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

CMR COLLEGE OF ENGINEERING & TECHNOLOGY
(UGC AUTONOMOUS)

Examination : **B.Tech VI Semester Regular Examinations June-2025**
Course Name : **Machine Design**
Course Code : **A403313**
Branch : **Mechanical Engineering**
Date & Session : **19-06-2025 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 Sommerfield number. 1 M
2. Define Hydrodynamic journal bearing. 1 M
3. Define Life of a roller bearing. 1 M
4. Write the expression for equivalent load of a roller bearing. 1 M
5. Explain the application of connecting rod. 1 M
6. Explain the functions of piston. 1 M
7. Define Spring Stiffness. 1 M
8. Define creep. 1 M
9. Define Helical gear. 1 M
10. Classify the gears. 1 M

PART-B

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

11.A). The following data is given for 3600 hydrodynamic bearings: journal diameter =100 mm, radial clearance =0.12mm, radial load =50kN, bearing length =100 mm, journal speed =1440 rpm and viscosity of lubricant = 16CP. Calculate (i) minimum film thickness (ii) coefficient of friction and (iii) power lost in friction 10M

OR

11. B). 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 = 17 centipoises 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 = 12.2 kN/m^2 /°C. 10M

12. A). The radial load on a roller bearing varies as follows a load of 50 kN is acting 20% of time at 500 rpm and a load of 40kN is acting 50% of the time at 600 rpm. In the remaining time the load varies from 40kN to 10kN linearly at 700 rpm. Select a roller bearing from NU22 series for a life of at least 4000 hours. The operating temperature is 175°C. 10M

OR

12. B). A single row deep groove ball bearing is to operate at 1600 rpm and carries 8kN radial load and 6kN thrust load. The bearing is subjected to a light shock load. Determine the rating life of the bearing. 10M

(P.T.O.)

13. A). Determine the dimensions of an I-section connecting rod for a petrol engine from the following data: Diameter of the piston = 110 mm; Mass of the reciprocating parts = 2kg; Length of the connecting rod from the centre to centre = 325mm; Stroke length = 150mm RPM = 1500 with possible over speed of 2500; Compression ratio = 4:1; Maximum explosion pressure = 2.5 N/mm^2. 10M

OR

13. B). A four stroke diesel engine has the following specifications : Brake power = 5 kW ; Speed = 1200 r.p.m. ; Indicated mean effective pressure = 0.35 N/mm^2 ; Mechanical efficiency = 80 %. Determine : (i). Bore and length of the cylinder ; (ii). Thickness of the cylinder head ; and (iii). Size of studs for the cylinder head. 10M

14. A). It is required to design a helical compression spring with plain ends, made of cold drawn plain carbon steel, for carrying a maximum pure static force of 1000 N. The ultimate tensile strength and modulus of rigidity for spring material are 1430 N/mm^2 and 85 N/mm^2 respectively. The spring rate is 48 N/mm. If spring index is 5, Determine: (i) Wire diameter. (ii) Total number of coils. (iii) Free length and (iv) Pitch. 10M

OR

14. B). Design and draw a valve spring of a petrol engine for the following operating conditions : Spring load when the valve is open = 400 N Spring load when the valve is closed = 250 N Maximum inside diameter of spring = 25 mm Length of the spring when the valve is open= 40 mm Length of the spring when the valve is closed= 50 mm Maximum permissible shear stress = 400 MPa. 10M

15. A). A pair of straight spur gears is required to reduce the speed of shaft from 500 to 100 rpm while continuously running 12hr per day. The pinion is of 40C8 steel and has 20 teeth. The wheel is of cast iron of grade FG200 and has 100 teeth. The gears are of 8mm module, 100 mm face width and 20° pressure angle. Calculate power rating. 10M

OR

15. B). A compressor running at 350 rpm is driven by 5 kW, 1400 rpm motor through 20° full depth spur gears. The motor pinion is to be of C30 forged steel hardened and tempered, and the driven gear is to be of cast iron grade 35. Assuming medium shock condition, design the gear drive completely. Take minimum number of teeth is 18 for the pinion. The gears are working for one shift per day in an industrial atmosphere and to work for two years before their replacement. 10M

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CMR COLLEGE OF ENGINEERING & TECHNOLOGY
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Examination	:	**B.Tech VI Semester Regular Examinations June-2025**
Course Name	:	**Finite Element Methods**
Course Code	:	**A403316**
Branch	:	**Mechanical Engineering**
Date & Session	:	**21-06-2025 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. Give an example of an engineering application of the Finite Element Method. 1 M
2. What are the different types of finite elements? 1 M
3. What is meant by the stiffness matrix in plane trusses? 1 M
4. Write the formula for element stiffness matrix of beams. 1 M
5. What is the purpose of finite element modelling in 2D stress analysis? 1 M
6. What is numerical integration in the finite element method? 1 M
7. What is meant by steady-state heat transfer analysis? 1 M
8. What is the role of the heat transfer coefficient in thermal analysis? 1 M
9. How is FEM used to model dynamic analysis problems? 1 M
10. What are hexahedral and tetrahedral elements in FEM? 1 M

PART-B

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

11.A). Discuss the shape function and derive the shape functions for a one-dimensional bar element. 10M

OR

11. B). Resolve nodal displacements, element stresses in a 1-D stepped bar with E=210GPa shown in the Figure. 10M

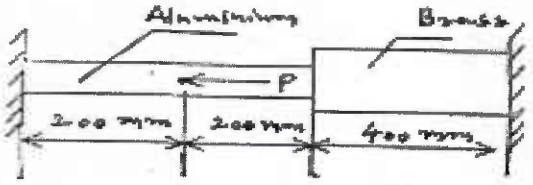


Fig. 2

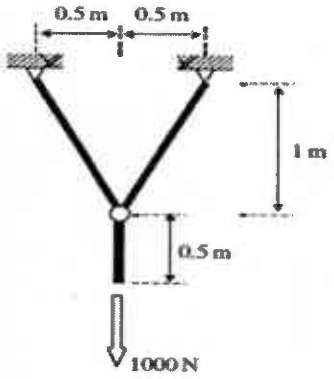
Aluminium
E=70GPa
A=800mm²
α=25x10⁻⁶ per°C
ΔT= 50°C

Brass
E=100GPa
A=1200mm²
α= 20x10⁻⁶ per °C
ΔT= 50°C

P=50kN

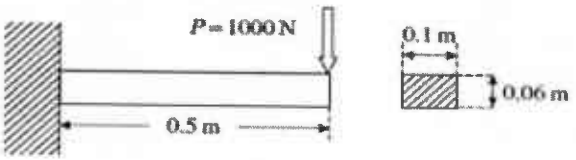
(P.T.O..)

12. A). Work out the displacements of the truss structure shown in the Figure. All the truss members are of the same material (E = 69.0 GPa) and have the same cross-sectional area of 0.01 m^2. 10M



OR

12. B). Consider the cantilever beam as shown in the Figure. The beam is fixed at one end, and it has a uniform cross-sectional area as shown. The beam undergoes static deflection by a downward load of P = 1000 N applied at the free end. The dimensions of the beam are shown in the figure, and the beam is made of Aluminum whose properties are Young's modulus, *E 69.0* GPa, and Poisson's ratio, v = *0.3*. Determine the deflection of the beam. 10M



13. A). Derive the element stiffness matrix [k] for a triangular CST element? 10M

OR

13. B). i) Derive shape fucntions for four noded isoparametric element. 5M

ii) Evaluate the integral I=$\int\int(2x^2 + 3xy + 4y^2)dx\,dy$ in the limits of -1 to +1 using gauss quadrature numerical integration (1 point and 2 point methods) and Verify with exact solution. 5M

14. A). Derive the finite element formulation for 1D steady-state heat conduction in a composite slab. Apply it to compute the temperature distribution across a slab with two layers of different thermal conductivities. 10M

OR

14. B). A metallic fin with thermal conductivity k=360 W/m ^{0}C, 0.001 m thick and 0.1m long, extends from a plane wall whose temperature is 235°C. How could you determine the temperature distribution and amount of heat transferred from the fin to the air at 20 °C with h= 9W/m^2C? Take the width of the fin to be 10 mm. 10M

15. A). Evaluate the eigenvalues, Eigen vectors and natural frequencies of a beam of cross section 360 cm^2 and of length 600 mm. Assume Young's modulus as 200 GPa, density 7850 kg/m^3 and moment of inertia of 3000 mm^4. Make two elements of 300 mm length each. 10M

OR

15. B). A 2D truss has two members forming a right triangle (nodes at (0,0), (1,0), (1,1)). Each member has area = 200 mm^2, E = 210 GPa, and density = 7850 kg/m^3. Compute the global mass matrix using consistent mass formulation and evaluate the first natural frequency. 10M

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CMR COLLEGE OF ENGINEERING & TECHNOLOGY
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Examination : **B.Tech VI Semester Regular Examinations June-2025**
Course Name : **Heat Transfer**
Course Code : **A403315**
Branch : **Mechanical Engineering**
Date & Session : **24-06-2025 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 conduction in the context of heat transfer. 1 M
2. Why is a problem called steady-state when the wall temperature profile no longer changes with time? 1 M
3. What is meant by variable thermal conductivity? Give one material where k varies strongly with temperature. 1 M
4. Explain the physical meaning of the Biot number (Bi) in transient conduction. 1 M
5. Name any three non-dimensional numbers commonly used in convection studies. 1 M
6. Why is dimensional analysis helpful before running a wind-tunnel experiment? 1 M
7. Define thermal entry length for laminar internal flow 1 M
8. When does natural (free) convection become dominant over forced convection around a vertical plate? 1 M
9. What is the difference between film boiling and nucleate boiling? 1 M
10. Why is the critical heat flux of practical concern to nuclear reactor engineers? 1 M

PART-B

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

11.A). Derive a general heat conduction equation in cartesian coordinate for 3-D. 10M

OR

11. B). A spherical gas container (inner Ø 2 m, k = 0.4 W m^{-1} K^{-1}) stores gas at 50°C while the ambient is 10°C. Determine the heat loss rate and the interface temperature if a 50-mm thick glass-wool insulation (k = 0.04 W m^{-1} K^{-1}) is added. Is the critical radius exceeded? 10M

12. A). An electrically heated plate (100 × 100 mm, k varies as k = 0.5 + 0.001 T W m^{-1} K^{-1} where T is in °C) is kept at 200°C on one side and 25°C on the other. Calculate the heat flux accounting for variable k (use average-k method). 10M

OR

12. B). Discuss how the Heisler charts are constructed for transient conduction and demonstrate, with a worked example, how engineers use them when analytical solutions are tedious. 10M

(P.T.O.)

13. A). Air at 20 °C blows over a 1 m-long flat plate maintained at 60 °C with free-stream velocity 5 m s^{-1}. Using suitable correlations, estimate (a) the local convective heat-transfer coefficient at x = 1 m and (b) the total heat lost from the plate width 0.3 m. 10M

OR

13. B). A person wants to model forced convection over a helicopter rotor blade in a wind tunnel. Design a similarity experiment by selecting proper Reynolds and Prandtl equivalence and calculate the required tunnel velocity if the model is 1/5-scale. 10M

14. A). Design a counter-flow shell-and-tube heat exchanger to cool 0.8 kg s^{-1} of water from 80 °C to 40 °C using 1 kg s^{-1} of cooling water entering at 25 °C, $\Delta T_{min} \geq 10$ °C, overall U = 800 W m^{-2} K^{-1}. Compute the required heat-transfer area by (a) LMTD and (b) NTU methods and comment on any difference. 10M

OR

14. B). Explain, with sketches, how hydrodynamic and thermal entry regions develop in pipe flow and discuss why designers sometimes insert honey-comb or nozzle sections at inlets. 10M

15. A). i) Explain boiling phenomena with a neat graph. 5M

ii) Define condensation and distinguish film wise and drop wise condensation. 5M

OR

15. B). Two large, parallel, diffuse-grey plates ($\varepsilon_1 = 0.8$, $\varepsilon_2 = 0.6$) exchange radiation. Plate 1 is at 900 K and plate 2 at 500 K. Find (a) the net radiative heat flux and (b) the percentage reduction if a polished aluminium shield ($\varepsilon = 0.05$) is introduced midway. 10M

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CMR COLLEGE OF ENGINEERING & TECHNOLOGY
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Examination : **B.Tech VI Semester Regular Examinations June-2025**
Course Name : **Refrigeration & Air Conditioning**
Course Code : **A403317**
Branch : **Mechanical Engineering**
Date & Session : **26-06-2025 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 COP and write its expression. 1 M
2. What is the Bell-Coleman cycle? 1 M
3. List the essential components of a vapour compression refrigeration system. 1 M
4. Identify and label the key processes on a T-s diagram of a simple vapour compression cycle. 1 M
5. Name any two commonly used refrigerants and their desirable properties. 1 M
6. What is the function of an expansion valve? 1 M
7. What is the principle of a vapor absorption system? 1 M
8. What is a vortex tube and how does it work? 1 M
9. Define Sensible Heat Factor (SHF). 1 M
10. List any two factors affecting human thermal comfort. 1 M

PART-B

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

11.A). Explain the working of Bell-Coleman cycle with a neat diagram. Derive an expression for its COP. 10M

OR

11. B). An aircraft refrigeration system operates on the Bell-Coleman cycle. Air enters the compressor at 1 bar and 270 K and is compressed to 4 bar. After cooling to 300 K, it expands back to 1 bar. Determine the COP and mass flow rate required for 20 kW refrigeration load. Assume $\gamma = 1.4$ and $cp = 1.005$ kJ/kg·K. 10M

12. A). Explain the p-h and T-s diagrams of a simple vapour compression refrigeration system with neat diagram. Discuss the effect of subcooling and superheating. 10M

OR

12. B). A vapour compression refrigeration system uses R-134a. The refrigerant enters the compressor at -10°C and leaves the condenser at 35°C. If the evaporator and condenser pressures are 2.5 bar and 9.5 bar respectively, determine the COP and refrigeration effect using p-h chart data. 10M

(P.T.O.)

13. A). Compare reciprocating and rotary compressors. Discuss their applications and limitations. 10M

OR

13. B). Explain the classification, construction, and working of condensers and evaporators. Also discuss the environmental impacts of refrigerants with examples. 10M

14. A). Describe the construction and working of a lithium bromide absorption refrigeration system. 10M

OR

14. B). Explain the working of (i) Thermoelectric refrigeration system and (ii) Vortex tube refrigeration system with suitable diagrams. 10M

15. A). Define and explain the concepts of SHF, RSHF, and ADP in air conditioning design. How are they used in load calculations? 10M

OR

15. B). An air conditioning system is required to handle 1000 m^3/h of air from an outdoor condition of 35°C DBT and 60% RH to an indoor condition of 25°C DBT and 50% RH. Determine the cooling load using a psychrometric chart. 10M

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CMR COLLEGE OF ENGINEERING & TECHNOLOGY
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Examination : **B.Tech VI Semester Regular Examinations June-2025**
Course Name : **Unconventional Machining Processes**
Course Code : **A403401**
Branch : **Mechanical Engineering**
Date & Session : **28-06-2025 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. Write any two characteristics of Unconventional Machining Processes. 1 M
2. Classify unconventional machining processes according to major energy source employed. 1 M
3. What are the desirable properties of carrier gas in Abrasive Jet Machining (AJM)? 1 M
4. What are the properties are expected from the electrolysis used in the Electrochemical machining (ECM)? 1 M
5. Name the most commonly used spark generating circuits in Electric Discharge Machining. 1 M
6. Identify the characteristics of an electrode material in order to serve as a good tool in Electric Discharge Machining (EDM). 1 M
7. What is solid state Laser? 1 M
8. What are the important process parameters of electron beam machining processes? 1 M
9. What is the main industrial application of plasma cutting systems? 1 M
10. Define abrasive flow machining. 1 M

PART-B

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

11.A). Explain the need for the development of Unconventional Machining Process by considering any four simple cases of your own interest. 10M

OR

11. B). What exactly are the items that can be considered with respect to the analysis of economics of various non – traditional machining processes? Briefly explain. 10M

12. A). Mention various elements of Abrasive Jet Machining (AJM) and explain them in brief. 10M

OR

12. B). Discuss about electrochemical Honing and Electrochemical Grinding with suitable sketches. 10M

13. A). Explain the process of wire cut EDM with respect to process equipment, applications, advantages and limitations. 10M

OR

13. B). Sketch different feasible dielectric flushing techniques applicable in case of EDM process? 10M

(P.T.O..)

14. A). Why is Electron beam machining carried out in vacuum? Explain the process with a neat sketch. 10M

OR

14. B). Explain the principle of Laser Beam Machining (LBM) with neat sketch and list out the advantages and disadvantages. 10M

15. A). Analyze non transferred and transferred modes of plasma arc machining (PAM). 10M

OR

15. B). Write about the Electro stream drilling process working principle with a neat diagram. 10M

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