Student Id

No. of Pages :

B Tech

Second semester (End Sem) Examination August 2023

Physics (PH101)

Branch : ETC, EEE & CE

Time 2.5 Hours

Max Marks : 50

(Answer any five questions)

1.(a) Discuss the phenomenon of double refraction or birefringence. Write the differences between positive and negative crystals. [5]

(b) A plane polarized light of wavelength 5893 Å is incident on thin quartz plate cut with faces parallel to the optics axis. Calculate (i) the minimum thickness of the plate, which introduces a phase differences 60° between ordinary and extraordinary rays (ii) find the minimum thickness of the plate for which the o-ray and e-ray will combine to produce plane polarized light. [5]

2. (a) How do you effectively realize coherent sources from incoherent light source. In Newton's ring experiment, it is observed that with a light of wavelength λ=5890 Å, the differences of squares of diameters of successive rings is 0.12 cm^2. What happens to this quantity if (i) λ is changed to 4840 Å (ii) a liquid of refractive index μ = 1.42 is introduced between the lens and glass (iii) the radius of plano-convex lens is doubled? [5]

(b) Monochromatic light of wavelength λ falls normally on a single-slit of width b. Show that intensities of the first and second secondary maxima are approximately 4.5% and 1.62% of principal maxima I_0 respectively. [5]

3.(a) Explain how classical theory cannot describe the blackbody radiation spectrum. Derive Plank's formula for blackbody radiation. [5]

(b) What are vector potential and scalar potential? Derive electromagnetic wave equation in terms of scalar and vector potential. [5]

4. (a) Calculate the expectation value of position for a particles trapped in infinite potential occupying ground state. [5]

(b) Why the minimum energy of a quantum mechanical oscillator is not zero? What is the minimum energy of harmonic oscillator of mass 10^{-30} kg if the frequency of oscillation is 10^{12} Hz. How much energy is required to excite the oscillator to first excited state? [5]

5. (a) State Gauss's divergence theorem. Evaluate $\iint \vec{A}.\vec{dS}$ where $\vec{A} = (2x + 3z)\hat{\imath} - (xz + y)\hat{\jmath} + (y^2 + 2z)\hat{k}$ and S is the surface of a sphere having centre at (3,-1,2) and radius 3. [5]

(b) Write the difference between Maxwell-Boltzmann statistics and Fermi-Dirac statistics. Under which condition Fermi-Dirac statistics reduces to Maxwell-Boltzmann statistics? [5]

6. (a) A body of mass 200 gm attached to a spring of spring constant 100 N/m. The whole system is inserted inside a liquid medium such that the oscillator undergoes critical damping. What is the damping constant of medium? [5]

(b) Two waves $\Psi_1 = 3\ sin\left(\omega t + \frac{\pi}{5}\right)$ and $\Psi_1 = 5\ sin\left(\omega t + \frac{\pi}{3}\right)$ superpose with each other. Write the resultant wave equation and calculate phase and amplitude of resultant wave. [5]

International Institute of Information Technology Bhubaneswar

Student ID :

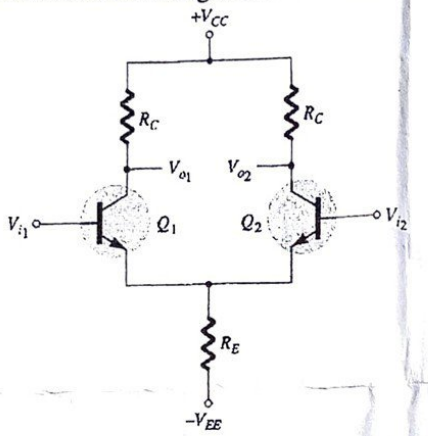
End Sem Examination 2023

Basic Electronics Engineering (ET21101)

Branch: CE/ETC/EEE | Duration: 2Hrs 30mins | Full Marks: 50

(Answer any FIVE questions)

01 a. Determine dc voltages and currents for the circuit given below. (5)



b. What do you mean by piezoelectric effect? Explain the operation of the oscillator circuit that is based on this effect. (5)

02. The efficiency of rectification η_r is defined as the ratio of dc output power, $P_{dc}=V_{dc}I_{dc}$, to the input power $P_i = \frac{1}{2\pi}\int_0^{2\pi} V_i i dt$. (3+3+4)

a. Show that for half wave rectifier circuit,

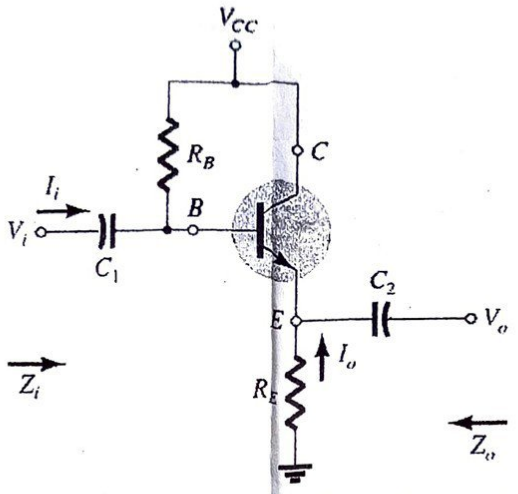
$\eta_r = \left(\frac{40.6}{1+(R_f/R_L)}\right)\%$, where R_f and R_L are the forward resistance of diode and load resistance of the rectifier circuit, respectively.

b. Show that for full wave rectifier circuit, η_r has twice the value given in (a).

c. Determine the ripple factor for half wave and full wave rectifier circuits.

03. For the circuit given below, derive the expression for input impedance, output impedance, and voltage gain. Why this circuit is called emitter follower? (10)

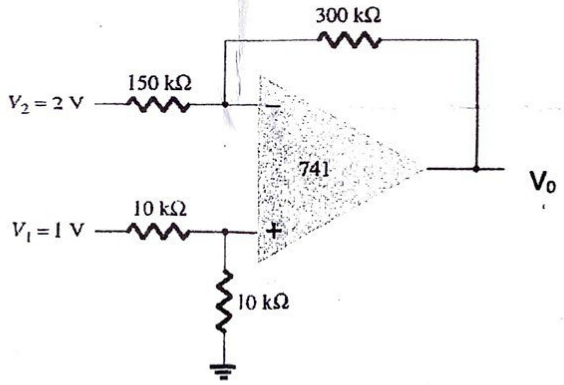
Student ID :



04 a. With proper diagram explain the construction and operation of p-channel DE-MOSFET and discuss the significance of pinch-off voltage. (5)

b. Compare between BJT, JFET, and MOSFET and find out which transistor is preferred for an amplifier design. (5)

05 a. Find the output voltage for the circuit given below: (5)



b. How Op-Amp can be used as a summing amplifier? Derive the input and output voltage relationship for it. At what condition, the magnitude of output voltage will be equal to the sum of all the input voltages? (5)

06 a. With the help of proper block diagram, explain the operation of a cathode ray oscilloscope. What is a Lissajous pattern, and how is it useful? (5)

b. How sine wave, triangular wave can be generated from square wave? With proper block diagram, explain the process. (5)

All The Best

Student Id | | | | | | | |

No. of Pages : 2

B Tech

2nd Semester (End-Semester) Examination August 2023

Data Structures (CS21102)

Branch :All

Time 2.5 HoursMax Marks : 50

Answer Q1 and any **four** from the rest.

1. Answer the following: **[2x5]**

A. Using the following recursive function, briefly explain how a stack is internally used when implementing recursion:

```
int factorial(int n)
{
      if (n==0)
            return 1;
         return n*factorial(n-1);
}
```

B. Write the pseudocode for a **single function**that takes a matrix and its dimensions as input and checks if it is sparse or not. A matrix is sparse if the number of non-zero elements in it is strictly less than half the total number of possible elements.

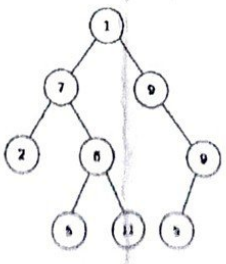
C. Write a function to traverse a linear linked list in reverse order, with only head pointer given.

D. Define the **structure for a single node** when a 3-variable polynomial is represented as a doubly linked list. Mention the significance of each structure member. What is the size of each such node?

E. Write the condition to check empty or full status of a linear queue.

2. A. Write the pseudocode for performing **Merge Sort** on a **linked list**. Perform the sorting for the given list: **L1 = {1, 9, 0, 2, 6, 3, 8, 4, 5, 7}** **[5x2]**

B. Write a non-recursive algorithm to traverse a binary tree in pre-order. Hence find the pre-order traversal of the following binary tree:



3. A. The level-order traversal of a binary search tree T is given as: **[5x2]**

46, 16, 85, 9, 21, 52, 107, 2

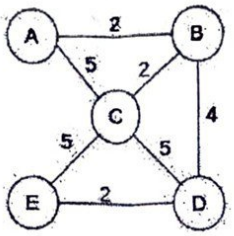
Build the tree T and find its inorder, preorder, andpostordertraversals.

B. Construct an AVL tree for the given numbers, showing the balance factor for each node:

2, 1, 3, 4, 5, 6, 7, 8

4. A. Derive the minimum spanning tree (MST) for the given graph using Prim's algorithm. **[5x2]**

B. Find the shortest path from vertex **'A'** to **'E'** in the same graph using Dijkstra's algorithm.



5. A. Show detailed steps to convert the given infix expression to postfix using a stack and **distinct BEDMAS-based priority** (no associativity to be considered): **[5x2]**

A^B*C-(D*E/F)+G

Henceevaluate the obtained postfix with the values:

A=2, B=4, C=3, D=5, E=6, F=8, G=7

B. Demonstrate with an example how to implement a stack using two queues.

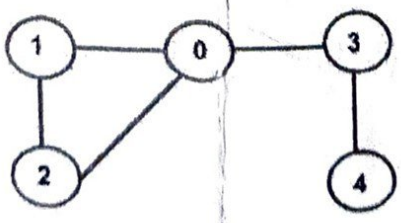
6. A. What is the length of the longest chain if the following keys are inserted into a table of **size 9** using **modulo division** and **separate chaining**? **[5x2]**

11, 22, 33, 44, 1, 2, 3, 5, 7

B. Also find the result when the same values are inserted into an empty table using the hash function **(5x+4) mod 9** with **linear probing**.

7. A. Write the pseudocode for sorting an unsorted array using a max-heap. **[5x2]**

B. Write the pseudocode for Breadth-First Traversal on a graph. Find all possible BFS order from the following graph with source '0':



Student Id | | | | | | | |

No. of Pages : 1 B Tech

2nd Semester (End-Semester) Examination August 2023

Communication Skills II (Professional English) HM21102

Branch :All

Time 2.5 Hours Max Marks : 50

Answer ALL.

1. Distinguish between General and Business Communication. Mention the fundamental principles of Business Communication with examples. **(10)**

2. Explain 3 important stages of the writing process. Prepare an idea map on the topic 'Digital Literacy'. **(10)**

3. As the HR manager, which approach of communication (Direct/Indirect) would you adopt while conveying the following messages.Draft a brief email in **BOTH** the cases demonstrating the chosen approach. **(10)**

   a. Change of Lunch Hour from 2-3 pm to 1-2 pm in your company.

   b. Postponement of Annual Increments and Appraisals of employees.

4. You are a fresh graduate in Engineering with only brief work experience of summer internships. Draft a **resumé** for the position of Systems Engineer at KPMG highlighting the required skill-set. Invent necessary details. **(10)**

5. The Government of Odisha has invited proposals from various State universities to set up a 'Communication Technology Centre' in Bhubaneswar for training professionals in the use of latest technological aids for face-to-face and distance communication. Assuming yourself to be the Dean of Communication of your university, write a technical **proposal** to the Director of Education, Government of Odisha, for necessary funding required to set up this Centre. Invent necessary details. **(10)**

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Student Id- .....

No. of Pages: 02 B.Tech 2nd Sem

End Semester Examination, Aug 2023

Mathematics-II (2023)

Branch : CSE, CE, IT, EEE & ETC

Time : 2 : 30 Hours

Max Marks : 50

Answer any **five** of the following questions.
The figures in the right hand margin indicate marks.

1. (a) Let $T : \mathbf{R}^2 \longrightarrow \mathbf{R}^3$ be a linear transformation. Let $A = \begin{bmatrix} 1 & 2 \\ 2 & 3 \\ 3 & 4 \end{bmatrix}$ be the matrix representation of the linear transformation T with respect to the order basis vector $v_1 = [1, 2]^T$, $v_2 = [3, 4]^T$ in $\mathbf{R}^2$ and $w_1 = [-1, 1, 1]^T$, $w_2 = [1, -1, 1]^T$, $w_3 = [1, 1, -1]^T$ in $\mathbf{R}^3$, then determine the linear transformation T. (4)

(b) Find the basis and dimension of the subspace W of the vector space $\mathbf{R}^3$ (2)

$$W = \{(x_1, x_2, x_3) \in \mathbf{R}^3 |\ 2x_1 - x_2 + 3x_3 = 0,\ x_1 + x_2 + x_3 = 0\}$$

(c) Find the inverse using Gauss-Jordan elimination method of the matrix (4)

$$A = \begin{bmatrix} -1 & 1 & 2 \\ 3 & -1 & 1 \\ -1 & 3 & 4 \end{bmatrix}.$$

2. (a) If $\int_0^{t^2} xf(x)dx = \frac{2}{5}t^5$ for $t > 0$, then find the value of $f(\frac{4}{25})$. (2)

(b) Calculate the area which is inside the cardioid $r = 2(1 + \cos\theta)$ and outside the circle $r = 2$. (5)

(c) Evaluate: $\int_0^1 x^n (\ln x)^m dx$. (3)

3. (a) Evaluate the Integral using reduction formula: (3)

$$\int_0^{2a} \frac{x^3}{\sqrt{2ax - x^2}} dx$$

(b) Find the area of the trapezium (using Integration) whose vertices are $(1, 3), (2, 1), (5, 3)$ and $(4, 1)$. (3)

(c) Show that $\int_C \vec{F} \cdot d\vec{r}$ is independent of the path of integration from $(1,2,2)$ to $(2,3,4)$. Where $\vec{F} = (yz-1)\hat{i} + (z+xz+z^2)\hat{j} + (y+xy+2yz)\hat{k}$. Also evaluate the above integral. (4)

4. (a) Evaluate the integral (3)

$$\oint_C x^2 y dx + x dy$$

where C is a triangle whose vertices are $(0,0)$, $(1,0)$ and $(1,2)$ in anti-clockwise direction.

(b) Find the equation of normal to the surface $x^2 - 3y^2 - z^2 = 2$ at $(3,1,2)$. Also, find the directional derivative of the given surface at $(3,1,2)$ in the direction $\vec{b} = 3\hat{i} + 4\hat{j} + 5\hat{k}$. (2)

(c) Find the outward flux of the vector field $\vec{F} = x^3\hat{i} + y^3\hat{j} + z^2\hat{k}$ across the surface of the region that is enclosed by the circular cylinder $x^2 + y^2 = 9$ and the planes $z = 0$ and $z = 2$. (5)

5. (a) Find all the Eigenvalues and Eigenvector of the matrix $A = \begin{bmatrix} 1 & -1 & 4 \\ 3 & 2 & -1 \\ 2 & 1 & -1 \end{bmatrix}$. (5)

(b) Perform Five iterations of the Secant method to obtain the approximate value of $\sqrt[3]{48}$. (5)

6. *(a) Evaluate the integral* (2.5)

$$I = \int_0^1 \frac{1}{1+x} dx$$

using trapezoidal rule with $h = 0.5$.

(b) Using 4-segment Simpson's $\frac{1}{3}$ rule to integrate $f(x) = 0.2 + 25x + 3x^2 + 2x^4$ from $a = 0$ to $b = 2$. (2.5)

(c) For the following data, construct the the forward and backward difference table. Using corresponding interpolating polynomials. Show that both are same. (5)

x	-4	-2	0	2	4	6
f(x)	-139	-21	1	23	141	451

Student Id

No. of Pages: 2

B Tech

2nd Semester End Examination Aug 2023

Subject: Basic Electrical Technology

Branch: CSE & IT

Time 2.5 Hours

Max Marks: 5

Answer any five questions including question no 1.

The figures in the right-hand margin indicate marks

1. Answer all the questions: [2x5]

a) Define linear and non-liner elements. State superposition theorem.

b) Define active, reactive and apparent power of an ac circuit. Also find the power factor from power triangle.

c) Define time constant in transient R-L and R-C circuit. Also determine its unit.

d) A three-phase, 50Hz, 4-pole induction motor has a slip of 4%. Calculate the speed of the motor.

e) Draw the phasor diagram of an ideal transformer at no-load condition with equivalent circuit.

2. a) Using Nodal analysis determine the voltages V_1 and V_2 in the network of Fig.1. [5]

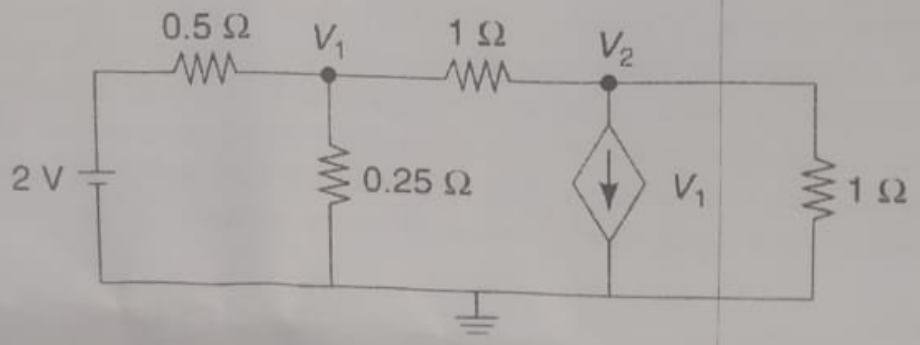


Fig.1

b) Briefly discuss the working of nuclear power plant with schematic diagram. [5]

3. a) Using Norton's Theorem find the current through the 10Ω resistor in Fig.2. [5]

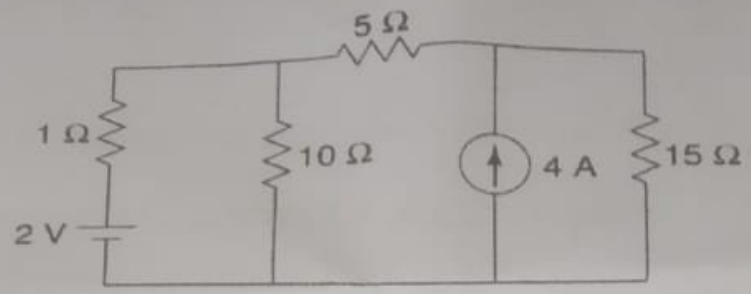


Fig.2

b) Classify different types of measuring instruments. Explain the construction and working of Electro-dynamo meter type wattmeter (EMMC Type). [5]

4.a) Two circuits A and B are connected in parallel to a 200V ac supply. Circuit A consists of a resistance of 10Ω in series with an inductive reactance of 10Ω and circuit B consists of a resistance of 20Ω in series with a capacitive reactance of 10Ω.Find the current taken by each circuit and the total current. Find also the power factor of the circuit. [5]

b) With the aid of a phasor diagram obtain the relationship between the line and phase values of voltage in a three-phase, star connected system. Three coils, each with resistance of 45Ω and with inductance 0.2H, are connected to a 415V, three-phase supply at 50Hz in delta. Calculate the current in each coil and the total power in the circuit. [5]

5.a) A 440V DC compound generator has an armature series field and shunt field resistance of 0.5 Ω, 1.0 Ω and 200 Ω respectively. Calculate the generated voltage while delivering 40 A to external circuit for both Long Shunt and Short Shunt Connections. [5]

b) A magnetic ring has a mean circumference of 1.5m and is of 0.01 m^2 in cross section and is wound with 175 turns. A saw cut of 4mm wide is made in the ring calculate the magnetizing current required to produce flux of 0.8 mWb in the air gap. Assume permeability of the as 400. [5]

6.a) The iron loss of an 80 kVA, 1000/250 V, 50 Hz transformer is 800 W. The copper loss, when primary carries 50 A is 400 W. Estimate: i) Area of Cross- Section of Limb, if working flux density is 1 tesla and there are 1000 turns on primary (hv winding) ii) current ratio iii) efficiency at full load and 0.8 p.f iv) efficiency for a load, when copper loss will equal iron loss, and p.f. remains 0.8 lag. [5]

b) Derive the torque equation of a D.C Motor. A 250V D.C shunt motor runs at 1000 r.p.m at no load takes 9A. The total armature and shunt field resistances are 0.3Ω and 250Ω respectively. Calculate the speed while taking 52A from the supply. Assume flux to be constant. [5]

**********All the best**********

Students Id:

BTECH
ME21101

End-semester Examination – Aug.2023

Basic Mechanical Engineering

BRANCH: CSE/IT/CE

Time: 2 and 1/2 Hours **Max marks: 50**

Answer any five. (Each question carries equal marks)

1. (a) On the string ACEDB are hung three equal weights Q symmetrically placed with respect to the vertical line through the mid-point E (Fig. 1). Determine the value of the angles β if the other angles are as shown in Fig. 1. [5]

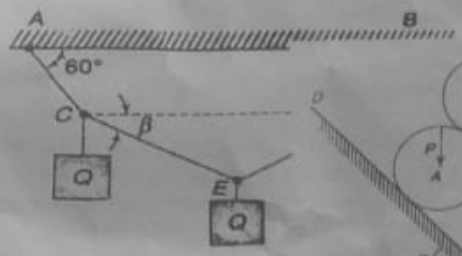


Fig.1

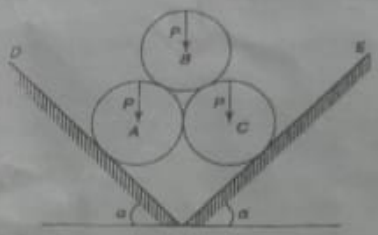
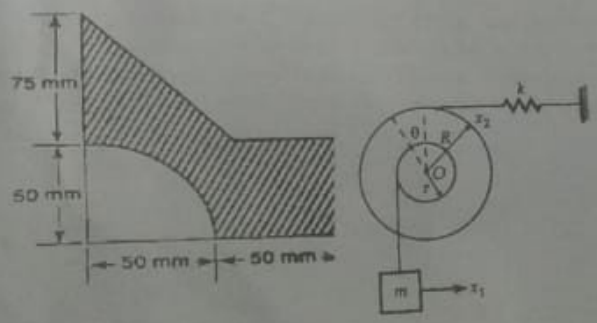


Fig.2

(b) In Fig. 2, three smooth right circular cylinders, each of radius r and weight P, are arranged on smooth inclined surfaces as shown. Determine the least value of angle α that will prevent the arrangement from slipping. [5]

2. (a) With respect to coordinate axes x and y, locate the centroid of the shaded area shown in Fig. 3, and calculate the area moment of inertia about the centroidal x-axis.[6]



(b) derive the expression of the natural frequency of the given configuration shown in Fig.4 [4]

3. (a) A solid circular shaft is to transmit 300 kW at 100 r.p.m. If the shear stress is not to exceed 80 N/mm2 find the diameter of the shaft. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, the material and the maximum shear stress being the same.
[5]
(b) The body of a freight car weighs 222.5 kN when empty and is observed to settle 75 mm during the loading of 267 kN of cargo. What period of vertical vibration will the car have on its springs: (a) when loaded; (b) when empty? [5]

4. (a) Draw the shear force and bending moment diagram for the given beam as shown in Fig. 5, also mention the point of contraflexure in the beam. [7]

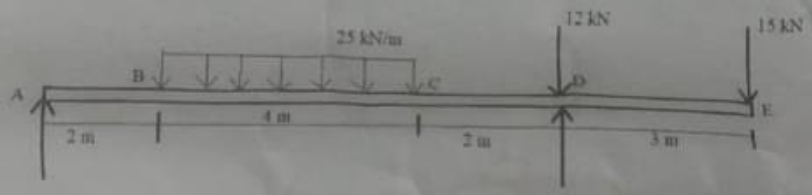


Fig.5

(b) Define pure bending, and write the assumptions in the theory of pure bending. [3]

5. (a) In a water-cooling tower air enters at a height of 1m above the ground level and leaves at height of 7m. the inlet and outlet velocities are 20 m/s and 30 m/s respectively. Water enters at a height of 8m and leaves at a height of 0.8 m. the velocities of water at entry and exit are 3 m/s and 1 m/s respectively. Water temperatures are 80 °C and 50 °C at the entry and exit respectively. Air temperatures are 30 °C and 70 °C at the entry and exit respectively. The cooling tower is well insulated and a fan of 2.25 kW drives the air through the cooler. Find the mass flow of air per second required for 1 kg/s of water flow. The value of c_p of air and water are 1.005 and 4.187 kJ/kg K respectively. [6]

(b) A mass of air is initially at 260°C and 700 kPa and occupies 0.028 m³. The air is expanded at constant pressure to 0.084 m³. A polytropic process with n = 15 is then carried out followed by a constant temperature process which completes a cycle. All the processes are reversible.
i) Draw the p-v diagram.
ii) Find the heat received and rejected in the cycle.
iii) Find the efficiency of the cycle. [4]

6. (a) A piston-cylinder device contains 0.05 m^3 of gas initially at 200 kPa and at this stage a linear spring having stiffness 150 N/m is attached with the piston without exerting any spring force on it. Now heat is supplied to the gas causing the piston to raise and to compress the spring until the volume inside the cylinder doubles. If the cross-sectional area of the piston is 0.25 m^2. Find the final pressure of gas inside the cylinder. [4]

(b) A heat pump working on the Carnot cycle takes heat from a reservoir at 5 °C and delivers to a reservoir at 60 °C. The heat pump is driven by a reversible heat engine which takes in a heat from reservoir at 840 °C and rejects heat to a reservoir at 60 °C. The reversible heat engine also drives a machine that absorbs 30 kW. If the heat pump extracts 17 kJ/s of heat, determine (a) the rate of heat supply from the reservoir at 840 °C, and (b) the rate of heat rejection to the 60 °C sink. [6]

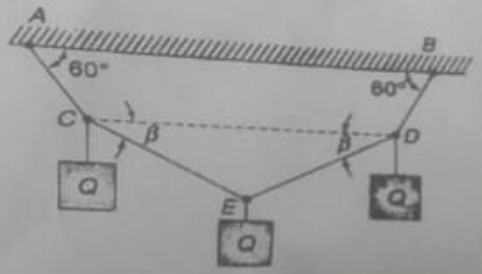


Fig. 1

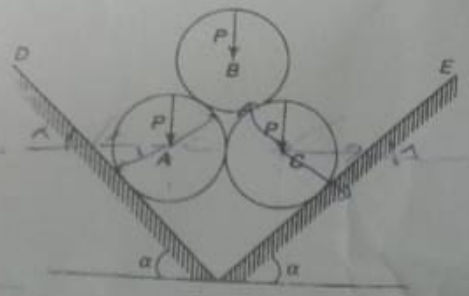


Fig.2

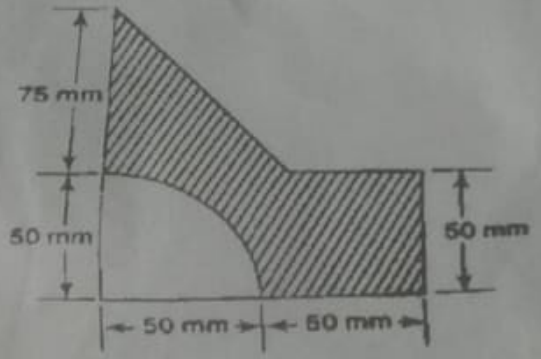


Fig. 3

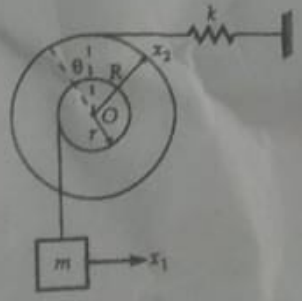


Fig. 4