- Q6)** a) What is regression analysis and how is it used in modeling relationships between variables in sensor data? [5]
b) What are the applications of optimization techniques in managing energy budgets in IoT devices? [5]
- Q7)** a) Explain the optimization challenges in designing an agricultural sensor network and how they can be addressed. [5]
b) Describe how dynamic programming is used in sequential decision-making problems. [5]
- Q8)** a) Explain the importance of optimization techniques in developing machine learning models for detecting anomalies in IoT systems. [5]
b) Explain the optimization techniques used for cryptographic key distribution in IoT networks and state its advantages. [5]

