H.T No: | | | | | | | | | | | R22

CMR COLLEGE OF ENGINEERING & TECHNOLOGY
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Examination : **B.Tech VI Semester Supplementary Examinations Nov/Dec-2025**
Course Name : **Machine Design**
Course Code : **A403313**
Branch : **Mechanical Engineering**
Date & Session : **09-12-2025 AN** **Duration: 3 hours** **Max. Marks: 60**

(Note: Assume suitable data if necessary)

PART-A

Answer all TEN questions

Each question carries ONE mark. **10x1=10M**

1. Define Partial Journal Bearing. 1 M
2. Write about modes of lubrication. 1 M
3. Define rating life of a bearing. 1 M
4. Define static load carrying capacity of a bearing. 1 M
5. Explain about failure of piston. 1 M
6. Explain the stresses in connecting rod. 1 M
7. Define Spring index. 1 M
8. Define Centrifugal tension. 1 M
9. Define Spur gear. 1 M
10. Define beam strength. 1 M

PART-B

Answer the following. Each question carries TEN Marks. **5x10=50M**

11.A). Design a journal bearing for centrifugal pump from the following data: Load on the journal = 20 kN, Speed of the journal = 900 rpm Type of oil SAE 10 for which absolute viscosity at 55°C = 0.017 kg/m.s. Ambient temperature of oil = 15.5°C Maximum bearing pressure for the pump = 1.5 N/mm^2 Calculate also the mass of the lubricating oil required for artificial cooling to rise in temperature of the oil limited to 10°C. Heat dissipation coefficient = 1232 W/m^2.°C. 10M

OR

11. B). Design a journal bearing for centrifugal pump for the following data: Load on the journal = 12kN, Diameter of the journal =75mm, Speed=1440 rpm, Atmosphere temperature =16^{0}C Operating temperature=60^{0}C, Absolute viscosity of oil at 60^{0}C = 0.023 kg/m.s. 10M

12. A). Select a suitable spherical roller bearing from SKF series 222C to support a radial load of 4kN and axial load of 2kN. Minimum life required is 10000 hrs at 1000 rpm. For this select bearing find (i) The expected life under the given loads (ii) The equivalent load that can be supported with a probability of survival of 95% with 10000 hours. 10M

OR

12. B). The ball bearing for the drilling machine spindle is rotating at 3000rpm. It is subjected to radial load of 2500N and an axial load of 1500N. It is to work 50 hours per week for one year. Design a suitable bearing if the diameter of the spindle is 40mm. 10M

(P.T.O..)

13. A). Design a connecting rod for an IC engine running at 1800 rpm and developing a maximum pressure of 3.15 N/mm^2 the diameter of piston is 100 mm, mass of the reciprocating parts per cylinder is 2.25 kg, length of connecting rod is 380 mm, stroke of piston is 190 mm and compression ratio 6:1. Take a factor of safety of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2, corresponding bearing pressure as 10N/mm2 and 15 N/mm^2. The density of the material rod may be taken as 8000 kg/m^3 and the allowable stress in the bolts as 60 N/mm^2 and in cap as 80 N/mm^2. The rod is to be of I-section for which you can choose your own proportions. Draw a neat sketch. Use Rankin's formulae for which the numerator constant may be taken as 320 N/mm^2 & denominator constant as $\frac{1}{7500}$. 10M

OR

13. B). Design a cast iron piston for a single acting four stroke engine for the following data: Any other data required for the design may be assumed. Cylinder bore = 100mm Stroke = 125 mm, Maximum gas pressure = 5 N/mm^2, Indicated mean effective pressure = 0.75 N/mm^2, Mechanical efficiency = 80%, Fuel consumption = 0.15 kg per brake power per hour, Higher calorific value of fuel = 42×10^3 kJ/kg, Speed = 2000 rpm Tensile stress for cast iron (σ_t) = 38 MPa. 10M

14. A). Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 kN/mm^2. Also calculate the maximum shear stress induced. 10M

OR

14. B). A semi-elliptical laminated vehicle spring to carry a load of 6000 N is to consist of seven leaves 65 mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.1 m in length and attached to the axle by two U-bolts 80 mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having a width equal to the distance between the bolts. Assume a design stress for spring material as 350 MPa. Determine: (i) Thickness of leaves. (ii) Deflection of spring. (iii) Diameter of eye. (iv) Length of leaves. (v) Radius to which leaves should be initially bent. 10M

15. A). A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4:1. The allowable static stresses for the bronze pinion and cast iron gear are 84 MPa and 105 MPa respectively. The pinion has 16 standard 20° full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength. 10M

OR

15. B). A helical gear set used in a paper pulping machine connects the driving motor to the blade shaft. A power of 20 kW is transmitted by the motor at 1600 rpm while the blade shaft runs at 400 rpm. Due to space restrictions the center distance between the gears is kept at 500 mm. Choosing suitable materials for the gears design the 20^0 full depth involute helical gears with a helix angle of 25^0. 10M

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H.T No: | | | | | | | | | | | R22

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Examination	:	**B.Tech VI Semester Supplementary Examinations Nov/Dec-2025**
Course Name	:	**Finite Element Methods**
Course Code	:	**A403316**
Branch	:	**Mechanical Engineering**
Date & Session	:	**10-12-2025 AN** **Duration: 3 hours** **Max. Marks: 60**

(Note: Assume suitable data if necessary)

PART-A

Answer all TEN questions

Each question carries ONE mark. **10x1=10M**

1. What is the principle of finite element method? 1 M
2. Write the stress strain relations for 2D plane stress and plane strain conditions. 1 M
3. What are the consistent nodal force vector for uniform load and varying load? 1 M
4. Write the stiffness matrix for 2-noded beam element. 1 M
5. Illustrate the importance of Constant Strain Triangles. 1 M
6. Write the strain displacement equations of axisymmetric problems using a cylindrical coordinate system. 1 M
7. What is the degree of freedom for the thermal problems? 1 M
8. Write the finite element equation used to analyze a two dimensional heat transfer problem. 1 M
9. What is characteristic polynomial technique? 1 M
10. Enlighten the importance of lumped mass matrix. 1 M

PART-B

Answer the following. Each question carries TEN Marks. **5x10=50M**

11.A). Derive the stiffness matrix and consistent load vector in matrix form for one dimensional quadratic element. 10M

OR

11. B). The structure in figure 1 is subjected to an increase in temperature, $\Delta T = 80°C$. Determine the displacements, stresses and support reactions. 10M

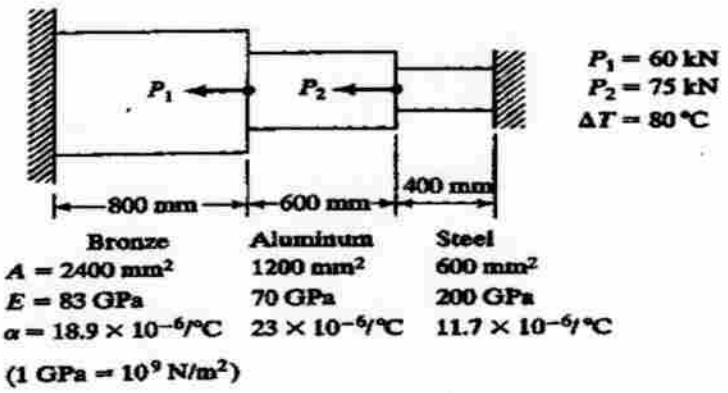

Figure 1

(P.T.O..)

12. A). For the pin-jointed truss structure as shown in figure 2 below, determine global stiffness matrix, nodal displacements and element stresses. 10M

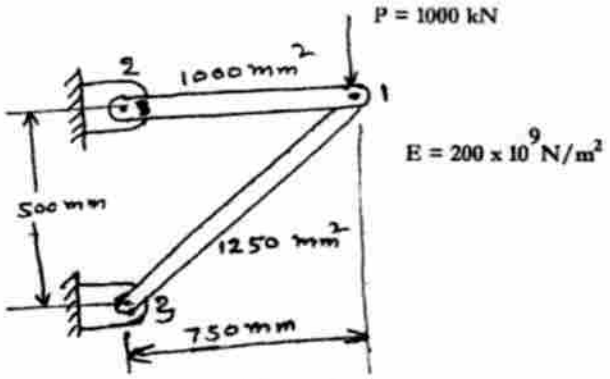

Figure 2

OR

12. B). For the beam and loading shown in figure 3. Determine the slopes at 2 and 3. And also the vertical deflection at the midpoint of the distributed load. 10M

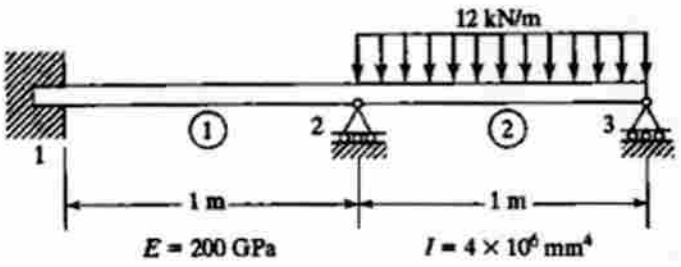

Figure 3

13. A). A two-dimensional plate is shown in figure 4. Determine the equivalent point loads at nodes 7, 8 and 9 for the linearly distributed pressure load acting on the edge 7-8-9. 10M

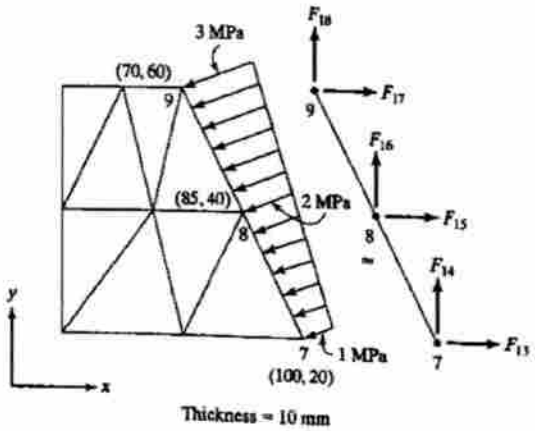

Figure 4

(P.T.O..)

OR

13. B). For the axisymmetric element shown in figure 5. Determine the element stiffness matrix. Take E=200 GPa and $\upsilon = 0.3$. 10M

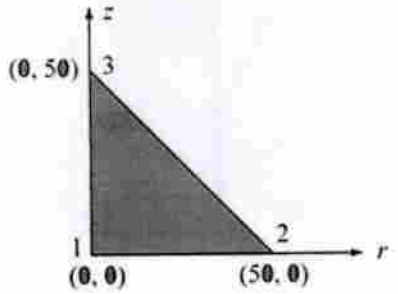

Figure 5

14. A). A composite slab consists of 3 materials of different conductivities, 22 W/m K, 32 W/m K, 52 W/m K of thickness 0.31 m, 0.14 m and 0.14 m respectively. The outer surface is 22°C and the inner surface is exposed to the convective heat transfer coefficient of 28 W/m^2 K, 800°C. Determine the temperature distribution within the wall. 10M

OR

14. B). Derive the conductivity matrix for two dimensional triangular element subjected to convection on one face of the element. 10M

15. A). For the stepped bar shown in the figure 6. Develop the global stiffness and mass matrices and also determine the natural frequencies and mode shapes. Assume E = 200 GPa and mass density = 7850 kg/m^3, $L_1 = L_2 = 0.3$ m, $A_1 = 350\ mm^2$, $A_2 = 600\ mm^2$. 10M

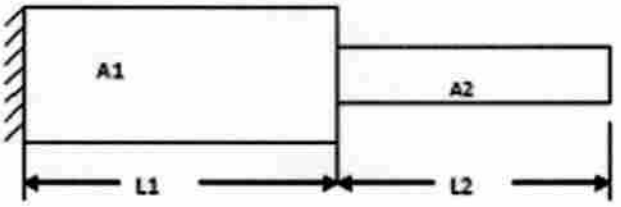

Figure 6

OR

15. B). Explain the importance of element mass matrix in FEM with suitable example. 10M

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H.T No: | | | | | | | | | | | R22

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Examination : **B.Tech VI Semester Supplementary Examinations Nov/Dec-2025**
Course Name : **Heat Transfer**
Course Code : **A403315**
Branch : **Mechanical Engineering**
Date & Session : **19-12-2025 AN** **Duration: 3 hours** **Max. Marks: 60**

(Note: Assume suitable data if necessary)

PART-A

Answer all TEN questions

Each question carries ONE mark. **10x1=10M**

1. What is the critical radius of insulation? 1 M
2. Differentiate between steady-state and transient heat conduction. 1 M
3. State the application of fins in thermal systems. 1 M
4. What is lumped system analysis? 1 M
5. Name two non-dimensional numbers used in convective heat transfer. 1 M
6. Define the thermal boundary layer. 1 M
7. State the difference between laminar and turbulent flow. 1 M
8. Define free convection. 1 M
9. What is the difference between film boiling and nucleate boiling? 1 M
10. Define emissivity. 1 M

PART-B

Answer the following. Each question carries TEN Marks. **5x10=50M**

11.A). Solve the one-dimensional steady-state heat conduction equation for a plane wall with constant thermal conductivity and uniform internal heat generation. 10M

OR

11. B). A cylindrical electric wire of radius 4 mm is insulated with a material having thermal conductivity k=0.25 W/m·K. The convective heat transfer coefficient at the outer surface of the insulation is h=15 W/m²·K. Determine the: 10M
i) Critical radius of insulation.
ii) Whether adding insulation increases or decreases the heat loss.

12. A). Derive the temperature distribution and heat transfer rate for a one-dimensional steady-state heat conduction in a long fin with uniform cross-sectional area. 10M

OR

12. B). A small copper sphere of diameter 5 cm is initially at 300°C. It is suddenly immersed in a fluid at 50°C with a heat transfer coefficient of 120 W/m²·K. Calculate the temperature of the sphere after 2 minutes, assuming lumped system model is valid. (Take: ρ=8950 kg/m³, Cp=385 J/kg·K, k=390 W/m·K). 10M

13. A). Derive the Von Karman Integral Momentum Equation for laminar flow over a flat plate. 10M

OR

13. B). Air at 35^0C flows across a cylinder of 50mm diameter at a velocity of 50m/s. The cylinder surface is maintained at 145^0C. Find the heat loss per unit length. 10M

(P.T.O..)

14. A). i) Define LMTD and NTU of heat exchanger. 2M

ii) Derive an expression for LMTD for counter flow heat exchanger. 8M

OR

14. B). Hot water enters a counter-flow heat exchanger at a rate of 1.5 kg/s and temperature of 90°C and exits at 60°C. Cold water enters at 30°C and exits at 50°C. The specific heat capacities of hot and cold water are both 4.18 kJ/kg·K. The overall heat transfer coefficient is 600 W/m²·K. Calculate the required surface area of the heat exchanger using the Log Mean Temperature Difference (LMTD) method. 10M

15. A). What are radiation shields? Describe the electrical analogy in radiation networks with relevant equations. 10M

OR

15. B). A black body emits radiation at 2000K. Calculate (i) the monochromatic emissive power at 1μm wavelength (ii) wavelength at which the emission is maximum (iii) the maximum emissive power. 10M

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H.T No: | | | | | | | | | | | R22

CMR COLLEGE OF ENGINEERING & TECHNOLOGY
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Examination : **B.Tech VI Semester Supplementary Examinations Nov/Dec-2025**
Course Name : **Refrigeration & Air Conditioning**
Course Code : **Mechanical Engineering**
Branch : **A403317**
Date & Session : **12-12-2025 AN** **Duration: 3 hours** **Max. Marks: 60**

(Note: Assume suitable data if necessary)

PART-A

Answer all TEN questions

Each question carries ONE mark. **10x1=10M**

1. What is the unit of refrigeration? 1 M
2. What are the refrigeration needs of aircraft? 1 M
3. Define C.O.P of a vapour compression system. 1 M
4. What is subcooling and superheating in refrigeration? 1 M
5. What is the function of a compressor? 1 M
6. Name some commonly used refrigerants. 1 M
7. What is a vortex tube (Hilsch tube)? 1 M
8. Mention any two applications of absorption refrigeration systems. 1 M
9. What is meant by psychrometric properties? 1 M
10. What is the need for ventilation? 1 M

PART-B

Answer the following. Each question carries TEN Marks. **5x10=50M**

11.A). Explain the working principle of an Air Refrigeration System. Show the layout and represent cycle on T-s plane. 10M

OR

11. B). In an ideal Bell-Coleman cycle, the pressure ratio is 6.25 air flow rate is 75kg/min and temperatures at the beginning of compression and expansion are 18^0c and 25^0c respectively. Find: (i) COP (ii) Net Power input in kW and (iii)Plant capacity in TR. Take v=1.4 and Cp=1.005 kJ/ kgk. 10M

12. A). Describe the working of a simple Vapour Compression Refrigeration System. Show the line diagram and represent the cycle on p-h plane. 10M

OR

12. B). An R22 refrigeration system operates across temperature limits of -20^0C and 20^0C. The refrigerant is dry at the end of compression, and the refrigerant flow rate is 1.8 kg/s. Determine (i) COP (ii) Plant Capacity in TR and (iii) Compressor Power in KW. 10M

13. A). Compare reciprocating, rotary, and centrifugal compressors. 10M

OR

13. B). Discuss the nomenclature and classification of refrigerants as per ASHRAE. 10M

(P.T.O..)

14. A). Explain the working principle of a vapour absorption refrigeration system and derive the expression for its maximum C.O.P. 10M

OR

14. B). Discuss the applications and limitations of absorption refrigeration systems. 10M

15. A). Air at 37^0C, 44 percent relative humidity, is cooled to 23^0C by spraying water at 13^0C into it. The mixture pressure remains constant at 101.3 kPa. Assuming that all of the water evaporates and that the mixing occurs in an insulated duct, calculate the mass of water added per kilogram of air. 10M

OR

15. B). Explain the factors affecting human comfort and the concept of effective temperature. 10M

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H.T No: | | | | | | | | | | | R22

CMR COLLEGE OF ENGINEERING & TECHNOLOGY
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Examination : **B.Tech VI Semester Supplementary Examinations Nov/Dec-2025**
Course Name : **Unconventional Machining Processes**
Course Code : **A403401**
Branch : **Mechanical Engineering**
Date & Session : **13-12-2025 AN** **Duration: 3 hours** **Max. Marks: 60**

(Note: Assume suitable data if necessary)

PART-A

Answer all TEN questions

Each question carries ONE mark. **10x1=10M**

1. Describe the importance of unconventional machining process. 1 M
2. Classify modern machining processes on the basis of the type of energy employed. 1 M
3. List the different type of abrasives used in AJM. 1 M
4. Summarize the application of ECM. 1 M
5. Describe the roles of dielectric fluid in EDM. 1 M
6. Classify the tool materials in EDM. 1 M
7. Define the principle of electron beam machining. 1 M
8. Classify the various types of lasers. 1 M
9. Define the working principle of Plasma arc Machine Process. 1 M
10. What is magnetic abrasive finishing process? 1 M

PART-B

Answer the following. Each question carries TEN Marks. **5x10=50M**

11.A). Discuss the basic limitations of conventional machining process and justify the need of conventional machining process in now a days. 10M

OR

11. B). Briefly explain the effect of operating parameters on material removal rate in Unconventional Machining Process. 10M

12. A). List out the applications and limitations of abrasive water jet machining. 10M

OR

12. B). With the help of a line diagram, explain the working of electro chemical deburring process. 10M

13. A). Explain the working principle, elements and characteristics of wire EDM process in detail. 10M

OR

13. B). State the recent developments in EDM and Wire cut EDM in detail. 10M

14. A). Explain the thermal features of Laser beam machining. Discuss the performance of various types of Lasers. 10M

OR

14. B). Explain with neat sketch construction, working principle of the Electron Beam Machining Process in detail. 10M

15. A). State the principle of Chemical Machining process. Why maskants are required in chemical machining process? 10M

OR

15. B). State the principle of magnetic abrasive finishing process and explain it briefly. 10M

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