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**F.Y. (M. Tech.) (Civil – Structures Engineering) (Semester - I) (New)  
(CBCS) Examination: March/April – 2026  
Advanced structural analysis (MTCE0101)**

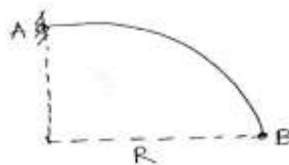
Day & Date: Thursday, 30-04-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) All question are compulsory.  
2) Figure to the right indicates full marks.  
3) Assume Suitable data if necessary and assume it clearly.

**SECTION – I**

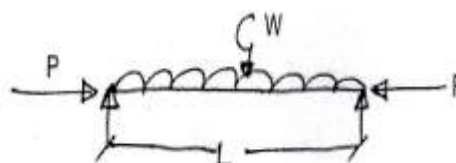
- Q.1** Two-point loads of 100 kN and 200 kN spaced 3 m apart cross a girder of span 12 m from left to right with the 100 kN leading. Draw the ILD for shear force and bending moment and find the values of maximum shear force and bending moment at a section 4 m from the left-hand support. Also evaluate the absolute maximum bending moment due to the given loading system. **12**
- Q.2** A quarter circular beams having uniform cross section is fixed at one end and free at other. It carries vertically downward load at free end. Draw SFD, BMD & TMD. Also determine vertical deflection at free end. **12**



- Q.3** An infinitely long beam supported on elastic foundation is subjected to a concentrated load  $P$  per unit width of Long Beam. Draw SFD, BMD, deflection and foundation pressure diagram. **11**

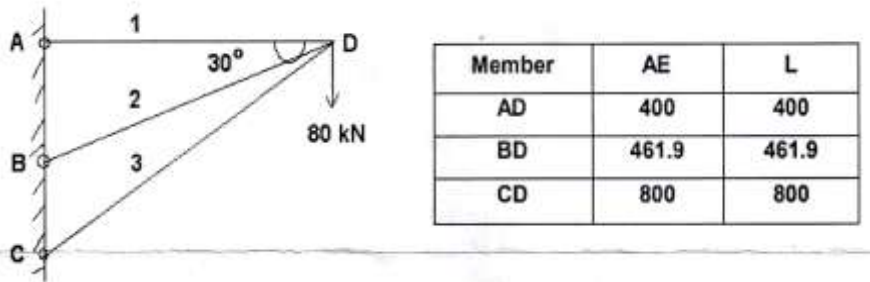
**SECTION – II**

- Q.4** A simply supported beam column is subjected to loading shown in Figure. Find maximum deflection and maximum bending moment in the beam column. **12**



**Q.5** A continuous beam is made up of two spans,  $L_1=5\text{m}$  and  $L_2=4\text{ m}$ . The beam is simply supported at A and B (at both ends), and it is subjected to a uniform load  $w=10\text{ kN/m}$   $w = 10$  over the entire span. The beam has a Young's modulus  $E=200\text{ GPa}$  and a moment of inertia  $I=300\times 10^6\text{ mm}^4$ . The goal is to determine the reactions at supports A and B using the stiffness method. **12**

**Q.6** Using matrix stiffness method, analyze the truss for the member forces in the truss loaded as shown in figure. AE and L are tabulated below for all the three members. **11**



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**F.Y. (M. Tech.) (Civil – Structures Engineering) (Semester - I)  
(New) (CBCS) Examination: March/April – 2026  
Advanced solid Mechanics (MTCE0102)**

Day & Date: Saturday, 02-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) All questions are compulsory.  
2) Use of an on-programmable calculator is allowed.  
3) Figure to the right indicates full marks.  
4) Assume Suitable data if necessary and assume it clearly.

**SECTION - I**

- Q.1** a) Derive the differential equations of equilibrium for 3-D problems of elasticity in Polar Coordinate System. **10**  
b) Explain the concept of stress components on an arbitrary plane. **05**
- Q.2** a) State the assumption made in theory of elasticity and Obtain the Strain compatibility equations for three dimensional problems of elasticity. **10**
- Q.3** a) What are the elementary concepts of strain in three-dimensional elasticity problems? **04**  
b) Explain the Airy's Stress function and examine whether following functions are Airy's stress functions **06**  
i)  $\phi = Ax^2 - By^2$   
ii)  $\phi = A(x^4 - 3x^2y^2)$

**SECTION - II**

- Q.4** a) Explain Saint Venant's Method. **04**  
b) Write short note on Torsion of Rectangular Bar. **06**
- Q.5** a) Explain Idealized Stress- Strain curve **07**  
b) What is isotropic hardening, and how does it influence the behavior of materials undergoing plastic deformation? **06**
- Q.6** a) What is the Tresca Yield Criterion, and how does it determine the onset of plastic deformation. **06**  
b) Write short note on Principle of Normality and Plastic Potential. **06**

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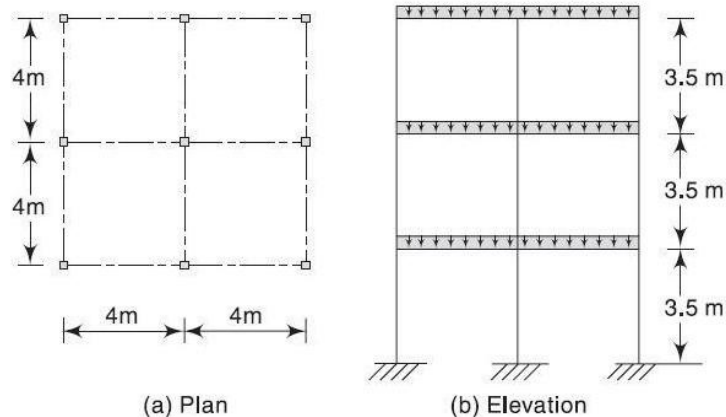
**F.Y. (M. Tech.) (Civil – Structures Engineering) (Semester - I) (New)  
(CBCS) Examination: March/April – 2026  
Dynamics & Earthquake Engineering (MTCE0103)**

Day & Date: Monday, 04-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) Solve any 5 questions.  
2) Figure to the right indicates full marks.  
3) Assume Suitable data if necessary and assume it clearly.

- Q.1** From the first principle derive the governing differential equation of the undamped free vibration. **14**
- Q.2 Solve Any Two.** **14**
- a) Derive an equation of motion for Duhamel’s integral.
  - b) What are Application to simple loading cases constant load and rectangular load?
  - c) Types of Damping.
- Q.3 Solve Any Two.** **14**
- a) MDOF System
  - b) frequency-Domain Analysis
  - c) Mode superposition Method
- Q.4** The plan and elevation of a three storey RCC School building is shown in figure. The building is located in seismic zone V. The type of soil encountered is medium stiff and it is proposed to design the building with a special moment-resisting frame. The intensity of DL is 10KN/m<sup>2</sup> and the floors are to cater to an IL of 3kN/m<sup>2</sup> Determine the design seismic loads on the structure by static analysis. **14**



- Q.5**   **a)** Explain the ductile detailing provisions specified in IS-13920 for reinforcing structural elements against seismic forces      **07**
- b)** Why is ductility important in the seismic design of reinforced concrete buildings, and how does it contribute to energy absorption during earthquakes?      **07**
- Q.6**   **a)** Explain the earthquake response spectrum and its use in characterizing seismic ground motions.      **07**
- b)** Explain how structural engineers use response spectra to assess the seismic performance of buildings and other structures.      **07**
- Q.7**   **a)** Differentiate between the magnitude and intensity of an earthquake. Also explain the interior of earth.      **07**
- b)** What is liquefaction, and how does it occur during earthquakes? Discuss its effects on soil and structures.      **07**

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**F.Y. (M.Tech.) (Civil – Structures Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Structural Audits (MTCE0106)**

Day & Date: Wednesday, 06-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

Instructions: 1) All question are compulsory.  
2) Figure to the right indicates full marks.

**SECTION - I**

**Q.1 Attempt the following question.**

- a) Write a note on effect of leakage, creep and fatigue on life of structure. **10**
- b) Explain methods for prevention of corrosion. **05**

**Q.2 Attempt the following questions. (Any Two)**

- a) Enlist Factors affecting durability of concrete, Corrosion in structures and explain them shortly. **10**
- b) Enlist various NDT Methods for assessing strength of distressed materials, and explain any Three in details. **10**
- c) Write a detailed note on Quality control & assurance of materials of structure. **10**

**SECTION - II**

**Q.3 Attempt the following question.**

- a) Elaborate briefly about Demolition of structure and Recycling of demolished materials. **10**
- b) Write a note on safety methods during construction. **05**

**Q.4 Attempt the following questions. (Any Two)**

- a) Explain various techniques for Retrofitting of structures. **10**
- b) Explain parameters of Structural aspects for formwork in buildings & bridges. **10**
- c) Enlist different construction chemicals used during restoration and explain parameters for its selection in details. **10**

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**F.Y. (M.Tech.) (Civil – Structures Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Design of Prestressed Concrete Structures (MTCE0107)**

Day & Date: Wednesday, 06-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) In Section - I, Q. No. is 1 is compulsory and attempt one question from the remaining.  
2) In Section - II, Q. No. is 4 is compulsory and attempt one question from the remaining.  
3) Use of is 1343 and non-programmable calculator are allowed.  
4) Figures to the right indicate full marks.  
5) Draw neat sketches wherever necessary.  
6) Assume suitable data if required.

**SECTION - I**

**Q.1** A pretensioned concrete beam  $300\text{ mm} \times 450\text{ mm}$  in section and is provided with 30 wires of  $3\text{ mm}$  diameter distributed uniformly over the section. Initially the wires are tensioned in the prestressing beds with a total pull of  $710\text{ kN}$ . Determine the final stress in concrete and the percentage loss of stress in wires. Take  $E_s = 2.08 \times 10^5\text{ N/mm}^2$ ,  $E_c = 3.20 \times 10^4\text{ N/mm}^2$ , Ultimate creep strain =  $32 \times 10^{-6}\text{ mm/mm}$  per  $\text{N/mm}^2$  Shrinkage of concrete =  $200 \times 10^{-6}$  Relaxation of steel stress = 4.5% of the initial stress. **18**

**Q.2** A Prestressed Concrete beam of size  $350\text{ mm} \times 700\text{ mm}$ . Determine the horizontal, vertical, shear stress and principal stresses. The tendons are placed at an eccentricity of  $75\text{ mm}$ . the anchor plate is  $300\text{ mm}$  wide and  $200\text{ mm}$  deep. Prestressing force in the tendons is  $750\text{ kN}$ . By Magnel' smethod, find principal stress at  $Q(600,600)$  by considering bottom edge of beam as origin. **17**

x/d	Kq	Kz
0.75	0.251	-2.47
0.76	0.226	-2.33

**Q.3** Design a prestressed concrete beam for following requirements, span of beam =  $14\text{ m}$ ,  
superimposed load =  $30\text{ kN/m}$  and  
Grade of concrete is  $M 35$ .  
Safe stress in concrete at transfer of prestress =  $0.5f_{ck}$ ,  
Safe stress in concrete due to final prestress  $f_c = 0.4 f_{ck}$ ,  
Allowable tensile stress in concrete =  $0.129 \sqrt{f_{ck}}$ ,  
Total loss of prestress is 15%,  
Ultimate stress in steel =  $1500\text{ N/mm}^2$ ,  
Safe stress in steel is 60% of ultimate stress. **17**

**SECTION - II**

- Q.4** A composite prestressed concrete beam section consisting of a prefabricated stem  $300\text{mm} \times 800\text{mm}$  and a cast-in-situ slab of  $800\text{mm} \times 150\text{mm}$ . if the differential shrinkage strain is  $1.2 \times 10^{-4}$ , find the shrinkage stress at the extreme edges of the slab and the stem. Take  $E_c = 2.75 \times 10^{-4} \text{ N/mm}^2$ . **18**
- Q.5** A post tensioned continuous beam consist of two spans each of  $21\text{m}$  long. The external loading other than the dead load of the beam is  $25\text{kN/m}$ . Design the beam. **17**
- Q.6** Design a non - cylinder prestressed concrete pipe of  $750\text{mm}$  and  $1000\text{mm}$  internal diameter to withstand a working hydrostatic pressure of  $1.05 \text{ N/mm}^2$ , using a  $2.5\text{mm}$  high tensile wire stressed to  $1000 \text{ N/mm}^2$  at transfer. Permissible maximum and minimum stresses in concrete at transfer and service loads are  $14$  and  $0.7 \text{ N/mm}^2$ . The loss ratio is  $0.8$ . Calculate also the test pressure required to produce a tensile stress of  $0.7 \text{ N/mm}^2$  in concrete when applied immediately after tensioning and also the winding stress in steel if  $E_s = 210 \text{ kN/mm}^2$  and  $E_c = 35\text{kN/mm}^2$ . For both cases mentioned above. **17**

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**F.Y. (M.Tech.) (Civil – Structures Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Advanced Design of Foundation (MTCE0108)**

Day & Date: Wednesday, 06-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) All questions are compulsory.  
2) Figure to the right indicates full marks.  
3) Make suitable assumption if necessary and mention it clearly.

**SECTION - I**

- Q.1**
- a) Explain the Effect of Water Table on Bearing Capacity. **04**
  - b) Describe different types of Soil Failures with Neat sketches. **04**
  - c) A square footing  $2m \times 2m$  is placed over loose sand of density  $17 KN/m^3$  and at a depth of 1m. The angle of shearing resistance is  $30^\circ$ . Determine the Total load that can be carried by the footing. Take  $N_c = 30.14$ ,  $N_q = 18.4$  and  $N_\gamma = 15.1$  **05**
- Q.2**
- a) Write a note on different types of Shallow Foundations with neat sketches? **05**
  - b) What are the different types of settlement of footings. **03**
  - c) Estimate the immediate settlement of a concrete footing  $1.5m \times 3m$  placed at a depth of  $1.5m$  in a soil with  $E = 25000KN/m^2$  and  $\mu = 0.3$ . The footing is subjected to a load of 500KN. Assume the footing to be rigid and take influence factor as 1.31. **04**
- Q.3**
- a) Explain the necessity of Mat or Raft Foundation. **03**
  - b) Explain in detail the conventional design of raft foundations. **07**

**SECTION - II**

- Q.4**
- a) Write a note on Under-Reamed Piles. **04**
  - b) In a 16 pile group, the pile diameter is  $450mm$  and centre to centre spacing of the square group is  $1.5m$ . If  $C = 50 KN/m^2$ , determine whether the failure would occur with the pile acting individually or as a group? Neglect bearing at the tip off the pile. All piles are  $10m$  long. Take  $\alpha = 0.7$  and factor of safety 2.5. Also Find safe allowable load. **08**

## SLR-QG-6

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| <b>Q.5</b> | <b>a)</b> Describe the various forces acting on well foundation.                   | <b>06</b> |
|            | <b>b)</b> Discuss in detail working of pneumatic caisson.                          | <b>05</b> |
| <b>Q.6</b> | <b>a)</b> Discuss the criteria for satisfactory performance of machine foundation. | <b>05</b> |
|            | <b>b)</b> Explain design of simple machine foundations using IS code method.       | <b>07</b> |

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**F.Y. (M.Tech.) (Civil – Structures Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Research Methodology and IPR© (MTCE0104)**

Day & Date: Thursday, 07-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) Section-I Q.3 is compulsory & attempt any one question from the remaining question.  
2) Section-II Q.6 is compulsory & attempt any one question from the remaining question.  
3) Figure to the right indicates full marks.  
4) Make necessary assumptions if required.

**SECTION - I**

- Q.1** a) What is research? Explain in detail, Steps involved in the research. **09**  
b) Explain in detail “Research design Process”. **08**
- Q.2** a) Explain literature survey in detail. **09**  
b) Explain the characteristics of a good research. **08**
- Q.3 Write Short Notes. (Any Three)** **18**  
a) Research Proposal  
b) Development Creativity  
c) Different methods of data collection  
d) Hypothesis

**SECTION - II**

- Q.4** a) Explain the process of Patent Development in India. **09**  
b) Explain the scope of Patent right's. **08**
- Q.5** a) What are the new developments in IPR? **09**  
b) Explain the steps to file patent in India. **08**
- Q.6 Write Short Notes. (Any Three)** **18**  
a) Technology Transfer  
b) Design and ‘Trademarks’  
c) Patent Database  
d) International Scenario on Intellectual Property

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**F.Y. (M.Tech.) (Civil – Structures Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
FEM in Structural Engineering (MTCE0201)**

Day & Date: Friday, 08-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) All Questions are compulsory.  
2) Figure to the right indicates full marks.  
3) Draw neat diagram wherever necessary.  
4) Make suitable assumptions if necessary and state it clearly.  
5) Use of non-programmable calculator is allowed.

**Q.1 Answer the following.**

- a) Explain various steps involved in finite element procedure. **05**  
b) Explain principle of Minimum Potential Energy. **06**

**Q.2 Answer the following.**

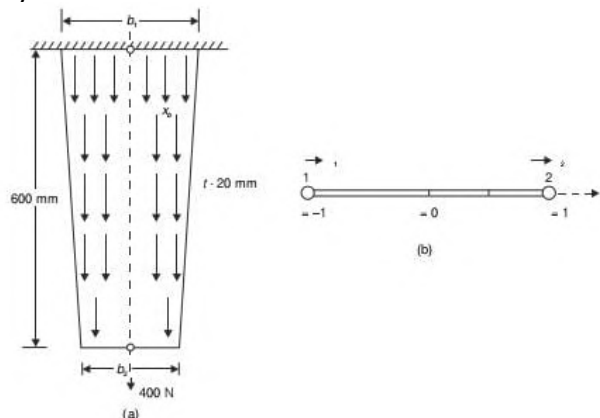
- a) Explain the terms CST, LST, QST. **06**  
b) Explain the terms Local coordinates, Global coordinates, Natural coordinates. **06**

**Q.3 Answer the following.**

- a) Explain Pascal's Triangle. **05**  
b) Using generalized coordinate approach, find shape function for two noded bar element. **07**

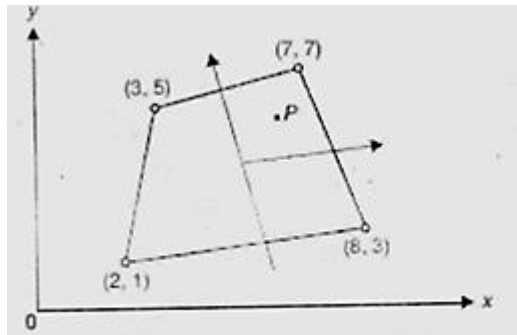
**Q.4 Answer the following.**

- a) Determine the extension of the bar shown in Fig. due to self-weight and a concentrated load of 400N applied at its end. Given **12**  
 $b_1 = 150 \text{ mm}$ ,  $b_2 = 75 \text{ mm}$ ,  $t = 20 \text{ mm}$ ,  $E = 2 \times 10^5 \text{ N/mm}^2$ ,  
 $\rho = 0.8 \times 10^{-4} \text{ N/mm}^2$



**Q.5 Answer the following.**

- a) Determine the Cartesian coordinate of the point P ( $\xi = 0.5, \eta = 0.6$ ) **08**  
shown in Fig. below



- b) What are the Finite Element Applications to Structural Dynamics? **04**

**Q.6 Answer the following.**

- a) Write short note on FEM. **05**  
b) Explain about the Axisymmetric Elements with its applications. **06**

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**F.Y. (M. Tech.) (Civil – Structures Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Advanced Design of Concrete Structures (MTCE0202)**

Day & Date: Monday, 11-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) In Section -I, Q. No. is 1 is compulsory and attempt one question from the remaining.  
2) In Section -II, Q. No. is 4 is compulsory and attempt one question from the remaining.  
3) Use of IS 456 and IS 3370 part IV are allowed.  
4) Assume suitable data if necessary.  
5) Draw neat sketches wherever necessary.

**SECTION - I**

- Q.1** a) Design an interior panel of a flat slab 6m×6m with a suitable column drop. Size of column is 500mm×500mm and a live load 4 kN/m<sup>2</sup>. Take floor finish as 1 kN/m<sup>2</sup>. Use M25 grade of concrete and Fe500 steel. **13**
- b) Draw a section showing reinforcement detailing for circular flat slab. **04**
- Q.2** a) A simply supported deep beam is 300 mm wide, 4200 mm deep and has a clear span of 6m. The carries a superimposed load of 300 kN/m. The beam has a bearing of 450 mm at each end. Design the beam with M20 concrete and Fe500 steel. **14**
- b) Explain imperial design method for shear wall subjected to in plane vertical loads. **04**
- Q.3** a) Design a combined footing to support two columns of 300mm×300mm and 600mm×600mm spaced 3.0 m apart, carrying axial loads of 600 kN and 900 kN respectively. The SBC of the soil is 200 kN/m<sup>2</sup>. Adopt M20 grade of concrete and Fe415 steel. **14**
- b) Discuss the conditions where raft foundation is constructed. **04**

**SECTION - II**

- Q.4** Design a circular ESR by assuming top slab simply supported at edges, vertical walls by assuming top free and bottom hinged. The bottom slab is supported by beams resting on four peripheral columns. The circular ESR is having capacity 45,000 liters. The depth of water may be kept as 3.2 m with free board 0.3 m. Adopt IS code method of design and use M25 grade of concrete and Fe500 Steel. **18**

## SLR-QG-10

- Q.5** a) A silo with internal diameter 5.7 m, height of cylindrical portion 18 m and central opening with 0.5 m is to be built to store wheat. Design the silo using M25 concrete and Fe500 steel. **14**
- b) Draw a sketch of bunker and show its components. **03**
- Q.6** Design a R.C. chimney using M25 concrete and Fe500 steel for the following requirement and check the stresses at a depth 51 m below the top. External Diameter = 4.5 m and Internal diameter = 4.2 m. Thickness of fire brick lining = 100 mm and air gap is 100 mm. Temperature difference is 90° C. Assume missing data suitably. **17**

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**F.Y. (M. Tech.) (Civil – Structures Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April - 2026  
Special Concrete & Concrete Composite (MTCE0203)**

Day & Date: Wednesday, 13-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) Section-I Q.1 is compulsory. Attempt any one question from the remaining.  
2) Section-II Q.4 is compulsory. Attempt any one question from the remaining.  
3) Figures to the right indicate full marks.

**SECTION - I**

- |            |  |           |
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| <b>Q.1</b> | <b>a)</b> What are the key constituents of modern concrete, and how do they contribute to the overall performance of concrete? | <b>06</b> |
|            | <b>b)</b> Compare the methods of concrete mix design, such as the IS method and the ACI method.                                | <b>06</b> |
|            | <b>c)</b> What is lightweight concrete, and how is it classified?  | <b>05</b> |
| <b>Q.2</b> | <b>a)</b> What are the common challenges in mixing and placing light weight concrete?  | <b>06</b> |
|            | <b>b)</b> What are the key properties of light weight concrete in terms of strength and durability?                            | <b>06</b> |
|            | <b>c)</b> Explains the mechanical properties of ferrocement.   | <b>06</b> |
| <b>Q.3</b> | <b>a)</b> What materials are typically used in high-density concrete to enhance its radiation shielding ability?               | <b>06</b> |
|            | <b>b)</b> Explain the production process of RMC and its advantages.  | <b>06</b> |
|            | <b>c)</b> Explains the merits of Ferro cement as a structural material.  | <b>06</b> |

**SECTION - II**

- |            |   |           |
|------------|---|-----------|
| <b>Q.4</b> | <b>a)</b> What are the physical and mechanical properties of Silica Fume Concrete with respect to durability of concrete? | <b>06</b> |
|            | <b>b)</b> What is Fiber Reinforced Concrete, and how does it differ from conventional concrete?                           | <b>06</b> |
|            | <b>c)</b> Discuss the behavior of Fiber Reinforced Concrete under compression, tension, and flexure.                      | <b>05</b> |

- Q.5**
- a)** What are the applications of polymer impregnated concrete and polymer concrete? **06**
  - b)** Briefly explain the following:
    - i)** What challenges might arise during the handling and placement of silica fume concrete? **06**
    - ii)** Merits of Silica Fume Concrete **06**
- Q.6**
- a)** Write note on types of polymer concrete. **06**
  - b)** What is polymer-impregnated concrete, and how is it prepared? **06**
  - c)** What are the primary materials used in polymer concrete, and what role does each play in its performance? **06**



**Q.6 Solve any two of the following.**

- a)** Explain the principles behind testing techniques such as ultrasonic testing, rebound hammer testing, and core sampling. **07**
- b)** Describe measures to prevent cracking and spalling in concrete due to thermal expansion and contraction. **07**
- c)** Explain how corrosion develops in reinforced concrete and the methods used for detecting corrosion. Describe the methods of corrosion protection. **07**

**Q.7 Solve any two of the following.**

- a)** Describe the properties and benefits of fiber-reinforced concrete (FRC) in structural applications. **07**
- b)** Explain the procedure, advantages, and limitations of epoxy injection in crack repair. **07**
- c)** Describe the process of Rust eliminators and applying polymers coating for rebar during repairs. **07**

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**F.Y. (M.Tech.) (Civil – Structures Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Design of RCC Bridges (MTCE0211)**

Day & Date: Monday, 18-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:**
- 1) In Section -I, Q. No. is 1 is compulsory and attempt two question from the remaining.
  - 2) In Section -II, Q. No. is 5 is compulsory and attempt two question from the remaining.
  - 3) Figures to the right indicate full marks.
  - 4) Assume suitable data if necessary & mention it clearly.

**SECTION - I**

- Q.1** Design a deck slab for following details: **11**
- a) Clear span – 4m
  - b) Width of footpath on either side – 0.6 m
  - c) Wearing coat – 80 mm thick
  - d) Loading – IRC Class AA (Tracked)
  - e) Material – M25 concrete, Fe 415 steel
  - f)  $\alpha = 3$
- Q.2** Answer the following. **12**
- a) Write a note on Courbon's theory. And discuss its limitations.
  - b) What is economic span? How it is calculated? Derive equation for the same.
  - c) Discuss the importance of bridges.
- Q.3** A RCC T beam type bridge having deck slab of 220 mm thick, wearing coat of 80 mm thick, three longitudinal girders and five cross girders. Determine the design bending moment for all the longitudinal girders. Use following additional data, **12**
- a) Carriage way width - 9 m
  - b) Span of bridge – 18 m
  - c) Live Load – IRC class A Two Lane
  - d) Kerb – 600 mm wide, 400 mm deep
  - e) Web thickness for Longitudinal and cross girder – 300 mm
  - f) Longitudinal Girder spacing – 3m
  - g) Use M–30 concrete and Fe –415 steel

**Q.4 Write a note on.**

- a) Components of bridges 12
- b) Importance of bridges
- c) General design considerations for bridges.

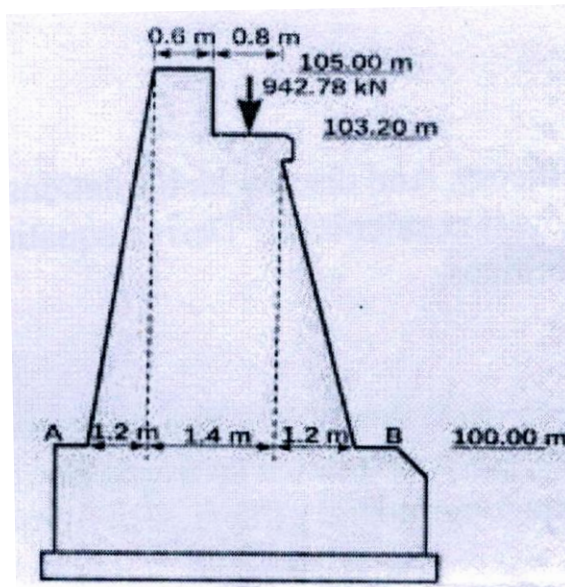
**SECTION - II**

**Q.5** Verify the adequacy of pier for following data: 11

Top width of pier – 1.8 m,  
 Height of pier up to springing level – 10 m,  
 C/C distance of bearing – 1 m, Side batter 1:14,  
 HFL – 1.5 m below the bearing level,  
 span of bridge – 18 m,  
 Self-weight of the structure – 200 KN/m  
 Maximum mean velocity of current – 3.6 m/sec  
 Material for pier: M20 grade concrete  
 Live load: IRC Class AA tracked.

**Q.6** Verify the stability of abutment shown in fig 12

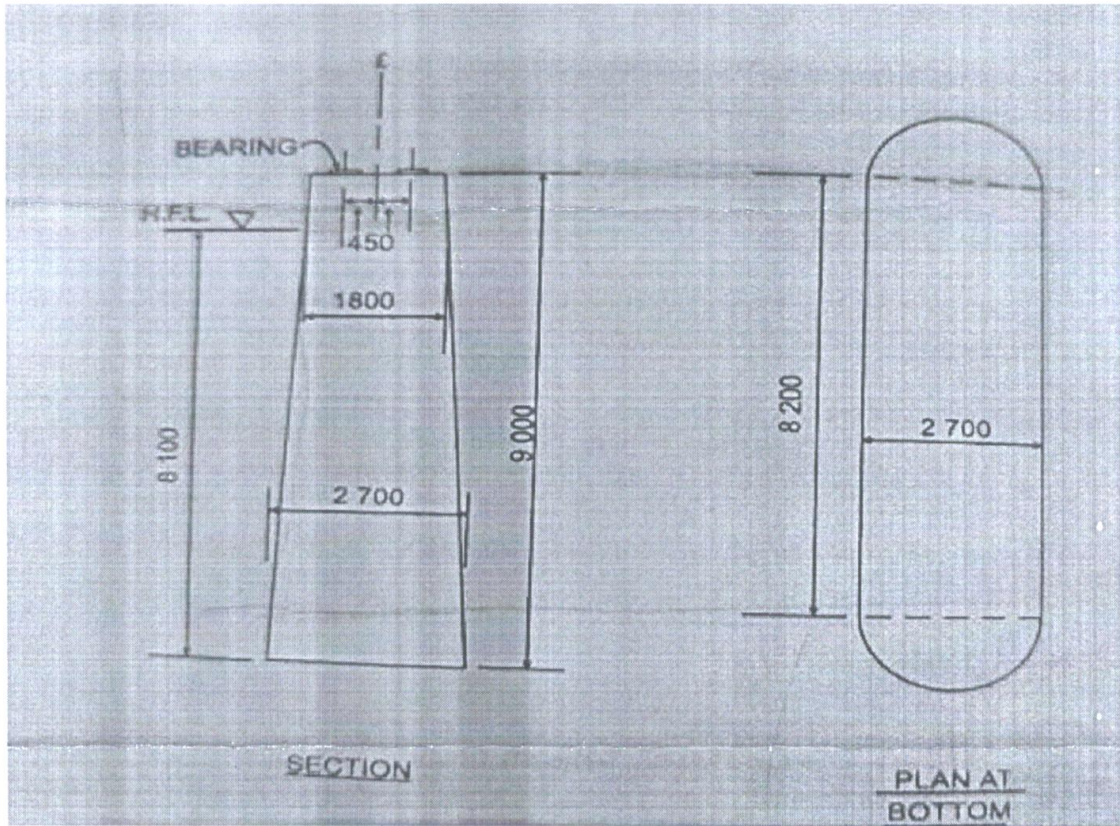
Material of abutment – Concrete M20  
 Density of the soil – 18 KN/m<sup>3</sup>  
 Coefficient of friction – 0.6  
 Angle of friction ( $\Phi$ ) – 30°  
 Live load – IRC Class AA (Tracked)  
 Span of bridge – 15m  
 Angle of friction between soil & concrete  $\delta = 18^\circ$



**Q.7 Write a note on following. (Any Three)** 12

- a) Erection methods for Bridges
- b) Types of bearing
- c) Expansion joints
- d) Well foundation

- Q.8 a)** Design a elastomeric unreinforced bearing pad for following data **07**  
Vertical load (sustained) = 180 KN  
Vertical load (dynamic) = 60 KN  
Horizontal force (H) = 90 KN  
Modulus of rigidity of elastomer (G) = 1.1 N/mm<sup>2</sup>  
Friction coefficient = 0.4
- b)** Write about inspection of bridges. **05**



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**F.Y. (M. Tech.) (Civil – Structures Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April- 2026  
Soil Structure Interaction (MTCE0213)**

Day & Date: Monday, 18-05-2026  
Time: 10:00 AM To 02:00 PM

Max. Marks: 70

- Instructions:** 1) All question are compulsory.  
2) Make suitable assumption if necessary and mention it clearly.  
3) Figures to the right indicate full marks.

**SECTION - I**

- Q.1** a) Explain Winkler's idealization method. **07**  
b) Differentiate contact pressures under perfectly flexible footings perfectly rigid footings in detail. **06**
- Q.2** a) Discuss the expressions for deflection, slope, bending moment and shear force for a beam with finite length. **05**  
b) Discuss about the time-dependent response of the soil. **06**
- Q.3** a) Explain the continuity among the foundation soil layers. **05**  
b) Discuss the procedure to be followed to obtain the solution in case of a two parameter linear model. **06**

**SECTION - II**

- Q.4** a) Solve the case of a rectangular plate resting on Winkler springs by FDM. **06**  
b) Discuss the procedure to be followed to obtain the solution in case of a two parameter non- linear model. **07**
- Q.5** a) Explain the classification of piles based on load criteria. **05**  
b) Derive the expression of ultimate bearing capacity for friction. **06**
- Q.6** a) Explain Reese and Matlock's generalized solution for grouped piles. **05**  
b) Discuss the settlement of pile group under compressive load by interaction factor approach. **06**

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**S.Y. (M. Tech.) (Civil – Structures Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April – 2026  
Business Analytics (OE001A)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.

**SECTION - I**

- Q.1 Attempt the Following. (Any Five) 35**
- a) What do you mean by Business Analytics? Explain the relation of Business Analytics process.
  - b) What is Data Mining? Explain Terminology & Notation in Data Mining.
  - c) Explain Supervised and & Unsupervised Learning in data mining.
  - d) Explain in detail Business Analytics Process.
  - e) Define & explain Box plots. Histograms with example.
  - f) Explain Data Mining Process in Detail.
  - g) Describe Manipulations in data visualization.

**SECTION - II**

- Q.2 Attempt the Following. (Any Five) 35**
- a) What is Multiple Linear Regression & Explain Predictive modeling.
  - b) Explain feature selection for clustering in detail.
  - c) Describe K-means algorithm in detail.
  - d) Explain Classification Matrix.
  - e) Explain the method for Evaluating Predictive Performance in detail.
  - f) Describe the Regression Equation and Prediction.
  - g) What is Regression Tree? Explain advantages & Weakness of it.

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**S.Y. (M. Tech.) (Civil – Structures Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Operation Research (OE001B)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

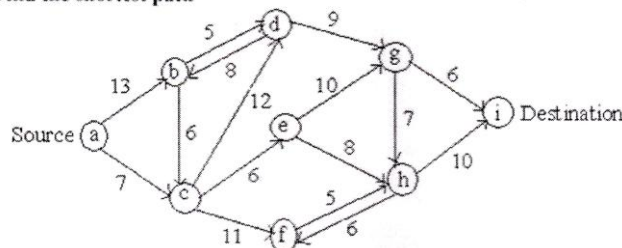
- Instructions:** 1) Q.1 and Q.5 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume suitable data necessary and mention if clearly.

**SECTION - I**

- Q.1** a) Explain different Linear Programming models. **09**  
b) Solve following LPP by Graphical method. **09**  
Minimize  $Z = 2y_1 + 3y_2$  s.t.  
constraints:  $y_1 + y_2 \geq 5, y_1 + 2y_2 \geq 6$   
 $y_1, y_2 \geq 0$
- Q.2** a) Explain Shadow Price- Sensitivity analysis. **09**  
b) Explain Monto-Carlo Simulation. **08**
- Q.3** a) Explain Structure of queuing system. **09**  
b) Explain Queuing Model - FIFO with suitable example. **08**

**SECTION - II**

- Q.4** a) Explain Price break model. **09**  
b) Explain Inventory management techniques. **08**
- Q.5** a) Explain Group replacement policy. **09**  
b) **Example 1**  
Find the shortest path **09**



- Q.6** a) Explain Cost optimization. **09**  
b) Explain Network crashing and its steps. **08**

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**S.Y. (M. Tech.) (Civil – Structures Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Nonconventional Energy (OE001D)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

- Instructions:** 1) Q.1 and Q.4 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume necessary data if necessary.

**SECTION - I**

- Q.1 Solve Any Four. 20**
- a) Compare conventional and renewable energy sources based on their environmental impact.
  - b) Write a note on the growth of the energy sector in India.
  - c) What do you understand by energy conservation? Explain its various aspects.
  - d) Explain cogeneration and its role in improving energy utilization.
  - e) Explain the specifications of energy storage devices.
- Q.2 a) Draw a schematic diagram of a solar pond-based electric power plant with a cooling tower and explain its working. 07**
- b) What are the emerging new technologies for energy conservation and efficiency? 08**
- Q.3 a) Why is energy storage necessary? Explain two methods of energy storage. 07**
- b) Describe different types of solar thermal energy collectors and their applications. 08**

**SECTION - II**

- Q.4 Solve Any Four 20**
- a) Explain the fundamentals of Solar Cell technology.
  - b) What are the major advantages and disadvantages of a solar PV system?
  - c) Explain the different modes of power generation.
  - d) Explain gasification and its role in biomass energy production.
  - e) What is a Fuel cell and explain its classification in detail?

- Q.5 a)** What is the importance of MPPT in an SPV system? Explain various strategies used for the operation of an MPPT. **07**
- b)** What is the origin of biomass energy? What is its global potential? What is the average efficiency of photosynthetic conversion of solar energy into biomass? **08**
- Q.6 a)** Discuss the process of urban waste-to-energy conversion, highlighting its benefits and challenges in sustainable development. **07**
- b)** Discuss the role of hydrogen as an energy carrier in fuel cell technology. Highlight the challenges associated with its storage and utilization. **08**

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**S.Y. (M. Tech.) (Civil – Structures Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Product Design and Development (OE001E)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

**Instructions:** 1) Q.No.3 and Q.No.6 are compulsory and solve any one question from remaining question from each section.  
2) Figures to the right indicate full marks.  
3) Figures to the right indicate full marks.  
4) Make suitable assumptions if required.

**SECTION - I**

- Q.1** a) What are the stages of the product life cycle, and how do they influence product design and development? **09**  
b) Outline the steps in the product design process and discuss the importance of design analysis. **08**
- Q.2** a) What is functional analysis, and what are the key steps in the Functional Analysis System Technique (FAST)? **09**  
b) Define value engineering and explain its role in reducing costs while maintaining product quality. **08**
- Q.3 Write Short Notes. (Any Three)** **18**  
a) How is Computer-Aided Design (CAD) used in product design?  
b) What is robust design, and how does it improve product quality?  
c) What is meant by Design for X (DFX)? Give a few examples.  
d) What are the key principles behind robust design and how are they applied in product development?

**SECTION - II**

- Q.4** a) What are the key guidelines for Design for Manufacturing and Assembly (DFMA), and how do they simplify the manufacturing process? **08**  
b) Describe the ergonomic design process and the role of posture and movement in creating user-friendly products. **09**
- Q.5** a) Explain the concept and advantages of rapid prototyping in product development. **08**  
b) What is the importance of cost evaluation and life cycle analysis in making economic decisions for product design? **09**

**Q.6 Write Short Notes. (Any Three)****18**

- a)** What are ergonomics, and why are they important in product design?
- b)** What is rapid prototyping, and how does it help in product development?
- c)** What is life cycle analysis, and how is it used in product design?
- d)** 'What are the main steps in the Design for Six Sigma (DFSS) process?

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**F.Y. (M. Tech.) (Mechanical - Design Engineering) (Semester - I)  
(New) (CBCS) Examination: March/April – 2026  
Advanced Stress Analysis (MTDE101)**

Day & Date: Thursday, 30-04-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) In Section – I, Q. No. 2 is compulsory. Attempt any one questions from Q. 1 & Q. 3.  
2) In Section – II, Q. No. 5 is compulsory. Attempt any one questions from Q. 4 & Q. 6.  
3) Make suitable assume data if necessary and state them clearly.  
4) Figure to the right indicates full marks.  
5) Use of non-programmable calculators is allowed.

**SECTION – I**

**Q.1 Solve the following questions.**

- a) Describe plane stress and plane strain using appropriate illustrations. **03**
- b) Obtain the differential equilibrium equations for plane stress in a Cartesian coordinate system. **07**
- c) Investigate what problem can be solved by the stress function 'ϕ' applied to the region included by  $y = \pm C, x = 0$  to  $x = 1$  **07**

$$\phi = \frac{3F}{4C} \left[ xy - \frac{xy^3}{3C^2} \right] + \frac{P}{2} y^2$$

**Q.2 Solve the following questions.**

- a) Explore the strain components using standard notations within a polar coordinate system. **05**
- b) Derive the stress distribution in a uniformly thick rotating disk with a central circular hole. **07**
- c) Formulate the equilibrium equation in polar coordinates for a plane stress problem. **06**

**Q.3 Write short notes on.**

- a) Saint Venant's principle and its utilization in stress analysis. **04**
- b) The correlation between elastic modulus and Poisson's ratio. **05**
- c) The flexure of a cantilever beam under end loading. **08**

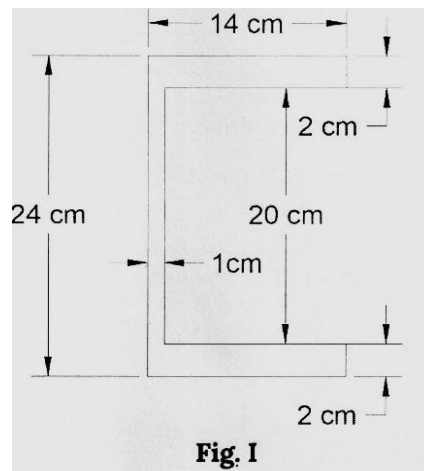
## SECTION – II

**Q.4 Solve the following questions.**

- a) Elaborate on the soap film analogy. **05**
- b) Derive the expression for torque and angle of twist for a prismatic bar with an elliptical cross section. **12**

**Q.5 Solve the following questions.**

- a) Demonstrate the principles utilized in determining the shear center. **06**
- b) Calculate the shear center of the channel section with flanges measuring 14 cm and a web of dimensions 20 cm × 1 cm. **12**



**Q.6 Solve the following questions.**

- a) Analyze in depth the fundamental assumptions underlying the theory of contact stresses and assess its significance. **05**
- b) Derive the expression for the area of contact and analyze the pressure distribution in the event of contact between two spheres. **12**

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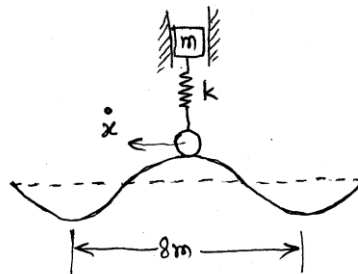
**F.Y. (M. Tech.) (Mechanical - Design Engineering) (Semester - I)  
(New) (CBCS) Examination: March/April – 2026  
Advanced Vibrations and Acoustics (MTDE102)**

Day & Date: Saturday, 02-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

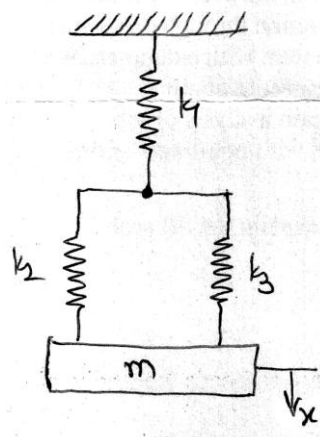
- Instructions:** 1) Solve any five questions.  
2) Figures to the right indicate full marks.  
3) Make suitable assumptions if necessary and state them clearly.

- Q.1 a)** Figure shows an automobile trailer which moves over the road surface making approximately sinusoidal profile with a wavelength of 8 meters and amplitude of 6 cm. The trailer is pulled on the road surface with a velocity of 60 km/hr. Calculate the critical speed of trailer if the vibration amplitude is 1.5 cm for the trailer of mass 50kg. **07**

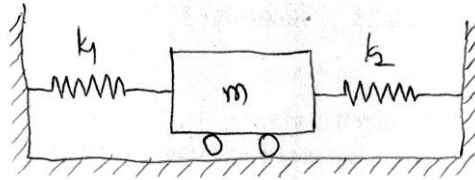


- b)** Write note on dynamic vibration absorber system. Explain difference between a vibration absorber and a vibration isolator. **07**

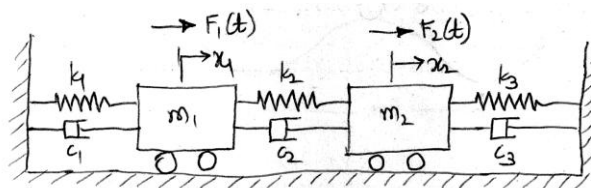
- Q.2 a)** A mass is suspended from a spring system as shown in the figure. Determine natural frequency of the system. **07**  
 $k_1=5000 \text{ N/m}$ ,  $k_2=k_3=8000 \text{ N/m}$ ,  $m=25 \text{ kg}$



- b) Derive the equation of motion of the system, using following methods. 07
- i) Newton's second law of motion
  - ii) D'Alembert's principle
  - iii) Principle of conservation of energy



- Q.3 a) Explain matrix iteration method to find natural frequency of multi-degree freedom system. 07
- b) Derive an equation for the response of undamped system under the harmonic force condition. 07
- Q.4 a) A two degree of freedom system is as shown below. Write the equations of motion and represent these equations in matrix form 07



- b) Derive equation of motion for the transverse vibration of a string. 07
- Q.5 a) Write note on FRF and its collection through experimental methods. 07
- b) Explain non-linear vibration system with examples. What is difference between linear and non-linear systems with respect to application of superposition principle? 07
- Q.6 a) Explain what is frequency domain analysis of vibration data. 07
- b) Write note on forced vibrations with non-linear spring forces (Duffing's equation). 07
- Q.7 a) Write note on sound fields. 07
- b) Define sound power level and explain the dB scale. 07

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**F.Y. (M. Tech.) (Mechanical–Design Engineering) (Semester - I)  
(New) (CBCS) Examination: March/April – 2026  
Industrial Instrumentation (MTDE103)**

Day & Date: Monday, 04-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) Section I Q.1 and Q.4 are compulsory & attempt any one from remaining question.  
2) Section II Q.5 and Q.8 are compulsory & attempt any one from remaining question.  
3) Figure to right indicate full marks.  
4) Draw neat sketches wherever necessary.

**SECTION - I**

- |            |   |           |
|------------|---|-----------|
| <b>Q.1</b> | <b>a)</b> Explain typical applications of instrument systems.   | <b>06</b> |
|            | <b>b)</b> Define Resolution, Dead band, Repeatability, back lash, drift and linearity characteristics of the measuring instruments. | <b>06</b> |
| <b>Q.2</b> | <b>a)</b> Explain use of filters in the instruments.  | <b>05</b> |
|            | <b>b)</b> Explain Electromagnetic and Eddy current transducer with neat sketch.   | <b>06</b> |
| <b>Q.3</b> | <b>a)</b> Explain with neat sketch McLeod Gauge.  | <b>05</b> |
|            | <b>b)</b> Explain with neat sketch absorption Dynamometer.  | <b>06</b> |
| <b>Q.4</b> | <b>Write Short Notes. (Any Three)</b>   | <b>12</b> |
|            | <b>a)</b> Hydraulic Load Cell   |           |
|            | <b>b)</b> Ionisation gauge  |           |
|            | <b>c)</b> Magnetostrictive transducer   |           |
|            | <b>d)</b> Strain gauge torque transducer  |           |

**SECTION - II**

- |            |  |           |
|------------|--|-----------|
| <b>Q.5</b> | <b>a)</b> Explain elastic force measurement devices.   | <b>06</b> |
|            | <b>b)</b> Explain the Knudsen gauge with neat sketch.  | <b>06</b> |
| <b>Q.6</b> | <b>a)</b> Explain Real Time Parallel Analyser with neat sketch.                              | <b>05</b> |
|            | <b>b)</b> Explain with neat sketch electromagnetic flow meter.                               | <b>06</b> |
| <b>Q.7</b> | <b>a)</b> Explain with neat sketch Atomic absorption spectrometer.                           | <b>05</b> |
|            | <b>b)</b> Explain the terms sound pressure level, sound power level & sound intensity level. | <b>06</b> |

**Q.8 Write Short Notes. (Any Three)**

- a)** Electret Microphone
- b)** System Analysis by Transient Testing
- c)** Thermistors
- d)** Galvanometric Recorder

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**F.Y. (M. Tech.) (Mechanical–Design Engineering) (Semester - I)  
(New) (CBCS) Examination: March/April – 2026  
Computational Techniques in Design Engineering (MTDE106)**

Day & Date: Wednesday, 06-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) In Section-I Q. No. 1 is compulsory. Attempt any one question from the remaining.  
2) In Section-II Q. No. 4 is compulsory. Attempt any one questions from the remaining.  
3) Figures to the right indicate full marks.  
4) Assume suitable data if required and mention it clearly.  
5) Use of non-programmable calculator is allowed.

**SECTION - I**

- Q.1 a)** The following table gives temperature ( $^{\circ}\text{C}$ ) a pressure (kPa). **06**

T	300	320	340	360	380
P	120	135	150	170	195

Estimate pressure at  $T=345^{\circ}\text{C}$  using divided differences.

- b)** Discuss the role and application of mathematical modeling in engineering research. **06**
- c)** A mechanical system is modeled by the following set of linear equations representing forces in a three-joint structure: **06**  
 $3x - 0.1y - 0.2z = 7.85$   
 $0.1x + 7y - 0.3z = -19.3$   
 $0.3x - 0.2y + 10z = 71.4$   
 where  $x, y, z$  represent the unknown forces (in kN) acting at the joints.

- Q.2 a)** Apply Lagrange's interpolation formula to estimate the profit for the year 2000 using the data provided below. **09**

Year:	1997	1999	2001	2002
Profit in lakhs of Rs.	43	65	159	248

- b)** A radioactive substance decays over time, and its mass (grams) is recorded: **08**

Time t (hours)	0	2	4	6
Mass m (g)	50	40	32	25

- i) Fit an exponential decay model  $m = Ae^{Bt}$ .  
ii) Estimate the mass remaining after 8 hours.

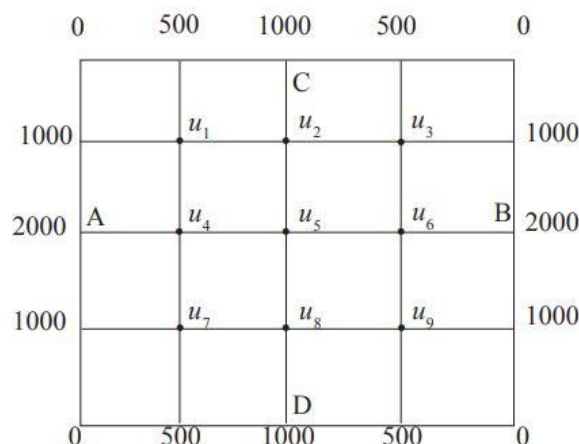
- Q.3 a)** Describe the different types of errors that occur in numerical calculations. **05**
- b)** Obtain by the power method, the numerically dominant eigenvalue and eigenvector of the matrix. **06**
- $$A = \begin{bmatrix} 15 & -4 & -3 \\ -10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$$
- c)** Fit a straight-line trend to the calf's monthly weight data using least squares, and determine the monthly growth rate. **06**

Month (x)	1	2	3	4	5	6	7	8	9	10
Weight (y in kg)	52.5	58.7	65.0	70.2	75.4	81.1	87.2	95.5	102.2	108.4

**SECTION - II**

- Q.4 a)** Evaluate  $\int_0^6 \frac{dx}{1+x^2}$  by using **06**
- i) Trapezoidal rule
  - ii) Simpson's 1/3 rule
  - iii) Simpson's 3/8 rule
- b)** Using Euler's method, find an approximate value of y corresponding to x = 1 given that  $dy/dx = x + y$  and y = 1 when x = 0. **06**
- c)** Find the values of  $u(x, t)$  satisfying the parabolic equation **06**
- $$\frac{\partial u}{\partial t} = 4 \frac{\partial^2 u}{\partial x^2}$$
- and the boundary conditions  $u(0, t) = 0 = u(8, t)$  and  $u(x, 0) = 4x - (1/2)x^2$  at the points  $x = i: i = 0, 1, 2, \dots, 7$  and  $t = 1/8 j: j = 0, 1, 2, \dots, 5$

- Q.5 a)** Solve the elliptic equation  $u_{xx} + u_{yy} = 0$  for the following square mesh with boundary values as shown in Figure 11.6 **09**



**b)** Evaluate the integral  $\int_0^{0.5} \left(\frac{x}{\sin x}\right) dx$  **08**  
 using Romberg's method, correct to three to three decimal places.

**Q.6 a)** Evaluate  $\int_{0.2}^{1.5} e^{-x^2} dx$  using the 3-point Gaussian quadrature. **05**

**b)** Using the Runge-Kutta method of fourth order, **06**  
 Solve  $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$  with  $y(0) = 1$  at  $x = 0.2, 0.4$

**c)** Give  $\frac{dy}{dx} = x^2(1 + y)$  and  $y(1) = 1, y(1.1) = 1.233, y(1.2) = 1.548, y(1.3) = 1.979$ , evaluate  $y(1.4)$  by the Adams-Bashforth method. **06**

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**F.Y. (M.Tech.) (Mechanical–Design Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Reliability Engineering (MTDE107)**

Day & Date: Wednesday, 06-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) In Section -I, Q. No. 3 is compulsory and attempt one question from the remaining.  
2) In Section - II, Q. No. 6 is compulsory and attempt one question from the remaining.  
3) Make suitable assumption if necessary and mention it clearly.  
4) Figures to the right indicate full marks.  
5) Draw neat diagram wherever necessary.

**SECTION - I**

- Q.1** a) Analyze how the concept of the system life cycle influences reliability decisions at different stages. Provide suitable engineering examples. **09**
- b) Outline the steps involved in collecting failure data and explain the importance of empirical methods in improving reliability predictions. **08**
- Q.2** a) Explain hazard rate  $\lambda(t)$  and typical hazard rate behaviors. Demonstrate how the bathtub curve characterizes real-world product failure patterns. **09**
- b) Given a probability density function of failure time, determine the reliability function, the median time to failure, and the variance, and explain what each of these measures indicates about system reliability. **08**
- Q.3 Write Short Notes. (Any Three)** **18**
- a) Different Types of Failure Modes in Engineering Systems
- b) Redundancy Techniques Using CFR Models
- c) Normal Distribution in Reliability and Life-Data Analysis
- d) Three-Parameter Weibull Distribution

**SECTION - II**

- Q.4** a) Analyze how reliability changes when a system is modeled in series, parallel, and mixed configurations using reliability block diagrams (RBDs). Explain with suitable engineering examples and expressions. **09**
- b) Using cut-set and tie-set methods, evaluate the-reliability of a complex network. Explain how minimal cut sets influence system failure probability. **08**



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**F.Y. (M.Tech.) (Mechanical–Design Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Mechanical System Design (MTDE108)**

Day & Date: Wednesday, 06-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) In Section - I Q. No. 1 & Q. No.4 is compulsory. Attempt any one question from the remaining.  
2) In Section - I Q. No. 5 & Q. No.8 is compulsory. Attempt any one question from the remaining  
3) Use of non-programmable calculator is allowed.  
4) Assume suitable data if necessary.  
5) Figures to the right indicate full marks.

**SECTION – I**

- |            |  |
|------------|--|
| <b>Q.1</b> | <p>a) Explain the optimization of structural diagram in the design of multi speed machine tool gear box. <span style="float: right;"><b>06</b></span></p> <p>b) Explain the advantages of geometrical progression for selecting the speed of multi speed machine tool gear box. <span style="float: right;"><b>06</b></span></p> |
| <b>Q.2</b> | <p>a) Explain various characteristics of frequency curves. <span style="float: right;"><b>05</b></span></p> <p>b) Explain different measures of central tendency and dispersion. <span style="float: right;"><b>06</b></span></p>  |
| <b>Q.3</b> | <p>a) Explain with neat sketch Belt tensions at various points. <span style="float: right;"><b>05</b></span></p> <p>b) Explain objectives of material handling. <span style="float: right;"><b>06</b></span></p>   |
| <b>Q.4</b> | <p><b>Write Short Notes.</b> <span style="float: right;"><b>12</b></span></p> <p>a) Basic consideration in design of multi speed gear box</p> <p>b) Population combinations</p> <p>c) Unit load and containerization</p>   |

**SECTION – II**

- |            |  |
|------------|--|
| <b>Q.5</b> | <p>a) Explain concept of cylinder liner with neat sketch. Also, write advantages and materials used for cylinder liner. <span style="float: right;"><b>06</b></span></p> <p>b) Explain design procedure for piston rings. <span style="float: right;"><b>06</b></span></p> |
| <b>Q.6</b> | <p>a) Derive Lamé's equation to determine thickness of pressure vessel. <span style="float: right;"><b>05</b></span></p> <p>b) Explain with neat sketch pressure vessel supports. <span style="float: right;"><b>06</b></span></p>   |
| <b>Q.7</b> | <p>a) Explain Johnson's method of optimum design. <span style="float: right;"><b>05</b></span></p> <p>b) Explain design considerations for castings. <span style="float: right;"><b>06</b></span></p>  |

**Q.8 Write Short Notes.**

**12**

- a)** Modes of failure in pressure vessels
- b)** Design of piston
- c)** Design for machining

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**F.Y. (M.Tech.) (Mechanical–Design Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Computer Aided Design (MTDE109)**

Day & Date: Wednesday, 06-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:**
- 1) In Section - I Q. No. 3 is compulsory. Attempt any one question from the remaining.
  - 2) In Section - I Q. No. 6 is compulsory. Attempt any one question from the remaining
  - 3) Figures to the right indicate full marks.
  - 4) Make suitable assumptions wherever necessary and state them clearly.
  - 5) Draw neat diagram wherever necessary.

**SECTION - I**

**Q.1 Answer the following questions.**

- a) Write a short note on CAD Hardware and Software, outlining the essential components of both hardware and software in computer-aided design. **08**
- b) Discuss the different Types of Systems in CAD and highlight the key considerations when selecting a CAD system for specific applications. **09**

**Q.2 Answer the following questions.**

- a) Given a triangle with coordinates P(1, 2), Q(3, 5), and R(4, 2), apply the following transformations sequentially: **09**
  - i) Translation by (2, 3)
  - ii) Scaling by 2 in X and 0.5 in Y
  - iii) Rotation by 90° counterclockwise

Find the final coordinates using homogeneous transformation matrices.
- b) What is homogeneous coordinate representation? Why is it essential in performing geometric transformations in computer graphics systems? **08**

**Q.3 Answer the following questions. (Any Three)**

- a) Write a short note on Parametric Representation of Analytic Curves. **06**
- b) Write a short note on Techniques and algorithms used in manipulating curves within geometric models. **06**
- c) Discuss the various types of curve manipulations such as subdivision, trimming, merging, and degree elevation. Why are these operations important in curve design? **06**
- d) Write a short note on Bezier Curve. **06**

**SECTION - II****Q.4 Answer the following questions.**

- a) Classify different types of computer networks based on their scale, architecture, and purpose. Compare LAN, MAN, and WAN in terms of topology, speed, and applications. **09**
- b) Illustrate and explain the function of different network interfaces such as NICs (Network Interface Cards), routers, switches, and gateways in modern computer networks. **08**

**Q.5 Answer the following questions.**

- a) Explain how solid modeling aids in mass properties calculations such as volume, centroid, and moment of inertia. Provide an example using any simple solid model. **09**
- b) Define solid manipulations in CAD. Explain how operations like translation, rotation, scaling, and Boolean modifications affect the underlying data structures of a solid model. **08**

**Q.6 Answer the following questions. (Any Three)**

- a) What is a system in the context of simulation? Define and differentiate between discrete and continuous systems, providing examples of each. **06**
- b) Write a short note on components that constitute a system and their interactions in a simulated environment. **06**
- c) Discuss the key requirements of a good mesh in finite element modeling. How do element shape, aspect ratio, and mesh density affect the accuracy and convergence of FEA results? **06**
- d) Define system simulation and explain its importance in engineering. What are the benefits of simulation over physical experimentation in product development and testing? **06**

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**F.Y. (M.Tech.) (Mechanical – Design Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Research Methodology and IPR (MTDE104)**

Day & Date: Thursday, 07-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) Section-I Q.3 is compulsory & attempt any one question from the remaining question.  
2) Section-II Q.6 is compulsory & attempt any one question from the remaining question.  
3) Figure to the right indicates full marks.  
4) Make suitable assumptions if required.

**SECTION - I**

- Q.1** a) What is research? Explain in detail the steps involved in research with flow chart. **09**  
b) What are different types of research? Explain any two with suitable examples. **08**
- Q.2** a) What is literature review in research? Explain its importance and methods. **09**  
b) What is research design? Explain research design process. **08**
- Q.3 Write short Notes. (Any Three) 18**  
a) Error in research  
b) selection of samples  
c) Creative problem-solving method  
d) Types of data

**SECTION - II**

- Q.4** a) Explain Process of Patenting & Development. **08**  
b) Explain Procedure for grants of patents. **09**
- Q.5** a) What is Geographical Indications? Explain with suitable examples. **09**  
b) Explain IPR of Biological Systems. **08**
- Q.6 Write Short Notes. (Any Three) 18**  
a) Trade and Copyright  
b) International Scenario on Intellectual Property  
c) Scope of Patent Rights  
d) Administration of Patent System

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**F.Y. (M.Tech.) (Mechanical–Design Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Finite Element Method (MTDE201)**

Day & Date: Friday, 08-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) Question No. 1 Section-I and Question No. 5 from section-II are compulsory.  
2) Attempt any two questions from question No2 to question No 4 and attempt any two questions from question No 6 to question No 8.  
3) Make suitable assumptions if necessary and state them clearly.

**SECTION - I**

- |            |                               |   |           |
|------------|-------------------------------|---|-----------|
| <b>Q.1</b> | <b>a)</b>                     | Derive the shape functions 1D elements using Lagrange's polynomial.                     | <b>08</b> |
|            | <b>b)</b>                     | Describe the standard steps followed in the finite element analysis process.            | <b>07</b> |
| <b>Q.2</b> | <b>a)</b>                     | Compare and explain the characteristics of 1D, 2D, and 3D elements used in FEM.         | <b>05</b> |
|            | <b>b)</b>                     | What is the weighted residual technique? Discuss its role in the finite element method. | <b>05</b> |
| <b>Q.3</b> | <b>a)</b>                     | Illustrate the formulation of a one-dimensional thermal conduction element.             | <b>05</b> |
|            | <b>b)</b>                     | Define a beam element and outline the development of its stiffness matrix.              | <b>05</b> |
| <b>Q.4</b> | <b>Write Notes. (Any Two)</b> |   | <b>10</b> |
|            | <b>a)</b>                     | Role and derivation of shape functions in FEM   |           |
|            | <b>b)</b>                     | Introduction to the Boundary Element Method and its applications                        |           |
|            | <b>c)</b>                     | Finite Volume Method and how it differs from FEM  |           |

**SECTION - II**

- Q.5** a) What is modal analysis? Illustrate it using a relevant example. **08**  
b) Describe the concept of transient analysis with real-world application examples. **07**
- Q.6** a) Explain natural coordinate systems for 1D, 2D, and 3D simplex-type finite elements. **05**  
b) What is a Jacobian matrix in finite element analysis? Explain its significance with a suitable example. **05**
- Q.7** a) Distinguish between static and dynamic analysis in FEM using practical illustrations. **05**  
b) Determine the shape functions for a two-dimensional quadrilateral element in terms of natural coordinates  $\xi$  and  $\eta$ . **05**
- Q.8 Write Notes. (Any Two)** **10**  
a) Overview and application of explicit dynamic analysis  
b) Fundamentals of shock spectrum analysis and where it is used  
c) Harmonic analysis and its role in vibration studies

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**F.Y. (M. Tech.) (Mechanical – Design Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Advanced Design Engineering (MTDE202)**

Day & Date: Monday, 11-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) In Section-I Q. No. 3 is compulsory. Attempt any one question from the remaining.  
2) In Section-II Q. No. 6 is compulsory. Attempt any one question from the remaining.  
3) Figures to the right indicate full marks.  
4) Assume necessary data if required and state it clearly.

**SECTION - I**

- Q.1**
- |           |  |           |
|-----------|--|-----------|
| <b>a)</b> | Explain types of cams with neat sketches.  | <b>10</b> |
| <b>b)</b> | Compare the kinematics of SHM and Cycloidal motion cam with the help of SVAJ diagrams. | <b>07</b> |
- Q.2**
- |           |  |           |
|-----------|--|-----------|
| <b>a)</b> | Explain the effect of pressure and temperature on viscosity.   | <b>10</b> |
| <b>b)</b> | The following data refers to a short hydrodynamic journal bearing:<br>Radial Load = 1000 N<br>Journal speed = 1800 rpm<br>(l/d) ratio = 0.5<br>Eccentricity ratio = 0.65<br>Radial clearance = 0.002 x Journal radius<br>Flow rate of lubricant = 3.50 litre per hour<br>Calculate:<br>i) Diameter of journal<br>ii) Radial Clearance<br>iii) Dimensions of Bearings<br>iv) Minimum oil-film thickness<br>v) Absolute viscosity of lubricant | <b>07</b> |
- Q.3** Write short notes on the following: **18**
- |           |   |
|-----------|---|
| <b>a)</b> | Polydyne Cams   |
| <b>b)</b> | Pressure development mechanism in hydrodynamic journal bearings |
| <b>c)</b> | Reynolds equation   |

**SECTION - II**

- Q.4** a) Discuss the design considerations for a hydrostatic. **10**  
 b) Distinguish between MTTF and MTBF. **07**
- Q.5** a) For a system of three components in series with individual reliabilities of 0.94, 0.93, and 0.96, calculate the overall system reliability. Also, compute the reliability if the components are arranged in parallel. **10**  
 b) In the reliability testing of 80 specimen components, following failure frequencies were observed. The total test period was 8 hours. **07**

<b>Time interval</b>	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8
<b>No. of failures</b>	4	13	12	22	13	9	4	3

Find the values of failure density, hazard rates and reliability.

- Q.6 Write short notes on the following** **18**
- a) Reliability Improvement and Testing  
 b) Weibull distribution  
 c) Design for manufacturing

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**F.Y. (M. Tech.) (Mechanical – Design Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Industrial Product Design (MTDE203)**

Day & Date: Wednesday, 13-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) Section-I Q.3 is compulsory. Attempt any one question from the remaining.  
2) Section-II Q.6 is compulsory. Attempt any one question from the remaining.  
3) Make suitable assumptions wherever necessary and state them clearly.  
4) Draw neat diagram wherever necessary.

**SECTION - I**

- |            |   |           |
|------------|---|-----------|
| <b>Q.1</b> | a) Classify and explain various types of physical models used in industrial design.                       | <b>09</b> |
|            | b) Illustrate the importance of modelling techniques in industrial product design with relevant examples. | <b>08</b> |
| <b>Q.2</b> | a) Identify challenges in product development and propose strategies to overcome them.                    | <b>09</b> |
|            | b) Analyze the relationship between design specifications and consumer needs.                             | <b>08</b> |
| <b>Q.3</b> | <b>Write Short Notes. (Any Three)</b>   | <b>18</b> |
|            | a) Ergonomic design of Tractor  |           |
|            | b) Significance of Color in Product design  |           |
|            | c) Mechanics of human vision and its role in product design   |           |
|            | d) Use and limitations of anthropometric data in ergonomic design   |           |

**SECTION - II**

- |            |  |           |
|------------|--|-----------|
| <b>Q.4</b> | a) Illustrate the role of inventiveness in concept design with an example.                 | <b>09</b> |
|            | b) Explain the importance of prototype design and pre-production inspection.               | <b>08</b> |
| <b>Q.5</b> | a) Explain producibility requirement in the design of machine components.                  | <b>09</b> |
|            | b) Analyze the impact of Design for Production (DFP) on cost, quality, and time-to-market. | <b>08</b> |

**Q.6 Write Short Notes. (Any Three)****18**

- a)** QFD process for customer-driven product design
- b)** Role of computer-aided industrial design in enhancing product quality
- c)** Concurrent Design for reducing time to market
- d)** Stereolithography Method in rapid prototyping

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**F.Y. (M. Tech.) (Mechanical - Design Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Theory and Analysis of Composite Materials (MTDE205)**

Day & Date: Friday, 15-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) Section - I Q.3 is compulsory. Attempt any one question from the remaining.  
2) Section - II Q.6 is compulsory. Attempt any one question from the remaining.  
3) Figures to the right indicate full marks.  
4) Assume suitable data if necessary and mention it clearly.

**SECTION – I**

- |            |                                       |  |           |
|------------|---------------------------------------|--|-----------|
| <b>Q.1</b> | <b>a)</b>                             | Explain Basic Terminology of fiber-reinforced composite material.        | <b>09</b> |
|            | <b>b)</b>                             | List out the applications of Composite Materials with suitable examples. | <b>08</b> |
| <b>Q.2</b> | <b>a)</b>                             | Explain Strengths of an Orthotropic Lamina.                              | <b>09</b> |
|            | <b>b)</b>                             | What is stiffness? Explain Elasticity Approach to Stiffness.             | <b>08</b> |
| <b>Q.3</b> | <b>Write Short Notes. (Any Three)</b> |  | <b>18</b> |
|            | <b>a)</b>                             | Classification and Characteristics of Composite Materials                |           |
|            | <b>b)</b>                             | Stress-Strain Relations for Anisotropic Materials                        |           |
|            | <b>c)</b>                             | Comparison of Approaches to Stiffness                                    |           |
|            | <b>d)</b>                             | Maximum Stress theory  |           |

**SECTION – II**

- |            |                                      |   |           |
|------------|--------------------------------------|---|-----------|
| <b>Q.4</b> | <b>a)</b>                            | Explain Classical Lamination Theory.                        | <b>09</b> |
|            | <b>b)</b>                            | Discuss Mechanics of Materials Approach to Strength.        | <b>08</b> |
| <b>Q.5</b> | <b>a)</b>                            | What is Buckling? Explain Governing Equations for Buckling. | <b>09</b> |
|            | <b>b)</b>                            | Explain Effect of discontinuity in laminates                | <b>08</b> |
| <b>Q.6</b> | <b>Write Short Note. (Any Three)</b> |   | <b>18</b> |
|            | <b>a)</b>                            | Inter-laminar stresses                                      |           |
|            | <b>b)</b>                            | Bending of laminated plates                                 |           |
|            | <b>c)</b>                            | Effect of discontinuity in laminates                        |           |
|            | <b>d)</b>                            | Design of composite structures                              |           |

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**F.Y. (M. Tech.) (Mechanical - Design Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Engineering Fracture Mechanics (MTDE209)**

Day & Date: Monday, 18-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:**
- 1) Section - I Q.2 is compulsory. Attempt any one question from the remaining.
  - 2) Section - II Q.5 is compulsory. Attempt any one question from the remaining.
  - 3) Figures to the right indicate full marks.
  - 4) Use of Scientific calculator is allowed.
  - 5) Assume suitable data if necessary & mention it clearly.

**SECTION – I**

- |            |   |           |
|------------|---|-----------|
| <b>Q.1</b> | <b>a)</b> Write short note on different modes of crack opening.   | <b>08</b> |
|            | <b>b)</b> Distinguish between the trans-granular and inter-granular fracture.   | <b>09</b> |
| <b>Q.2</b> | <b>a)</b> Write short note on resistance curve for brittle and ductile material.  | <b>05</b> |
|            | <b>b)</b> Explain the Griffith's energy balance approach to identify catastrophic failure of a material.  | <b>05</b> |
|            | <b>c)</b> Draw and enlist the Stress Intensity Factor (SIF) for different geometry.   | <b>08</b> |
| <b>Q.3</b> | <b>a)</b> Explain historical aspects of fracture mechanics.   | <b>07</b> |
|            | <b>b)</b> Find the energy release rate of specimen loaded in tensile testing machine. The thickness of specimen is 30 mm. The depth of cantilever is 15 mm and crack length is 60 mm. it is made of harden steel with young's modulus 200 GPa and crack is about to propagate 10 KN pulling load. | <b>10</b> |

**SECTION – II**

- |            |   |           |
|------------|---|-----------|
| <b>Q.4</b> | <b>a)</b> Define J- integral. Discuss the significance and limitations of J-integral as a fracture parameter. | <b>06</b> |
|            | <b>b)</b> Explain plastic zone shape according to Tresca and VonMises criteria.                               | <b>05</b> |
|            | <b>c)</b> Write short note on fatigue crack propagation laws (Paris law).                                     | <b>06</b> |

- Q.5** a) Explain S-N diagram related with fatigue mechanics. **07**  
b) Write short note on fatigue life calculations methods. **06**  
c) Write short note on J integral. **05**
- Q.6** a) Estimate the failure load under the uni-axial tension for a centre cracked panel of aluminum alloy of width  $W = 500$  mm and thickness  $B = 4$  mm for the following values of crack length  $2a = 20$  mm and  $2a = 10$  mm. Yield stress  $\sigma_y = 350$  MPa and fracture toughness  $K_{IC} = 70 \text{ MPa}\sqrt{\text{m}}$  **10**  
b) Write short note on Crack tip opening displacement (CTOD). **07**

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**F.Y. (M. Tech.) (Mechanical - Design Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Project Management (MTDE210)**

Day & Date: Monday, 18-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) Section - I Q.3 is compulsory. Attempt any one question from the remaining.  
2) Section - II Q.6 is compulsory. Attempt any one question from the remaining.  
3) Draw neat diagram wherever necessary.  
4) Make suitable assumptions wherever necessary and state them clearly.

**SECTION – I**

- Q.1** a) Define project management. Explain its objectives in the context of achieving strategic organizational goals. **09**  
b) Differentiate between CPM and PERT. For a given project network, explain how project duration and slack time can be calculated. **08**
- Q.2** a) Explain the project planning process in detail. How does effective planning contribute to project success? **09**  
b) Discuss various time estimation methods used in project management. Illustrate with examples. **08**
- Q.3 Write Short Notes. (Any Three)** **18**  
a) Importance of project management software in modern project execution  
b) Cost-time trade-off analysis  
c) Project Crashing  
d) Resource allocation and leveling in project management

**SECTION – II**

- Q.4** a) Define project cash flow. Explain the steps involved in preparing a project cash flow statement with a suitable example. **09**  
b) What is a time-cost trade-off in project management? Describe how it influences decision-making. **08**

- Q.5**
- a) Discuss the role of computers and software tools in project implementation and control. **09**
  - b) Define contract management. Explain its significance in the successful execution of projects. **08**
- Q.6 Write Short Notes. (Any Three)** **18**
- a) Distinctive features of managing Research & Development projects
  - b) High-Tech (Hi-Tech) projects and the risks associated
  - c) Software Engineering (SE) projects and their management challenges
  - d) Mega projects Management

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**F.Y. (M. Tech.) (Mechanical - Design Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Design for Manufacture and Assembly (MTDE211)**

Day & Date: Monday, 18-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:**
- 1) In Section -I, Q. No. is 3 is compulsory and attempt one question from the remaining.
  - 2) In Section -II, Q. No. is 6 is compulsory and attempt one question from the remaining.
  - 3) Figures to the right indicate full marks.
  - 4) Make suitable assumptions wherever necessary and state them clearly.
  - 5) Draw neat diagram wherever necessary.

**SECTION – I**

- |            |  |           |
|------------|--|-----------|
| <b>Q.1</b> | a) Discuss the concept of simplification by amalgamation and provide examples.               | <b>09</b> |
|            | b) Describe the evaluation methods used in assessing manufacturability.                      | <b>08</b> |
| <b>Q.2</b> | a) Discuss the importance of material choice in the context of manufacturability and design. | <b>09</b> |
|            | b) Explain the strategies that can be used to ensure the economy in machining design.        | <b>08</b> |
| <b>Q.3</b> | <b>Write short notes on. (Any Three)</b>   | <b>18</b> |
|            | a) Form design requirements for castings   |           |
|            | b) Feature tolerances significance in manufacturing  |           |
|            | c) Form Design of Forgings   |           |
|            | d) General design principles for manufacturability   |           |

**SECTION – II**

- |            |   |           |
|------------|---|-----------|
| <b>Q.4</b> | a) Discuss the process of identifying and modifying uneconomical casting designs.                                     | <b>09</b> |
|            | b) Explain the lifecycle assessment (LCA) method and its role in environmentally responsible design.                  | <b>08</b> |
| <b>Q.5</b> | a) Explain the role of group technology in the design and manufacturing of castings.                                  | <b>09</b> |
|            | b) Explain how energy efficiency can be incorporated into product design while adhering to regulations and standards. | <b>08</b> |

**Q.6 Write short notes on (Any Three)**

- a)** Computer applications into casting design processes
- b)** DFE Methods
- c)** Minimizing core requirements
- d)** Design for disassembly

<b>Seat No.</b>	
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**Set P**

**S.Y. (M. Tech.) (Mechanical – Design Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April – 2026  
Business Analytics (OE001A)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.

**SECTION - I**

- Q.1 Attempt the Following. (Any Five) 35**
- a) What do you mean by Business Analytics? Explain the relation of Business Analytics process.
  - b) What is Data Mining? Explain Terminology & Notation in Data Mining.
  - c) Explain Supervised and & Unsupervised Learning in data mining.
  - d) Explain in detail Business Analytics Process.
  - e) Define & explain Box plots. Histograms with example.
  - f) Explain Data Mining Process in Detail.
  - g) Describe Manipulations in data visualization.

**SECTION - II**

- Q.2 Attempt the Following. (Any Five) 35**
- a) What is Multiple Linear Regression & Explain Predictive modeling.
  - b) Explain feature selection for clustering in detail.
  - c) Describe K-means algorithm in detail.
  - d) Explain Classification Matrix.
  - e) Explain the method for Evaluating Predictive Performance in detail.
  - f) Describe the Regression Equation and Prediction.
  - g) What is Regression Tree? Explain advantages & Weakness of it.

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**S.Y. (M. Tech.) (Mechanical – Design Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Operation Research (OE001B)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

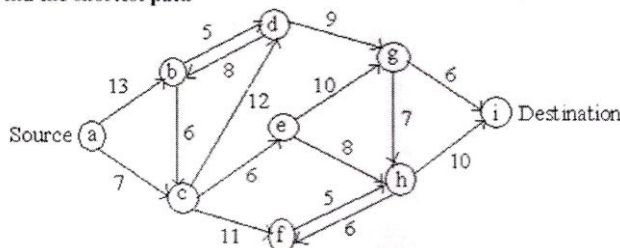
- Instructions:** 1) Q.1 and Q.5 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume suitable data necessary and mention if clearly.

**SECTION - I**

- Q.1** a) Explain different Linear Programming models. **09**  
b) Solve following LPP by Graphical method. **09**  
Minimize  $Z = 2y_1 + 3y_2$  s.t.  
constraints:  $y_1 + y_2 \geq 5, y_1 + 2y_2 \geq 6$   
 $y_1, y_2 \geq 0$
- Q.2** a) Explain Shadow Price- Sensitivity analysis. **09**  
b) Explain Monto-Carlo Simulation. **08**
- Q.3** a) Explain Structure of queuing system. **09**  
b) Explain Queuing Model - FIFO with suitable example. **08**

**SECTION - II**

- Q.4** a) Explain Price break model. **09**  
b) Explain Inventory management techniques. **08**
- Q.5** a) Explain Group replacement policy. **09**  
b) **Example 1**  
Find the shortest path **09**



- Q.6** a) Explain Cost optimization. **09**  
b) Explain Network crashing and its steps. **08**

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**Set P**

**S.Y. (M. Tech.) (Mechanical – Design Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Nonconventional Energy (OE001D)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

- Instructions:** 1) Q.1 and Q.4 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume necessary data if necessary.

**SECTION - I**

- Q.1 Solve Any Four. 20**
- a) Compare conventional and renewable energy sources based on their environmental impact.
  - b) Write a note on the growth of the energy sector in India.
  - c) What do you understand by energy conservation? Explain its various aspects.
  - d) Explain cogeneration and its role in improving energy utilization.
  - e) Explain the specifications of energy storage devices.
- Q.2 a) Draw a schematic diagram of a solar pond-based electric power plant with a cooling tower and explain its working. 07**
- b) What are the emerging new technologies for energy conservation and efficiency? 08**
- Q.3 a) Why is energy storage necessary? Explain two methods of energy storage. 07**
- b) Describe different types of solar thermal energy collectors and their applications. 08**

**SECTION - II**

- Q.4 Solve Any Four 20**
- a) Explain the fundamentals of Solar Cell technology.
  - b) What are the major advantages and disadvantages of a solar PV system?
  - c) Explain the different modes of power generation.
  - d) Explain gasification and its role in biomass energy production.
  - e) What is a Fuel cell and explain its classification in detail?

- Q.5 a)** What is the importance of MPPT in an SPV system? Explain various strategies used for the operation of an MPPT. **07**
- b)** What is the origin of biomass energy? What is its global potential? What is the average efficiency of photosynthetic conversion of solar energy into biomass? **08**
- Q.6 a)** Discuss the process of urban waste-to-energy conversion, highlighting its benefits and challenges in sustainable development. **07**
- b)** Discuss the role of hydrogen as an energy carrier in fuel cell technology. Highlight the challenges associated with its storage and utilization. **08**

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**S.Y. (M. Tech.) (Mechanical – Design Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Product Design and Development (OE001E)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

- Instructions:** 1) Q.No.3 and Q.No.6 are compulsory and solve any one question from remaining question from each section.  
3) Figures to the right indicate full marks.  
4) Make suitable assumptions if required.

**SECTION - I**

- Q.1** a) What are the stages of the product life cycle, and how do they influence product design and development? **09**  
b) Outline the steps in the product design process and discuss the importance of design analysis. **08**
- Q.2** a) What is functional analysis, and what are the key steps in the Functional Analysis System Technique (FAST)? **09**  
b) Define value engineering and explain its role in reducing costs while maintaining product quality. **08**
- Q.3 Write Short Notes. (Any Three)** **18**  
a) How is Computer-Aided Design (CAD) used in product design?  
b) What is robust design, and how does it improve product quality?  
c) What is meant by Design for X (DFX)? Give a few examples.  
d) What are the key principles behind robust design and how are they applied in product development?

**SECTION - II**

- Q.4** a) What are the key guidelines for Design for Manufacturing and Assembly (DFMA), and how do they simplify the manufacturing process? **08**  
b) Describe the ergonomic design process and the role of posture and movement in creating user-friendly products. **09**
- Q.5** a) Explain the concept and advantages of rapid prototyping in product development. **08**  
b) What is the importance of cost evaluation and life cycle analysis in making economic decisions for product design? **09**

**Q.6 Write Short Notes. (Any Three)****18**

- a)** What are ergonomics, and why are they important in product design?
- b)** What is rapid prototyping, and how does it help in product development?
- c)** What is life cycle analysis, and how is it used in product design?
- d)** 'What are the main steps in the Design for Six Sigma (DFSS) process?

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**F.Y. (M. Tech.) (Electronics Engineering) (Semester - I) (New)  
(CBCS) Examination: March/April – 2026  
Digital Design and Verification (MTEL101)**

Day & Date: Thursday, 30-04-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.

- Q.1 Attempt any TWO of the following. 14**
- a) Explain in brief randomization in system Verilog.
  - b) Explain the built-in data types of system Verilog with example.
  - c) Explain in brief the guidelines for choosing the storage type in System Verilog.
- Q.2 Draw and explain Booth's multiplier. 07**
- Q.3 Attempt following. 14**
- a) Write Verilog code for modeling JK Flip-flop. Also write the testbench for testing it.
  - b) Write Verilog code for modeling 2:4 decoder. Also write the testbench for testing it.

**SECTION - II**

- Q.4 Attempt following. 14**
- a) Explain following.
    - i) IP as RTL source code
    - ii) IP as an Encrypted source code
  - b) What are stuck at faults? Explain how to detect these faults with a suitable example.
- Q.5 Attempt any ONE of the following. 07**
- a) Write a short note on Electro migration.
  - b) Explain noise and crosstalk with respect to signal Integrity challenge.
- Q.6 Attempt following. 14**
- a) What are the different categories of FPGA structures? Explain any one of them.
  - b) Explain SRAM based FPGA in brief.

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**F.Y. (M. Tech.) (Electronics Engineering) (Semester - I) (New)  
(CBCS) Examination: March/April – 2026  
Advanced Digital Signal Processing (MTEL102)**

Day & Date: Saturday, 02-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All question are compulsory.  
2) Figures to the right indicate full marks.

**Q.2 Attempt Any Five.**

**35**

- a) Differentiate between FIR and IIR filters.
- b) What is Decimator and Interpolator? Explain Sampling rate conversion.
- c) Explain steps in designing IIR filter using BLT Method.
- d) Explain applications in Sub band coding.
- e) Explain wiener filtering and prediction.
- f) Explain steps in designing FIR filter using Windowing Method.

**Q.3 Attempt Any Five.**

**35**

- a) Explain recursive least square algorithm.
- b) Explain multirate DSP.
- c) How wavelets are used in Image processing?
- d) What is Joint Probability Distribution with properties.
- e) Explain minimum variance spectral estimation.
- f) Explain applications of DSP in Speech processing.

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**F.Y. (M. Tech.) (Electronics Engineering) (Semester - I) (New)  
(CBCS) Examination: March/April – 2026  
Voice and Data Networks (MTEL103)**

Day & Date: Monday, 04-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Assume suitable data wherever necessary.  
3) Draw neat sketches wherever necessary.

- Q.1 Answer following questions. 12**
- a) Explain Network design issues.
  - b) What are the voice traffic characteristics? Describe voice communication network briefly.
  - c) Explain link layer design adaptation and link layer protocols.
- Q.2 Answer the following questions. (Any Two) 12**
- a) Explain centralized and distributed approaches for network design.
  - b) Explain Circuit switching and packet switching. Which control signals are used in circuit switching?
  - c) What is Go\_Back\_N mechanism? What is the effect of long frames on its performance?
- Q.3 Answer following questions. 06**
- a) Explain different Network terminology. 06
  - b) What is the need of multiplexing in communication? Discuss statistical multiplexing. 05
- OR**
- b) Describe ARQ and Hybrid ARQ retransmission in details. 05
- Q.4 Answer the following questions. 12**
- a) Explain concept of routing in internet and end to end protocols.
  - b) What is congestion avoidance in TCP? Describe RED mechanism briefly.
  - c) Explain attacks and measures in network security.
- Q.5 Answer the following questions. (Any Two) 12**
- a) Explain slow start, fast retransmit /fast recovery in network.
  - b) Draw IPv4 header format and describe it in brief.
  - c) Explain authentication, integrity, key distribution and certification in network security.

**Q.6 Answer the following questions.**

**a) Explain the following terms: 06**

i) TCP and UDP

ii) Congestion control

**b) Write note on network calculus. 05**

**OR**

**b) Describe DES-data encryption standard in detail. 05**

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**F.Y. (M.Tech.) (Electronics Engineering) (Sem - I) (New) (CBCS)**  
**Examination: March/April – 2026**  
**Machine Learning© (MTEL104)**

Day & Date: Wednesday, 06-05-2026  
 Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All question are compulsory.  
 2) Figures to the right indicate full marks.

**SECTION - I**

- |            |           |  |           |
|------------|-----------|--|-----------|
| <b>Q.1</b> | <b>a)</b> | Explain Bayesian Linear regression with example in brief.          | <b>06</b> |
|            | <b>b)</b> | Explain Decision Tree with example in brief.                       | <b>06</b> |
| <b>Q.2</b> |           | Explain Supervised and Unsupervised learning with examples.        | <b>11</b> |
| <b>Q.3</b> |           | Explain Goals and Applications of machine learning in detail.      | <b>12</b> |
| <b>OR</b>  |           |  |           |
|            |           | Distinguish between supervised learning and unsupervised learning. | <b>12</b> |

**SECTION - II**

- |            |           |   |           |
|------------|-----------|---|-----------|
| <b>Q.4</b> | <b>a)</b> | Explain Support Vector Machines and its applications.       | <b>06</b> |
|            | <b>b)</b> | Explain key perspectives on machine learning in brief.      | <b>06</b> |
| <b>Q.5</b> | <b>a)</b> | Explain error backpropagation in brief.                     | <b>06</b> |
|            | <b>b)</b> | Explain where machine learning is headed next.              | <b>06</b> |
| <b>Q.6</b> |           | Explain deep neural networks and its applications in brief. | <b>11</b> |
| <b>OR</b>  |           |   |           |
|            |           | Distinguish between Machine learning and Deep learning.     | <b>11</b> |

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**F.Y. (M.Tech.) (Electronics Engineering) (Sem - I) (New) (CBCS)**  
**Examination: March/April – 2026**  
**Image and Video Processing (MTEL108)**

Day & Date: Thursday, 07-05-2026  
 Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All question are compulsory.  
 2) Figures to right indicate full marks.  
 3) Assume suitable data if required.

**SECTION - I**

- Q.1 Solve Any Four Questions. 20**
- a) Explain 2D orthogonal and unitary transforms.
  - b) Explain basic concepts of digital video.
  - c) Explain point processing techniques.
  - d) Explain Wavelet transform.
  - e) Write short note on sampling in 2 & 3-dimension image.
- Q.2 Solve the following Questions. 08**
- a) Explain the following
    - 1) Inverse & Wiener filtering
    - 2) Multi frame restoration
  - b) Explain frame rate conversion and deinterlacing. 07

**SECTION - II**

- Q.3 Solve Any Four Questions. 20**
- a) Explain any two method of edge detection.
  - b) Explain lossy image compression.
  - c) Explain spatiotemporal change detection.
  - d) Explain details of special feature extraction.
  - e) Write short note on video quality assessment.
- Q.4 Solve the following Questions. 08**
- a) Explain the following:
    - 1) Spatial feature extraction
    - 2) Image segmentation
  - b) Explain image segmentation and classification techniques. 07

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**F.Y. (M.Tech.) (Electronics Engineering) (Sem - II) (New) (CBCS)**  
**Examination: March/April – 2026**  
**Research Methodology and IPR© (MTEL201)**

Day & Date: Friday, 08-05-2026  
 Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
 2) Figures to right indicate full marks.

**SECTION – I**

- Q.1 Answer the following Questions. 12**
- a) Discuss the research design. What are its features?
  - b) Explain ethical issues in research.
  - c) Explain objective of research.
- Q.2 Answer Any Three from the following Questions. 18**
- a) Explain basic principle of experimental design.
  - b) Explain need of Research Report writing.
  - c) Explain e-research in detail.
  - d) Write a comprehensive note on the “Writing Research Proposal (Synopsis)”.
- Q.3 Explain characteristics of good abstract. 05**

**SECTION – II**

- Q.4 Write short notes on. 12**
- a) Need of simulation in research
  - b) Copyright-IPR
  - c) Scope of Patent rights
- Q.5 Answer Any Three from the following Questions. 18**
- a) Explain need and techniques of mathematical modelling.
  - b) Briefly explain procedure for grants of patents.
  - c) Explain in brief “Filing Copyright”.
  - d) Explain trademarks for identification of products or services.
- Q.6 Explain Monte Carlo Simulation. 05**

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**Set P**

**F.Y. (M. Tech.) (Electronics Engineering) (Sem - II) (New) (CBCS)  
Examination: March/April – 2026  
Communication Buses & Interfaces (MTEL202)**

Day & Date: Monday, 11-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All question are compulsory.  
2) Figure to the right indicates full marks.

**Q.1 Attempt Any Five.**

**35**

- a) Explain in short I<sup>2</sup>C with its limitations and applications.
- b) Explain serial communication formats.
- c) Differentiate between RS232 and RS 485.
- d) Explain RS485 with its pin configuration.
- e) Explain in short SPI with its limitations and applications.
- f) Explain in short CAN architecture.

**Q.2 Attempt Any Five.**

**35**

- a) Write short note on PCI.
- b) Explain in short configuration space.
- c) What is data streaming serial communication protocol.
- d) Explain descriptor types and contents.
- e) Explain hardware protocols and applications.
- f) Explain PCI Express.

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**F.Y. (M. Tech.) (Electronics Engineering) (Sem - II) (New) (CBCS)  
Examination: March/April – 2026  
Advanced IOT (MTEL203)**

Day & Date: Wednesday, 13-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All questions are compulsory.  
2) Assume suitable data wherever necessary.  
3) Draw neat sketches wherever necessary.

- Q.1 Attempt Any One question. 10**  
a) Explain protocols to support IoT communications.  
b) Explain edge resource pooling and caching in wireless sensor networks.
- Q.2 Explain Smart cities and revolution of IoT. 10**
- Q.3 Attempt Any One question. 15**  
a) Explain IoT networks PAN, LAN and WAN.  
b) Write the difference between IoT vs M2M? Explain M2M and peer networking concepts.
- Q.4 Attempt Any One question. 10**  
a) Discuss smart objects as the building blocks of IoT.  
b) Explain the concept of security and legal considerations in IoT.
- Q.5 Explain the use of IoT in the smart grid and healthcare sectors. 10**
- Q.6 Attempt Any One question. 15**  
a) Describe the open-source hardware and embedded system platforms used for IoT. Write a note on I/O drivers used in IoT Platforms.  
b) Explain RIoT and Contiki operating systems.

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**Set P**

**F.Y. (M.Tech.) (Electronics Engineering) (Sem - II) (New) (CBCS)  
Examination: March/April – 2026  
PLC, SCADA and Distributed Control Systems (MTEL204)**

Day & Date: Friday, 15-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All question are compulsory.  
2) Figures to right indicate full marks.

**SECTION - I**

- Q.1** a) Draw architecture of PLC and explain. **06**  
b) What are discrete I/O modules for PLC? **06**
- Q.2** What are the expectations of automation? What are applications of automation? Explain any one application with block schematic. **12**
- Q.3** a) Explain PLC counters in detail. **11**  
**OR**  
b) Explain PLC timers in detail.

**SECTION - II**

- Q.4** a) Explain Human Machine Interface (HMI) used in DCS. **06**  
b) Explain Data Highway used in DCS. **06**
- Q.5** a) What are functions of MTU and RTU used in SCADA? **06**  
b) What are protocols used for communication in SCADA? **06**
- Q.6** a) Explain automation of bottle filling plant using PLC. **11**  
**OR**  
b) Explain material flow using PLC.

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**F.Y. (M. Tech.) (Electronics Engineering) (Sem - II) (New) (CBCS)  
Examination: March/April – 2026  
VLSI in Signal Processing (MTEL208)**

Day & Date: Monday, 18-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

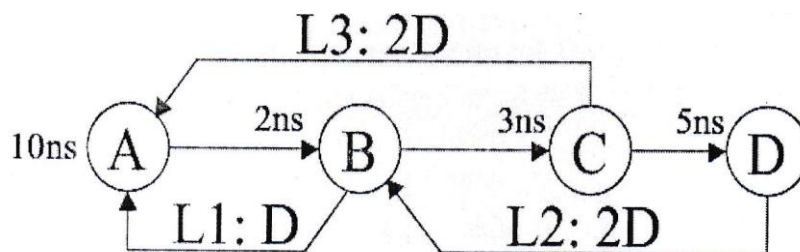
- Instructions:** 1) All question are compulsory.  
2) Figures to the right indicate full marks.  
3) Assume suitable data required.

**SECTION - I**

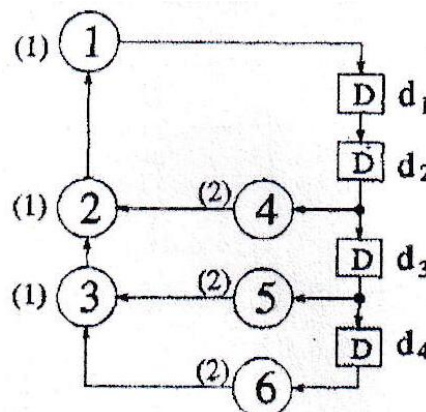
**Q.1 Solve any Two:**

**14**

- a) Compute the Loop Bound and Iteration Bound for the following loops:



- b) Explain the advantages of pipelining & parallel processing on account of power consumption and justify the same.  
c) For DFG shown below find iteration bound using MCM algorithm.



**Q.2 Solve (Any Two)**

14

- a) In the SFG shown in fig (a) the computation time for each node is assumed to be 1u.t.
- 1) Calculate critical path computation time.
  - 2) The critical path has been reduced to 2 u.t by inserting 3 extra delay element as shown in fig. (b) Is this valid pipelining if not obtain an appropriate pipelining ckt with critical path of 2 u.t.

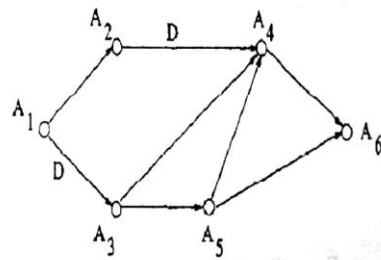


Fig. a

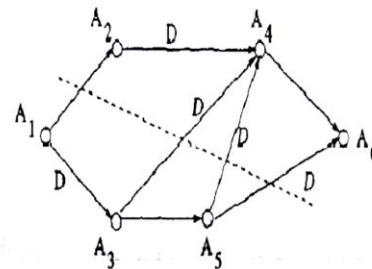


Fig. b

- b) Explain the concept of pipelining with the help of example.
- c) What is retiming of DFG? Explain properties of retiming

**Q.3 Write a note on.**

07

- a) LPM algorithm
- b) Parallel Processing

**SECTION - II**

**Q.4 Solve (Any Two)**

14

- a) State the properties of unfolding. Explain unfolding algorithm.
- b) Draw the constraint graph & use it to determine if the following system inequalities have a solution & find the solution if one exists using Floyd Warshall algorithm.  
 $r1 - r2 \leq 0, r3 - r1 \leq 5, r4 - r1 \leq 4, r4 - r3 \leq -1, r3 - r2 \leq 2.$
- c) Design B1 filter for FIR systolic array.

**Q.5 Solve (Any Two)**

14

- a) Write a note on systolic design for matrix-matrix multiplication.
- b) Draw the circular life time chart for following with period  $N = 9$ :

Variable Name	Tin
a	0
b	1
c	2
d	3
e	4
f	5
g	6
h	7
i	8

- c) Explain parallel multipliers with modified booth recoding.

**Q.6 Write a note on**

**07**

- a) Parallel carry ripple array multipliers.
- b) Parallel carry save array multipliers.

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**Set P**

**S.Y. (M. Tech.) (Electronics Engineering) (Sem - III) (New) (CBCS)  
Examination: March/April – 2026  
Business Analytics (OE001A)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.

**SECTION - I**

- Q.1 Attempt the Following. (Any Five) 35**
- a) What do you mean by Business Analytics? Explain the relation of Business Analytics process.
  - b) What is Data Mining? Explain Terminology & Notation in Data Mining.
  - c) Explain Supervised and & Unsupervised Learning in data mining.
  - d) Explain in detail Business Analytics Process.
  - e) Define & explain Box plots. Histograms with example.
  - f) Explain Data Mining Process in Detail.
  - g) Describe Manipulations in data visualization.

**SECTION - II**

- Q.2 Attempt the Following. (Any Five) 35**
- a) What is Multiple Linear Regression & Explain Predictive modeling.
  - b) Explain feature selection for clustering in detail.
  - c) Describe K-means algorithm in detail.
  - d) Explain Classification Matrix.
  - e) Explain the method for Evaluating Predictive Performance in detail.
  - f) Describe the Regression Equation and Prediction.
  - g) What is Regression Tree? Explain advantages & Weakness of it.

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**S.Y. (M. Tech.) (Electronics Engineering) (Sem - III) (New) (CBCS)  
Examination: March/April - 2026  
Operation Research (OE001B)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

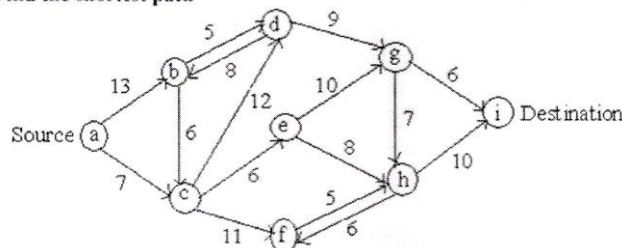
- Instructions:** 1) Q.1 and Q.5 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume suitable data necessary and mention if clearly.

**SECTION - I**

- Q.1** a) Explain different Linear Programming models. **09**  
b) Solve following LPP by Graphical method. **09**  
Minimize  $Z = 2y_1 + 3y_2$  s.t.  
constraints:  $y_1 + y_2 \geq 5, y_1 + 2y_2 \geq 6$   
 $y_1, y_2 \geq 0$
- Q.2** a) Explain Shadow Price- Sensitivity analysis. **09**  
b) Explain Monto-Carlo Simulation. **08**
- Q.3** a) Explain Structure of queuing system. **09**  
b) Explain Queuing Model - FIFO with suitable example. **08**

**SECTION - II**

- Q.4** a) Explain Price break model. **09**  
b) Explain Inventory management techniques. **08**
- Q.5** a) Explain Group replacement policy. **09**  
b) **Example 1**  
Find the shortest path **09**



- Q.6** a) Explain Cost optimization. **09**  
b) Explain Network crashing and its steps. **08**

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**Set P**

**S.Y. (M. Tech.) (Electronics Engineering) (Sem - III) (New) (CBCS)  
Examination: March/April - 2026  
Nonconventional Energy (OE001D)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

- Instructions:** 1) Q.1 and Q.4 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume necessary data if necessary.

**SECTION - I**

- Q.1 Solve Any Four. 20**
- a) Compare conventional and renewable energy sources based on their environmental impact.
  - b) Write a note on the growth of the energy sector in India.
  - c) What do you understand by energy conservation? Explain its various aspects.
  - d) Explain cogeneration and its role in improving energy utilization.
  - e) Explain the specifications of energy storage devices.
- Q.2 a) Draw a schematic diagram of a solar pond-based electric power plant with a cooling tower and explain its working. 07**
- b) What are the emerging new technologies for energy conservation and efficiency? 08**
- Q.3 a) Why is energy storage necessary? Explain two methods of energy storage. 07**
- b) Describe different types of solar thermal energy collectors and their applications. 08**

**SECTION - II**

- Q.4 Solve Any Four 20**
- a) Explain the fundamentals of Solar Cell technology.
  - b) What are the major advantages and disadvantages of a solar PV system?
  - c) Explain the different modes of power generation.
  - d) Explain gasification and its role in biomass energy production.
  - e) What is a Fuel cell and explain its classification in detail?

- Q.5 a)** What is the importance of MPPT in an SPV system? Explain various strategies used for the operation of an MPPT. **07**
- b)** What is the origin of biomass energy? What is its global potential? What is the average efficiency of photosynthetic conversion of solar energy into biomass? **08**
- Q.6 a)** Discuss the process of urban waste-to-energy conversion, highlighting its benefits and challenges in sustainable development. **07**
- b)** Discuss the role of hydrogen as an energy carrier in fuel cell technology. Highlight the challenges associated with its storage and utilization. **08**

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**S.Y. (M. Tech.) (Electronics Engineering) (Sem - III) (New) (CBCS)**  
**Examination: March/April - 2026**  
**Product Design and Development (OE001E)**

Day & Date: Monday, 11-05-2026  
 Time: 03:00 PM To 06:00 PM

Max. Marks: 70

- Instructions:** 1) Q.No.3 and Q.No.6 are compulsory and solve any one question from remaining question from each section.  
 2) Figures to the right indicate full marks.  
 3) Figures to the right indicate full marks.  
 4) Make suitable assumptions if required.

**SECTION - I**

- Q.1** a) What are the stages of the product life cycle, and how do they influence product design and development? **09**  
 b) Outline the steps in the product design process and discuss the importance of design analysis. **08**
- Q.2** a) What is functional analysis, and what are the key steps in the Functional Analysis System Technique (FAST)? **09**  
 b) Define value engineering and explain its role in reducing costs while maintaining product quality. **08**
- Q.3 Write Short Notes. (Any Three)** **18**  
 a) How is Computer-Aided Design (CAD) used in product design?  
 b) What is robust design, and how does it improve product quality?  
 c) What is meant by Design for X (DFX)? Give a few examples.  
 d) What are the key principles behind robust design and how are they applied in product development?

**SECTION - II**

- Q.4** a) What are the key guidelines for Design for Manufacturing and Assembly (DFMA), and how do they simplify the manufacturing process? **08**  
 b) Describe the ergonomic design process and the role of posture and movement in creating user-friendly products. **09**
- Q.5** a) Explain the concept and advantages of rapid prototyping in product development. **08**  
 b) What is the importance of cost evaluation and life cycle analysis in making economic decisions for product design? **09**

**Q.6 Write Short Notes. (Any Three)****18**

- a) What are ergonomics, and why are they important in product design?
- b) What is rapid prototyping, and how does it help in product development?
- c) What is life cycle analysis, and how is it used in product design?
- d) 'What are the main steps in the Design for Six Sigma (DFSS) process?

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**F.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Semester - I) (New) (CBCS) Examination: March/April – 2026  
Research Methodology & IPR (MTETC101)**

Day & Date: Thursday, 30-04-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All question are compulsory.  
2) Figures to the right indicate full marks.

**SECTION – I**

**Q.1 Solve Any Four of the following.** **20**

- a) Discuss the steps involved in the research process with a suitable flowchart.
- b) What are different types of research? Briefly explain each type with suitable example.
- c) Discuss the key components of the scientific method used in research.
- d) List and explain the different categories of research designs.
- e) Discuss the key concepts related to research design such as variables, hypothesis, and research questions.

**Q.2 Solve Any Two of the following.** **15**

- a) What are the different types of problem solving?
- b) What is the Delphi method, and how does it work?
- c) Based on case study, explain any one type of problem solving for any agriculture-based research problem.

**SECTION – II**

**Q.3 Solve Any Four of the following.** **20**

- a) Explain the difference between patents, designs, and copyrights. How do these protect intellectual property? Provide relevant examples.
- b) Elaborate procedure for grants of patents.
- c) What are the major challenges in the patenting process?
- d) Explain patent licensing and technology transfer in relation to patents.
- e) What is geographical indication (GI), and how does it differ from a patent? Explain the importance of GI Protection.

**Q.4 Solve Any Two of the following.** **15**

- a) Discuss IPR in the context of biological systems.
- b) Explain the administration of the patent system in India. How does it accommodate traditional knowledge?
- c) Discuss traditional knowledge system.

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**F.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Semester - I) (New) (CBCS) Examination: March/April – 2026  
Antenna Theory & Techniques (MTETC102)**

Day & Date: Saturday, 02-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All question are compulsory.  
2) Figures to the right indicate full marks.

**SECTION - I**

- Q.1 Solve the questions. (Any Two) 10**
- Derive an array factor equation for linear array of n-isotropic point sources.
  - Explain the radiation mechanism of a microstrip antenna.
  - Explain Broad side array radiation pattern with mathematical expression.
- Q.2 Solve the questions. (Any One) 07**
- Derive the expression for Electric field intensity at a point due to two Non Isotropic Sources which has equal Amplitude and in phase to each other.
  - Explain transmission line model for the analysis of micro strip antenna.
- Q.3 Solve questions. (Any Three) 18**
- Given a linear, broadside, uniform array of 10 isotropic elements with a separation of  $\lambda/4$  between the elements, find the directivity of the array.
  - Derive an equation for Array factor for array of two isotropic point source of Equal amplitude and spacing.
  - Explain End fire Array radiation pattern with mathematical expression.
  - Explain different feeding mechanism of microstrip antenna.

**SECTION - II**

- Q.4 Solve the questions. (Any Two) 10**
- Explain about substrate characteristics for Microstrip antenna.
  - Explain about various micro strip antenna configurations.
  - Explain desirable substrate characteristics for antenna fabrication.

**Q.5 Solve the questions. (Any One) 07**

- a) Explain Linear array design with Micro strip patches using series feed Arrays.
- b) Explain about antenna design consideration and its application for
  - i) Bluetooth
  - ii) WLAN (Wi-Fi)
  - iii) Zigbee

**Q.6 Solve the questions. (Any Three) 18**

- a) Explain the effects of substrate parameters on Bandwidth.
- b) Write a note on semiconductor substrate.
- c) Explain about antenna design consideration and its application for Satellite communication.
- d) Explain series feed excitation method for microstrip antenna.

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**F.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Semester - I) (New) (CBCS) Examination: March/April – 2026  
Advanced Embedded System (MTETC103)**

Day & Date: Monday, 04-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.  
3) Use of non programmable calculator is allowed.  
4) Assume necessary data if necessary.

### SECTION - I

- Q.1 Solve Any Two. 20**
- a) Draw and explain register structure of ARM 11.
  - b) Explain Pipeline stages, Debug and programming support from ARM processors.
  - c) Explain the features of ARM 11 MP core processor with the help of block diagram.
- Q.2 Solve Any Two. 14**
- a) Describe Instruction length, Data types, and Memory formats in MP core system.
  - b) Write a note on embedded system development life cycle with block diagram.
  - c) Describe Power management and Debug programming support system in MP11 CPU.

### SECTION - II

- Q.3 Solve Any Two. 20**
- a) Explain Mutex management and Semaphore management.
  - b) What is real time OS? Describe various functions of it.
  - c) What are different software development tools?
- Q.4 Solve Any Two. 16**
- a) Explain Task scheduling in RTOS.
  - b) Whether Raspberry Pi consists of inbuilt ADC? How we are able to interface analog output with Raspberry Pi? Describe functions of GPIO pins of Raspberry Pi board. State types of representation of GPIO in programming.
  - c) Draw connection diagram and write a code to interface LCD (16×2) with Raspberry Pi to display "GOD DAY".

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**F.Y. (M.Tech.) (Electronics & Telecommunication Engineering)  
(Sem - I) (New) (CBCS) Examination: March/April – 2026  
Soft Computing Methods (MTETC106)**

Day & Date: Wednesday, 06-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicates full marks.  
3) Use of non-programmable calculator is allowed.  
4) Assume necessary data if necessary.

**SECTION - I**

**Q.1 Solve Any Four.**

**20**

- What is union in Fuzzy set operation and intersection in Fuzzy operation?
- Explain fuzzification and defuzzification.
- Using your own intuition and your own definitions of the universe of discourse, plot fuzzy membership functions for the following variables: Age of people
  - Very young
  - Young
  - Middle-aged
  - Old
  - Veryold
- Consider fuzzy relations
 
$$R = \begin{bmatrix} 0.4 & 0.6 \\ 0.8 & 0.7 \end{bmatrix} \quad S = \begin{bmatrix} 0.80 & 0.50 & 0.4 \\ 0.90 & 0.30 & 0.7 \end{bmatrix}$$
 Find the relation  $T = R \circ S$  using max-min
- What is Roulette wheel selection in GA? Explain in detail.

**Q.2 Solve Any Two.**

**15**

- How would you apply different methods of developing membership functions in practical scenarios like customer satisfaction or temperature control?
- What are the basic Genetic Algorithm Operators/state the operators of Genetic Algorithm?
- We will define inputs on the universe  $X = [0, 50, 100, 150, 200]$  femtotesla & outputs on the universe  $Y = [0, 50, 100, 150, 200]$  femtotesla. We will define two fuzzy sets, two different stimuli, on the universe  $X$ .  $W = \text{weak stimulus} = \left\{ \frac{1}{0} + \frac{0.4}{50} + \frac{0.7}{100} + \frac{0.6}{150} + \frac{0}{200} \right\} \subset X$   
 $M = \text{medium stimulus} = \left\{ \frac{0.4}{0} + \frac{0.8}{50} + \frac{1}{100} + \frac{0.4}{150} + \frac{0}{200} \right\} \subset X$   
& one fuzzy set on the output universe  $Y$ ,

$$S = \text{severe response} = \left\{ \frac{1}{0} + \frac{0.9}{50} + \frac{0.3}{100} + \frac{0.2}{150} + \frac{0}{200} \right\} \subset Y$$

Construct the preposition: If “weak stimulus” THEN “not severe response” using fuzzy implication?

**SECTION - II**

**Q.3 Solve Any Four.**

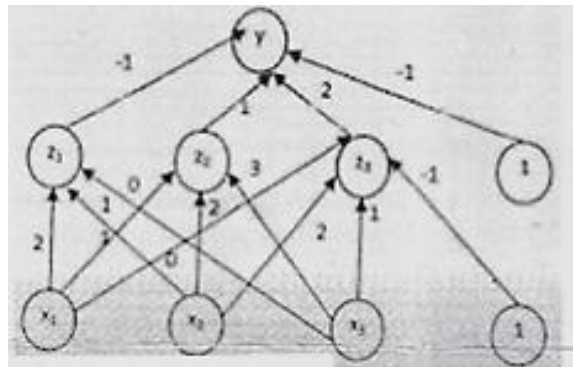
**20**

- a) Distinguish between artificial neuron & biological neuron.
- b) How would you apply the McCulloch-Pitts model of an Artificial Neural Network to solve a basic classification problem? Provide an example.
- c) What is Neural Network Architecture? Give its types and Explain them.
- d) Explain in detail about Deep Learning.
- e) Draw a 3-5-1 artificial neural network.

**Q.4 Solve Any Two.**

**15**

- a) Using the Back-propagation training algorithm, find the new weights when illustrated in below figure is presented the input pattern [0.6.0.8.0] and the target output is 0.9 use learning rate  $\alpha = 0.3$  and use binary sigmoid activation function.



- b) What is meant by learning? Give types of learning with examples.
- c) How would you implement the architecture of a multilayer feedforward neural network to classify handwritten digits? Explain the process and describe how each layer contributes to the classification task.

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**F.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Sem - II) (New) (CBCS) Examination: March/April – 2026  
RF & Microwave Engineering (MTETC202)**

Day & Date: Monday, 11-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All question are compulsory.  
2) Figure to the right indicates full marks.  
3) Assume suitable data if required.

**SECTION - I**

- Q.1 Solve any two questions. 10**
- Define S-parameters. Explain S parameters from SPICE analysis.
  - Design a resistive tee network using ABCD Parameters.
  - Define and Derive expressions for two port power gains.
- Q.2 Solve any one question. 07**
- Explain the working principal of Tunnel diode and BARITT diode.
  - The S parameters for the HP HFET-102 GaAs FET at 2 GHz with a bias voltage of  $V_{gs} = 0$  are given as follow ( $Z_0 = 50 \text{ Ohm}$ ):  
 $S_{11} = 0.894 \angle -60.6^\circ, S_{21} = 3.122 \angle 123.6^\circ, S_{12} = 0.020 \angle 62.4^\circ, S_{22} = 0.781 \angle -27.6^\circ$   
Determine the stability of this transistor using the K- $\Delta$  test and the  $\mu$  test, and plot the Stability circles on the Smith Chart.
- Q.3 Attempt any three questions. 18**
- Explain a balanced amplifier using  $90^\circ$  hybrid couplers.
  - Explain about different diodes like TRAPAT and IMPATT diodes.
  - Derive the equations for constant-noise figure circles and show how they are used in transistor amplifier design.
  - Explain in brief types of lossless feedback amplifier.
  - Explain a balanced amplifier using  $90^\circ$  hybrid couplers.

**SECTION - II**

- Q.4 Solve any two questions. 10**
- Explain how transistor model is used for producing the negative resistance in the design of two port oscillator.
  - Draw oscillator design flowchart and explain in brief.
  - Explain the process of filter design by image parameter method.

- Q.5 Solve any one question.** **07**
- a) Explain nonlinear active model for oscillator.
  - b) List MMIC fabrication Techniques and explain.
- Q.6 Attempt any three questions.** **18**
- a) Write a note on Richards's transformation for filter implementation.
  - b) Explain the characteristics of ideal substrate material and ideal conductor material used for the manufacturing of monolithic microwave integrated circuits.
  - c) Explain the characteristics of material used for the manufacturing of monolithic microwave integrated circuits.
  - d) Explain kuroda's identity.

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**F.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Sem - II) (New) (CBCS) Examination: March/April – 2026  
Advanced IoT (MTETC203)**

Day & Date: Wednesday, 13-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All question are compulsory.  
2) Figure to the right indicates full marks.  
3) Use of non-programmable calculator is allowed.  
4) Assume suitable data if necessary.

**SECTION - I**

- Q.1 Solve Any Two.** **20**
- a) Design a circuit with C code to turn on LED when switch is pressed using LPC1768 microcontroller. State features of LPC1768.
  - b) Draw block diagram of IOT enabled systems. Explain major blocks in details
  - c) Describe Memory mapping structure of Cortex M 3 in detail.
- Q.2 Solve Any Two.** **14**
- a) What are different types of Instructions of ARM CORTEX processor? Explain with the help of its examples.
  - b) What is IOT? Describe industrial IOT with examples in detail used for fourth industrial revolution.
  - c) Explain LEAN production system in detail. How IoT will improve production quality?

**Section – II**

- Q.3 Solve Any Two** **20**
- a) Describe architecture of Zigbee. State characteristics, limitations and applications of Zigbee.
  - b) Explain COAP Transactions, COAP Methods and COAP features in detail.
  - c) Describe Wi-Fi Write a note on Bluetooth Low Energy (BLE).
- Q.4 Solve Any Two.** **16**
- a) Explain costing structure of IoT cloud for IoT services and performance matrices of Cloud platforms in IoT.
  - b) Compare CoAP with MQTT. State applications of MQTT.
  - c) Describe Serial communication supported by Cortex M-3.

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**S.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Sem - III) (New) (CBCS) Examination: March/April – 2026  
Business Analytics (OE001A)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.

**SECTION - I**

- Q.1 Attempt the Following. (Any Five) 35**
- a) What do you mean by Business Analytics? Explain the relation of Business Analytics process.
  - b) What is Data Mining? Explain Terminology & Notation in Data Mining.
  - c) Explain Supervised and & Unsupervised Learning in data mining.
  - d) Explain in detail Business Analytics Process.
  - e) Define & explain Box plots. Histograms with example.
  - f) Explain Data Mining Process in Detail.
  - g) Describe Manipulations in data visualization.

**SECTION - II**

- Q.2 Attempt the Following. (Any Five) 35**
- a) What is Multiple Linear Regression & Explain Predictive modeling.
  - b) Explain feature selection for clustering in detail.
  - c) Describe K-means algorithm in detail.
  - d) Explain Classification Matrix.
  - e) Explain the method for Evaluating Predictive Performance in detail.
  - f) Describe the Regression Equation and Prediction.
  - g) What is Regression Tree? Explain advantages & Weakness of it.

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**S.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Sem - III) (New) (CBCS) Examination: March/April - 2026  
Operation Research (OE001B)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

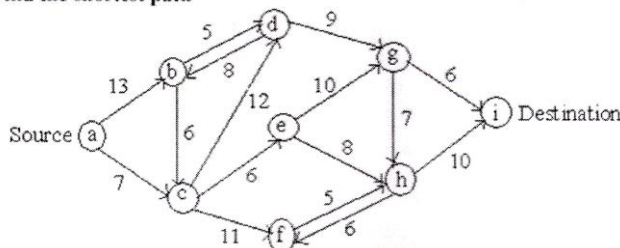
- Instructions:** 1) Q.1 and Q.5 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume suitable data necessary and mention if clearly.

**SECTION - I**

- Q.1** a) Explain different Linear Programming models. **09**  
b) Solve following LPP by Graphical method. **09**  
Minimize  $Z = 2y_1 + 3y_2$  s.t.  
constraints:  $y_1 + y_2 \geq 5$ ,  $y_1 + 2y_2 \geq 6$   
 $y_1, y_2 \geq 0$
- Q.2** a) Explain Shadow Price- Sensitivity analysis. **09**  
b) Explain Monto-Carlo Simulation. **08**
- Q.3** a) Explain Structure of queuing system. **09**  
b) Explain Queuing Model - FIFO with suitable example. **08**

**SECTION - II**

- Q.4** a) Explain Price break model. **09**  
b) Explain Inventory management techniques. **08**
- Q.5** a) Explain Group replacement policy. **09**  
b) **Example 1**  
Find the shortest path **09**



- Q.6** a) Explain Cost optimization. **09**  
b) Explain Network crashing and its steps. **08**

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**Set P**

**S.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Sem - III) (New) (CBCS) Examination: March/April - 2026  
Nonconventional Energy (OE001D)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

- Instructions:** 1) Q.1 and Q.4 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume necessary data if necessary.

**SECTION - I**

- Q.1 Solve Any Four. 20**
- a) Compare conventional and renewable energy sources based on their environmental impact.
  - b) Write a note on the growth of the energy sector in India.
  - c) What do you understand by energy conservation? Explain its various aspects.
  - d) Explain cogeneration and its role in improving energy utilization.
  - e) Explain the specifications of energy storage devices.
- Q.2 a) Draw a schematic diagram of a solar pond-based electric power plant with a cooling tower and explain its working. 07**
- b) What are the emerging new technologies for energy conservation and efficiency? 08**
- Q.3 a) Why is energy storage necessary? Explain two methods of energy storage. 07**
- b) Describe different types of solar thermal energy collectors and their applications. 08**

**SECTION - II**

- Q.4 Solve Any Four 20**
- a) Explain the fundamentals of Solar Cell technology.
  - b) What are the major advantages and disadvantages of a solar PV system?
  - c) Explain the different modes of power generation.
  - d) Explain gasification and its role in biomass energy production.
  - e) What is a Fuel cell and explain its classification in detail?

- Q.5 a)** What is the importance of MPPT in an SPV system? Explain various strategies used for the operation of an MPPT. **07**
- b)** What is the origin of biomass energy? What is its global potential? **08**  
What is the average efficiency of photosynthetic conversion of solar energy into biomass?
- Q.6 a)** Discuss the process of urban waste-to-energy conversion, highlighting its benefits and challenges in sustainable development. **07**
- b)** Discuss the role of hydrogen as an energy carrier in fuel cell technology. Highlight the challenges associated with its storage and utilization. **08**

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**S.Y. (M. Tech.) (Electronics & Telecommunication Engineering)  
(Sem - III) (New) (CBCS) Examination: March/April - 2026  
Product Design and Development (OE001E)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

- Instructions:** 1) Q.No.3 and Q.No.6 are compulsory and solve any one question from remaining question from each section.  
2) Figures to the right indicate full marks.  
3) Figures to the right indicate full marks.  
4) Make suitable assumptions if required.

**SECTION - I**

- Q.1** a) What are the stages of the product life cycle, and how do they influence product design and development? **09**  
b) Outline the steps in the product design process and discuss the importance of design analysis. **08**
- Q.2** a) What is functional analysis, and what are the key steps in the Functional Analysis System Technique (FAST)? **09**  
b) Define value engineering and explain its role in reducing costs while maintaining product quality. **08**
- Q.3 Write Short Notes. (Any Three)** **18**  
a) How is Computer-Aided Design (CAD) used in product design?  
b) What is robust design, and how does it improve product quality?  
c) What is meant by Design for X (DFX)? Give a few examples.  
d) What are the key principles behind robust design and how are they applied in product development?

**SECTION - II**

- Q.4** a) What are the key guidelines for Design for Manufacturing and Assembly (DFMA), and how do they simplify the manufacturing process? **08**  
b) Describe the ergonomic design process and the role of posture and movement in creating user-friendly products. **09**
- Q.5** a) Explain the concept and advantages of rapid prototyping in product development. **08**  
b) What is the importance of cost evaluation and life cycle analysis in making economic decisions for product design? **09**

**Q.6 Write Short Notes. (Any Three)****18**

- a)** What are ergonomics, and why are they important in product design?
- b)** What is rapid prototyping, and how does it help in product development?
- c)** What is life cycle analysis, and how is it used in product design?
- d)** 'What are the main steps in the Design for Six Sigma (DFSS) process?

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**F.Y. (M. Tech.) (Computer Science & Engineering) (Semester - I)  
(New) (CBCS) Examination: March/April – 2026  
Applied Algorithms (MTCSE101)**

Day & Date: Thursday, 30-04-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All question are compulsory.  
2) Figures to the right indicate full marks.

**SECTION – I**

- Q.1 Answer both questions. 15**
- What are asymptotic efficiency classes? Explain the concepts of Big O, Big Omega, and Big Theta with examples.
  - Explain the substitution method and master method. Highlight their advantages, limitations.
- Q.2 Answer Any One question. 10**
- Explain Kruskal's method using suitable example.
  - Explain Dijkstra's algorithm for the graph and analyze its time complexity.
- Q.3 Answer Any One question. 10**
- Explain the Longest Common Subsequence (LCS) problem with a suitable example. Also describe the algorithm and its complexity.
  - Explain Floyd-Warshall algorithm with the help of suitable example.

**SECTION – II**

- Q.4 Answer both questions. 15**
- Describe in detail the construction of a convex hull using Graham Scan and Jarvis March algorithms.
  - Explain the basic properties of line segments and intersection of lines. Also explain the Closest Pair of Points problem using divide and conquer approach.

**Q.5 Answer Any One question. 10**

- a) Describe approximation approaches for the Vertex Cover problem and Subset-Sum problem with suitable examples and time complexity analysis.
- b) Explain the concept of NP-Completeness in detail. Define classes P, NP, NP-hard, and NP-complete.

**Q.6 Answer Any One question. 10**

- a) Explain the basic number-theoretic concepts used in algorithms, including the Greatest Common Divisor (GCD).
- b) Explain Monte Carlo and Las Vegas algorithms with suitable examples and analyze their performance.

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**F.Y. (M. Tech.) (Computer Science & Engineering) (Semester - I)  
(New) (CBCS) Examination: March/April – 2026  
Theory of Computation (MTCSE102)**

Day & Date: Saturday, 02-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) Solve any five questions.  
2) Figure to the right indicates full marks.

**SECTION - I**

- Q.1 Solve the following. (Any Five) 25**
- a) Explain subset construction algorithm with example.
  - b) Design a CFG for a language of palindromes.
  - c) Explain non deterministic TM in detail.
  - d) Prove that the Halting problem is undecidable.
  - e) Explain equivalence of CFG and PDA.
  - f) Design a TM for  $f(n) = n + 2$ .
- Q.2 Solve the following. (Any One) 10**
- a) Design a TM for copying a string over  $\{a,b\}$  and draw transition diagram for the same.
  - b) Explain diagonalization method with example.

**Section – II**

- Q.3 Solve the following. (Any Five) 25**
- a) Explain decidability of languages with example.
  - b) Explain PCP in detail.
  - c) Explain recursive function with example.
  - d) Explain tractable decision problems with example.
  - e) Explain reducibility mapping with example.
  - f) Explain the concept of reducibility.
- Q.4 Solve the following. (Any One) 10**
- a) Differentiate between tractable and intractable problems with example.
  - b) Explain how growth function is computed

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**F.Y. (M. Tech.) (Computer Science & Engineering) (Semester - I)  
(New) (CBCS) Examination: March/April – 2026  
Data Mining (MTCSE103)**

Day & Date: Monday, 04-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) Attempt any Five questions from each section.  
2) Figure to the right indicates full marks.  
3) Assume suitable data if needed.

**SECTION - I**

- |            |  |           |
|------------|--|-----------|
| <b>Q.1</b> | Explain in detail association rule mining.                                     | <b>07</b> |
| <b>Q.2</b> | Explain data warehousing in detail.  | <b>07</b> |
| <b>Q.3</b> | Explain k-means clustering algorithms in detail.                               | <b>07</b> |
| <b>Q.4</b> | Explain decision tree based classifiers with examples.                         | <b>07</b> |
| <b>Q.5</b> | Explain in detail Online Analytical Processing (OLAP).                         | <b>07</b> |
| <b>Q.6</b> | Write a short note on KDD environment.   | <b>07</b> |
| <b>Q.7</b> | Define clustering. State the difference between clustering and classification. | <b>07</b> |

**Section - II**

- |             |  |           |
|-------------|--|-----------|
| <b>Q.8</b>  | Explain in detail mining descriptive statistical measures in large database. | <b>07</b> |
| <b>Q.9</b>  | Write a short note on discriminating between classes.                        | <b>07</b> |
| <b>Q.10</b> | Describe architectures of data mining systems.                               | <b>07</b> |
| <b>Q.11</b> | What do you mean by web content mining?                                      | <b>07</b> |
| <b>Q.12</b> | List and explain applications of data mining.                                | <b>07</b> |
| <b>Q.13</b> | What is data generalization? Explain in detail.                              | <b>07</b> |
| <b>Q.14</b> | Write a short note on temporal mining.                                       | <b>07</b> |

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**F.Y. (M.Tech.) (Computer Science & Engineering) (Sem - I) (New)**  
**(CBCS) Examination: March/April – 2026**  
**Machine Learning© (MTCSE104)**

Day & Date: Wednesday, 06-05-2026  
 Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) Figures to the right indicate full marks.  
 2) All questions are compulsory.  
 3) Wherever required draw diagrams and assume data.

**SECTION - I**

- Q.1 Attempt the questions. (Any Four) 20**
- a) Explain the different types of machine learning algorithm.
  - b) Explain Simple Linear regression algorithm.
  - c) Consider a classification problem with two classes the proportion of positive at node is 30%. Calculate the value of entropy at this node.
  - d) Explain Bayesian logistic regression.
  - e) Define machine learning? Explain its application.
- Q.2 Attempt any two questions. 10**
- a) Elaborate on the concept of the CART algorithm for decision trees.
  - b) What are the 'training Set' and 'test Set' in a Machine Learning Model? How Much Data Will You Allocate for Your Training, Validation, and Test Sets?
  - c) Explain the stochastic optimization technique.
- Q.3 Attempt the questions. 05**
- Explain logistic regression with an example.

**SECTION - II**

- Q.4 Attempt Any Four questions. 20**
- a) Explain clustering with example.
  - b) Define neural network. Write its applications.
  - c) Define regularization. Explain the use of regularization.
  - d) Explain the terms bias and variance.
  - e) Write the applications of machine learning.

**Q.5 Attempt Any Two questions.**

**10**

- a) Assume a simple MLP model with 3 neurons and inputs= 1,2,3. The weights to the input neurons are 1,2 and 3 respectively. Assume the activation function is a linear constant value of 5. Calculate the value of Output.
- b) State the key ideas in machine learning and explain it
- c) What is deep neural network? Explain it with example.

**Q.6 Attempt the following.**

**05**

Explain the Support vector machine with an example.

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**F.Y. (M.Tech.) (Computer Science & Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Natural Language Processing (MTCSE106)**

Day & Date: Thursday, 07-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Figure to the right indicates full marks.

**SECTION - I**

- Q.1 Solve Any Two. 14**
- a) Explain Steps of NLP in detail.
  - b) Explain phonetics in detail.
  - c) Explain Biology of speech processing in detail.
- Q.2 Solve Any Two. 14**
- a) What is WSD? Explain different types of ambiguities and approaches to WSD.
  - b) What is semantic relatedness? Explain measures for semantic relatedness in detail.
  - c) What is morphology? Explain morphology fundamentals in detail.
- Q.3 Solve Any One. 07**
- a) Explain training issues in detail.
  - b) Explain scope ambiguity and attachment ambiguity.

**SECTION - II**

- Q.4 Solve Any Two. 14**
- a) Explain Graphical Models for Sequence Labeling in NLP.
  - b) Explain forward backward probability.
  - c) Explain sentiment analysis and opinions on the Web.
- Q.5 Solve Any Two. 14**
- a) Explain HMM and speech recognition.
  - b) Explain Dependency parsing in detail.
  - c) Explain Machine Translation and MT tools
- Q.6 Solve Any One. 07**
- a) Explain Text entailment in detail.
  - b) Explain Question answering in multilingual setting.

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**F.Y. (M.Tech.) (Computer Science & Engineering) (Sem - I) (New)  
(CBCS) Examination: March/April – 2026  
Soft Computing (MTCSE107)**

Day & Date: Thursday, 07-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All questions are compulsory.  
2) Figure to the right indicates full marks.  
3) Assume suitable data if necessary.

**SECTION – I**

- Q.1 Attempt the Any Two. 14**
- a) Evaluate the role of biological inspiration in the evolution of computational models leading to Soft Computing techniques.
  - b) Explain the concept of a Fuzzy Set. How does it differ from a classical (crisp) set? Give a real- world example to illustrate.
  - c) Describe the architecture of a feedforward neural network. How does information propagate through the layers?
- Q.2 Attempt the Any Two. 14**
- a) Compare supervised, unsupervised, and reinforcement learning in terms of objective, data requirements, and applications.
  - b) Explain the concept of rule base in fuzzy systems. How are multiple fuzzy rules combined to produce a final decision?
  - c) Define unsupervised learning. Explain how neural networks learn patterns without labeled data.
- Q.3 Explain the concept of Adaptive Resonance Theory (ART). Why is it called “adaptive resonance”? 07**

**SECTION - II**

- Q.4 Attempt the Any Two. 14**
- a) Explain how hybrid models combining GAs with neural networks (GA-NN) improve performance in predictive modeling.
  - b) Explain how Classification and Regression Trees (CART) can be integrated into neuro-fuzzy modeling.
  - c) Compare CNN, RNN, and Transformer architectures in terms of structure, learning mechanism, and use cases.

- Q.5 Attempt the Any Two.** **14**
- a)** Describe the process of tuning GA parameters (population size, crossover rate, mutation rate) for optimal performance.
  - b)** Explain how fuzzy clustering improves the initialization and structure identification process in ANFIS.
  - c)** Discuss the role of soft margin and kernel functions in improving classifier generalization capability.
- Q.6 Compare Genetic Algorithms with other evolutionary approaches such as Differential Evolution and Particle Swarm Optimization.** **07**

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**F.Y. (M.Tech.) (Computer Science & Engineering) (Sem - I)  
(New) (CBCS) Examination: March/April – 2026  
Object Oriented Software Engineering (MTCSE109)**

Day & Date: Thursday, 07-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.  
3) Assume suitable data if necessary.

**SECTION - I**

- Q.1 Answer the following Question. 15**
- Explain the requirements workflow in the Unified Process with an example.
  - Describe architectural styles. Give examples of two widely used architectural styles and their applications.
  - Define UML. Why is UML essential in software engineering?
- Q.2 Answer the following Questions. 10**
- Define software architecture; explain the relationships of software architecture with other disciplines like system engineering, project management, and software design.
  - Explain the purpose and components of an activity diagram.
- Q.3 Answer the following Question. (Any One) 10**
- Explain use case diagram and Draw a use case diagram for an online banking system that includes the following actors: **Customer, Administrator, and System**. Include at least 5 use cases such as "Login," "Transfer Funds," and "View Account Balance."
  - Explain the challenges and solutions in designing software architectures for large-scale distributed systems.

**SECTION - II**

- Q.4 Attempt following questions. 15**
- Explain Allocation View type and Styles.
  - Explain Access Control Patterns and provide a real-world scenario where they are useful.
  - Explain Patterns for Interactive Systems.
- Q.5 Attempt following question. 10**
- Explain Patterns for Concurrent and Networked Objects in Detail.

**Q.6 Attempt following questions.**

**10**

- a)** Compare Analysis Patterns and Architectural Patterns.
- b)** Write a short note on Product Archetype Pattern, Quantity Archetype Pattern.

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**F.Y. (M.Tech.) (Computer Science & Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Research Methodology and IPR© (MTCSE201)**

Day & Date: Friday, 08-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.

**SECTION - I**

**Q.1 Write Answers to Any Five questions. 35**

- a) Draw the block diagram of research process & explain it.
- b) Explain objective & Scope of research.
- c) Explain Monte Carlo Method with example.
- d) What is hypothesis & explain its characteristics.
- e) Explain problems encountered by Researchers in India.
- f) What is Mathematical Modeling? Explain the Techniques used for mathematical Modeling.
- g) Explain corporate Model with block diagram.

**SECTION - II**

**Q.2 Write Answers to Any Five questions. 35**

- a) Explain Report Writing & Presentation of results in detail.
- b) Explain in detail how to write Technical Paper.
- c) What is simulation? Explain the role of probability in simulation.
- d) Explain different ethical issues in research.
- e) Give Guidelines for Design of Experiments.
- f) Explain in detail the concept of e-research.
- g) Differentiate between bibliography & footnotes of references.

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**F.Y. (M. Tech.) (Computer Science & Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April - 2026  
Internet of Things (MTCSE202)**

Day & Date: Monday, 11-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All question are compulsory.  
2) Figure to the right indicates full marks.  
3) Assume Suitable data if necessary and assume it clearly.

**SECTION - I**

- Q.1 Attempt any two. 14**  
 a) Explain the physical and logical design of IoT system.  
 b) Describe sensing and processing in IoT nodes.  
 c) Write a detailed note on IoT communication models.
- Q.2 Attempt any two. 14**  
 a) Compare WiFi, ZigBee, and Bluetooth technologies used in IoT.  
 b) Explain the concept of UWB (IEEE 802.15.4) in IoT.  
 c) Describe 6LoWPAN and its significance in IoT.
- Q.3 Write a short note on. 07**  
 Powering and energy management in IoT.

**SECTION - II**

- Q.4 Attempt any two. 14**  
 a) Explain how to interface sensors with Raspberry Pi.  
 b) Discuss the programming workflow for Raspberry Pi in IoT.  
 c) Explain the use of APIs in building IoT applications.
- Q.5 Attempt any two. 14**  
 a) Describe the concept of open-sourced vs. licensed IoT databases.  
 b) Discuss AT&T M2M and Google M2M platforms.  
 c) Explain the role of Libellium in IoT database implementation.
- Q.6 Write short notes on. 07**  
 Electric vehicle charging system using IoT.

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**F.Y. (M.Tech.) (Computer Science & Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Internet Routing Algorithm (MTCSE203)**

Day & Date: Wednesday, 13-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.  
3) Wherever required draw diagrams and assume data.

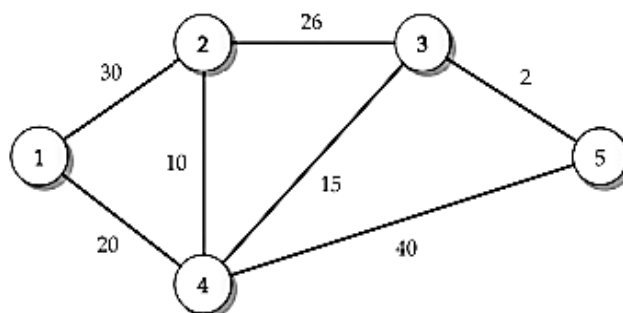
**SECTION - I**

**Q.1 Write answer to Any Two questions. 10**

- Write a short note on IP Protocol stack Architecture.
- Which IPv4 address blocks are reserved for current usage? Why is it necessary to reserve some addresses from an address space rather than making all of them available?
- What is a link state advertisement? What are different types of LSAs?

**Q.2 Write answer to Any Two questions. 10**

- Draw the functional view of Router architecture and state three functions of the Router.
- Consider the following network topology. The number listed next to the links is assumed to be bandwidth. Determine the widest path from node 2 to node 5 using widest path algorithm, computed at node i (Dijkstra based).



- Compare RIPv1, RIPv2 and RIPv3?

**Q.3 a) What are the different states in the BGP finite state machine? 10**  
**b) What are the different BGP timers? 05**

**SECTION - II**

- Q.4 Write answer to Any Two questions. 10**
- a) List three differences between a distance vector protocol and a link state protocol.
  - b) What is the relation between an AS and an ISP?
  - c) What is packet processing? Explain fast path versus slow path.
- Q.5 Write answer to Any Two questions. 10**
- a) What are the basic requirements of Longest Prefix matching algorithm?
  - b) For a given IP address, how would you find out its home AS number?
  - c) Illustrate search and update operations in a binary trie with example.
- Q.6 a) Describe basic framework of distance vector protocol. 10**
- b) With diagram, explain shared nothing architecture of routers. 05**

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**F.Y. (M. Tech.) (Computer Science & Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April – 2026  
Deep Learning (MTCSE205)**

Day & Date: Friday, 15-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) All question are compulsory.  
2) Figure to the right indicates full marks.  
3) Assume suitable data if necessary and mention it clearly.

**SECTION - I**

- Q.1 Solve Any Three questions. 15**
- a) Differentiate between linearly separable and linearly non-separable classes with the help of diagrams.
  - b) Explain the architecture and working of a Deep Feedforward Network with a neat diagram.
  - c) Describe Adaptive Optimization methods: AdaGrad, RMSProp, and Adam.
  - d) What is Early Stopping and Dropout? Explain its importance.
- Q.2 Solve Any Two questions. 10**
- a) Explain the three classes and basic terminologies of Deep Learning.
  - b) What is Parameter Initialization? Why is it important?
  - c) Describe the Backpropagation Algorithm.
- Q.3 Solve Any Two questions 10**
- a) Describe L1 and L2 Regularization techniques.
  - b) Describe Gradient-Based Learning.
  - c) Explain the McCulloch-Pitts neuron model, its working, and limitations.

**Section - II**

- Q.4 Solve Any Three questions. 15**
- a) Describe the LeNet architecture.
  - b) Describe Denoising and Sparse Autoencoders.
  - c) What is a Generative Adversarial Network (GAN)? Describe its architecture.
  - d) What is a Bidirectional RNN?

**Q.5 Solve Any Two questions. 10**

- a) Explain the basic architecture of CNN.
- b) What are Deep Fakes? How are they created using GANs?
- c) Explain the application of Autoencoders in Image Compression.

**Q.6 Solve Any Two questions. 10**

- a) Explain applications of CNN in image classification and object detection.
- b) Describe the Linear Autoencoder.
- c) Explain the Encoder-Decoder architecture.

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**F.Y. (M. Tech.) (Computer Science & Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April - 2026  
Advanced Cloud Computing (MTCSE206)**

Day & Date: Friday, 15-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

**Instructions:** 1) All question are compulsory.  
2) Figure to the right indicates full marks.

**SECTION – I**

- Q.1 Solve any three of the following. 21**
- a) Define computing? Explain the terms Grid Computing, Cluster Computing, Utility Computing.
  - b) Define community cloud along with architecture. Explain its use in healthcare sector.
  - c) What is virtualization. Explain approaches of virtualization.
  - d) Explain various service model of cloud computing.
- Q.2 Solve the following. 14**
- a) Explain the working of Amazon EC2 with the help of a diagram.
  - b) Compare cloud computing with cluster computing model.

**SECTION – II**

- Q.3 Solve any three of the following. 21**
- a) Explain Microsoft Azure platform as service.
  - b) What are the jurisdictional and compliance issues raised by data location in cloud computing?
  - c) Explain Cloud Contracting Model in detail.
  - d) Explain large scale data processing.
- Q.4 Solve the following. 14**
- a) Explain the various layers of security in cloud computing.
  - b) What are the challenges of scaling hardware in traditional IT infrastructure compared to cloud computing?

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**F.Y. (M.Tech.) (Computer Science & Engineering) (Sem - II) (New)  
(CBCS) Examination: March/April - 2026  
Real Time Operating System (MTCSE211)**

Day & Date: Monday, 18-05-2026  
Time: 10:00 AM To 01:00 PM

Max. Marks: 70

- Instructions:** 1) Q.1 from Section I and Q. 5 from Section II are compulsory.  
2) Attempt any two questions from Q.2 to Q.4 for Section I and any two questions from Q. 6 to Q.8 for Section II.  
3) Figures to the right indicate full marks.

**SECTION - I**

- Q.1** Explain the principles and policies of process synchronization. **07**
- Q.2** a) Discuss the various fields that contribute to the design of real-time systems and the practical problems faced during implementation. **07**  
b) Explain Application of Real Time Systems. **07**
- Q.3** a) Illustrate the priority-ceiling protocol with diagram. **07**  
b) Discuss the working of Linear Buffer, Time-Related Buffer, and Ring Buffer. **07**
- Q.4** a) Explain Exception Handling in Details with example. **07**  
b) Explain automatic code generation procedure. **07**

**SECTION - II**

- Q.5** Analyze the importance of UML in representing software architecture and design models. **07**
- Q.6** a) Describe the essential properties of a real-time software system. **07**  
b) Explain Petri nets with example. **07**
- Q.7** a) Explain the software development Agile Methodologies. **07**  
b) Explain term reliability and demonstrate the calculation of system reliability. **07**
- Q.8** a) State and Explain following laws: **07**  
1) Gustafson's Law  
2) Amdahl's Law  
b) How does a Real-Time Operating System (RTOS) manage input/output operations, and what factors influence its I/O performance? Illustrate with examples. **07**

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**Set P**

**S.Y. (M. Tech.) (Computer Science & Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April – 2026  
Business Analytics (OE001A)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

**Instructions:** 1) All questions are compulsory.  
2) Figures to the right indicate full marks.

**SECTION - I**

- Q.1 Attempt the Following. (Any Five) 35**
- a) What do you mean by Business Analytics? Explain the relation of Business Analytics process.
  - b) What is Data Mining? Explain Terminology & Notation in Data Mining.
  - c) Explain Supervised and & Unsupervised Learning in data mining.
  - d) Explain in detail Business Analytics Process.
  - e) Define & explain Box plots. Histograms with example.
  - f) Explain Data Mining Process in Detail.
  - g) Describe Manipulations in data visualization.

**SECTION - II**

- Q.2 Attempt the Following. (Any Five) 35**
- a) What is Multiple Linear Regression & Explain Predictive modeling.
  - b) Explain feature selection for clustering in detail.
  - c) Describe K-means algorithm in detail.
  - d) Explain Classification Matrix.
  - e) Explain the method for Evaluating Predictive Performance in detail.
  - f) Describe the Regression Equation and Prediction.
  - g) What is Regression Tree? Explain advantages & Weakness of it.

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**S.Y. (M. Tech.) (Computer Science & Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Operation Research (OE001B)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

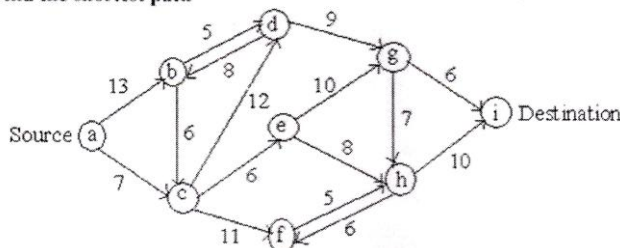
- Instructions:** 1) Q.1 and Q.5 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume suitable data necessary and mention if clearly.

**SECTION - I**

- Q.1** a) Explain different Linear Programming models. **09**  
 b) Solve following LPP by Graphical method. **09**  
 Minimize  $Z = 2y_1 + 3y_2$  s.t.  
 constraints:  $y_1 + y_2 \geq 5, y_1 + 2y_2 \geq 6$   
 $y_1, y_2 \geq 0$
- Q.2** a) Explain Shadow Price- Sensitivity analysis. **09**  
 b) Explain Monto-Carlo Simulation. **08**
- Q.3** a) Explain Structure of queuing system. **09**  
 b) Explain Queuing Model - FIFO with suitable example. **08**

**SECTION - II**

- Q.4** a) Explain Price break model. **09**  
 b) Explain Inventory management techniques. **08**
- Q.5** a) Explain Group replacement policy. **09**  
 b) **Example 1**  
 Find the shortest path **09**



- Q.6** a) Explain Cost optimization. **09**  
 b) Explain Network crashing and its steps. **08**

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**S.Y. (M. Tech.) (Computer Science & Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Nonconventional Energy (OE001D)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

- Instructions:** 1) Q.1 and Q.4 are compulsory. Solve any one question from the remaining questions in each section.  
2) Figures to the right indicate full marks.  
3) Assume necessary data if necessary.

**SECTION - I**

- Q.1 Solve Any Four. 20**
- a) Compare conventional and renewable energy sources based on their environmental impact.
  - b) Write a note on the growth of the energy sector in India.
  - c) What do you understand by energy conservation? Explain its various aspects.
  - d) Explain cogeneration and its role in improving energy utilization.
  - e) Explain the specifications of energy storage devices.
- Q.2 a) Draw a schematic diagram of a solar pond-based electric power plant with a cooling tower and explain its working. 07**
- b) What are the emerging new technologies for energy conservation and efficiency? 08**
- Q.3 a) Why is energy storage necessary? Explain two methods of energy storage. 07**
- b) Describe different types of solar thermal energy collectors and their applications. 08**

**SECTION - II**

- Q.4 Solve Any Four 20**
- a) Explain the fundamentals of Solar Cell technology.
  - b) What are the major advantages and disadvantages of a solar PV system?
  - c) Explain the different modes of power generation.
  - d) Explain gasification and its role in biomass energy production.
  - e) What is a Fuel cell and explain its classification in detail?

- Q.5 a)** What is the importance of MPPT in an SPV system? Explain various strategies used for the operation of an MPPT. **07**
- b)** What is the origin of biomass energy? What is its global potential? **08**  
What is the average efficiency of photosynthetic conversion of solar energy into biomass?
- Q.6 a)** Discuss the process of urban waste-to-energy conversion, highlighting its benefits and challenges in sustainable development. **07**
- b)** Discuss the role of hydrogen as an energy carrier in fuel cell technology. Highlight the challenges associated with its storage and utilization. **08**

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**S.Y. (M. Tech.) (Computer Science & Engineering) (Sem - III) (New)  
(CBCS) Examination: March/April - 2026  
Product Design and Development (OE001E)**

Day & Date: Monday, 11-05-2026  
Time: 03:00 PM To 06:00 PM

Max. Marks: 70

**Instructions:** 1) Q.No.3 and Q.No.6 are compulsory and solve any one question from remaining question from each section.  
3) Figures to the right indicate full marks.  
4) Make suitable assumptions if required.

**SECTION - I**

- Q.1** a) What are the stages of the product life cycle, and how do they influence product design and development? **09**  
b) Outline the steps in the product design process and discuss the importance of design analysis. **08**
- Q.2** a) What is functional analysis, and what are the key steps in the Functional Analysis System Technique (FAST)? **09**  
b) Define value engineering and explain its role in reducing costs while maintaining product quality. **08**
- Q.3 Write Short Notes. (Any Three)** **18**  
a) How is Computer-Aided Design (CAD) used in product design?  
b) What is robust design, and how does it improve product quality?  
c) What is meant by Design for X (DFX)? Give a few examples.  
d) What are the key principles behind robust design and how are they applied in product development?

**SECTION - II**

- Q.4** a) What are the key guidelines for Design for Manufacturing and Assembly (DFMA), and how do they simplify the manufacturing process? **08**  
b) Describe the ergonomic design process and the role of posture and movement in creating user-friendly products. **09**
- Q.5** a) Explain the concept and advantages of rapid prototyping in product development. **08**  
b) What is the importance of cost evaluation and life cycle analysis in making economic decisions for product design? **09**

**Q.6 Write Short Notes. (Any Three)****18**

- a)** What are ergonomics, and why are they important in product design?
- b)** What is rapid prototyping, and how does it help in product development?
- c)** What is life cycle analysis, and how is it used in product design?
- d)** 'What are the main steps in the Design for Six Sigma (DFSS) process?