SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

Electronics and Instrumentation Engineering

QUESTION BANK

III SEMESTER

ME3366– APPLIED FLUID DYNAMICS AND THERMO DYNAMICS

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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

SUBJECT   : ME3366– APPLIED FLUID DYNAMICS AND THERMO DYNAMICS

SEM / YEAR: III Semester / II Year EIE

UNIT I - BASIC CONCEPT OF FLUID MECHANICS & FLOW OF FLUIDS			
Introduction – classification - types of fluids – properties - laws of pressure - atmospheric, gauge, absolute pressure, pressure measurement – manometers - mechanical gauges. Head of a liquid - Bernoulli's theorem - orifice and venturi meter.			
PART A (2 Marks)			
Q. No.	Questions	CO	BT Level	Competence
1	Describe Fluid mechanics.	1	1	Remember
2	Compare the term fluid statics, fluid kinematics and fluid dynamics.	1	2	Understand
3	Define Mass Density.	1	1	Remember
4	What does Weight Density mean?	1	1	Remember
5	Define Specific Volume.	1	1	Remember
6	What does Specific Gravity mean?.	1	1	Remember
7	Solve the specific weight, density and specific gravity of one litre of a liquid which weighs 7 N.	1	2	Understand
8	Draw the shear stress-velocity gradient profile for non-Newtonian fluid.	1	2	Understand
9	Construct the shear stress-velocity gradient profile for Ideal plastic fluid.	1	2	Understand
10	Draw the shear stress-velocity gradient profile for Newtonian fluid.	1	2	Understand
11	Define surface tension and capillarity.	1	1	Remember
12	When is a fluid considered steady and when it is unsteady?	1	1	Remember
13	Define Pascal's law.	1	1	Remember
14	Describe the Hydrostatic law.	1	1	Remember
15	Differentiate kinematic viscosity with dynamic viscosity.	1	2	Understand
16	Summarize the terms Absolute pressure, Gauge pressure and Vacuum Pressure.	1	2	Understand

17	Define the term buoyancy.	1	1	Remember
18	Classify the different types of manometers.	1	2	Understand
19	Define Newton's second law of motion.	1	1	Remember
20	List out the phenomena responsible for capillary rise or fall.	1	2	Understand
21	List out the devices used to measure the fluid pressure.	1	2	Understand
22	What is viscosity?	1	1	Remember
23	Compare uniform flow and non-uniform flow.	1	2	Understand
24	Lable Bernoulli's theorem mathematically.	1	1	Remember
25	List out the forces involved in fluid flow.	1	2	Understand

PART B (16 Marks)

Q. No.	Questions	CO	BT Level	Competence
1	**(i)** Explain any four properties of hydraulic fluid. **(10)**	1	3	Apply
	(ii) Explain the dynamic viscosity and kinematic viscosity and variation of viscosity with temperature. **(6)**	1	3	Apply
2	**(i)** Explain the types of fluids and draw the shear stress-velocity gradient profile for each fluid **(7)**	1	3	Apply
	(ii) Calculate the density, specific weight and weight of one litre of petrol of specific gravity 0.7. **(6)**	1	3	Apply
3	**(i)** A plate 0.025 mm distant from a fixed plate, moves at 60 cm/s and requires a force of 2 N per unit area (i.e., 2 N/m^2) to maintain this speed. Calculate the fluid viscosity between the plates. **(7)**	1	3	Apply
	(ii) A flat plate of area 1.5 x 10^6 mm^2 is pulled with a speed of 0.4 m/s relative to another plate located at a distance of 0.15 mm from it. Calculate the force and power required to maintain the speed if the fluid separating them is having viscosity as 1 poise. **(6)**	1	3	Apply
4	The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine: (i) Dynamic viscosity of the oil in poise. (ii) Kinematic viscosity of the oil in stoke if the specific gravity of the oil is 0.95.	1	4	Analyze

5	(i)The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Calculate the pressure of fluid in the pipe if the difference of mercury level in the two limb is 20 cm. **(7)**	1	3	Apply
	(ii) A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Calculate the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below. **(6)**	1	3	Apply
6	A U- Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mecury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, Calculate the new difference in the level of mercury. Sketch the arrangements in both cases.	1	3	Apply
7	A hydraulic press has a ram of 30 cm diameter and a plunger of 4.5 cm diameter. Calculate the weight lifted by the hydraulic press when the force applied at plunger is 500 N. **(7)**	1	3	Apply
	A hydraulic press has a ram of 20 cm diameter and a plunger of 3 cm diameter. It is used for lifting a weight of 30kN. Calculate the force required at the plunger. **(6)**	1	3	Apply
8	The water is flowing through a pipe having diameters 20 cm and 10 cm at section 1 and 2 respectively. The rate of flow through pipe is 35 litres/sec. The section 1 is 6 m above datum and section 2 is 4 m above the datum. If the pressure at section 1 is 39.24 N/cm^2, Calculate the intensity of pressure at section 2.	1	4	Analyze

9	Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm² and the pressure at the upper end is 9.81 N/cm². Determine the difference in datum head if the rate of flow through pipe is 40 litre/sec.	1	4	Analyze
10	The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end 300 mm at the lower end, at the rate of 50 litre/sec. the pipe has slope of 1 in 30. Calculate the pressure at the lower end if the pressure at the higher level is 19.62 N/cm².	1	3	Apply
11	The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates ar 190 r.p.m. Calculate the power lost in the bearing for sleeve length of 90 mm. the thickness of the film is 1.5 mm.	1	3	Apply
12	The space between two square flat parallel plates is filled with oil. Each side of the plate is 80 cm. The thickness of the oil film is 15 mm. The upper plate, which moves at 3 m/s requires a force of 98.1 N to maintain the speed. Determine: (i) Dynamic viscosity of the oil in poise. (ii) Kinematic viscosity of the oil in stoke if the specific gravity of the oil is 0.95.	1	3	Apply
13	The water is flowing through a pipe having diameters 30 cm and 15 cm at section 1 and 2 respectively. The rate of flow through pipe is 40 litres/sec. The section 1 is 7 m above datum and section 2 is 5 m above the datum. If the pressure at section 1 is 42 N/cm², Calculate the intensity of pressure at section 2.	1	3	Apply
14	Horizontal pipe carrying water is gradually tapering. At one section the diameter is 150 mm and flow velocity is 1.5 m/s. If the drop in pressure is 1.104 bar at a reduced section, measure the diameter of that section. If the drop is 5 kN/m², what will be the diameter? — Neglect losses.	1	3	Apply
15	Categorize the classification and theory of different types of mechanical gauges for pressure measurement.	1	3	Apply

16	A 300 mm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/s. If the axis of the pipe turns through 45°, determine the magnitude and direction of the resultant force at the bend.	1	3	Apply
17	A vertical pipe conveying oil of specific gravity 0.8, two pressure gauges have been installed at A and B where the diameter are 16 cm and 8 cm respectively. A is 2 m above B. The pressure gauge readings have shown that the pressure at B is greater than at A by 0.981 N/cm^2. Neglecting all losses, calculate the flow rate. If the gauges at A B are replaced by tubes filled with the same liquid and connected to a U-tube containing mercury, calculate the	1	3	Apply
18	A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at the throat is 30 cm of mercury. Determine the discharge of water through venturimeter. Take C$_d$ = 0.98.	1	3	Apply

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UNIT II - DIMENSIONAL ANALYSIS			
Introduction – dimensions - dimensional analyses - Rayleigh's and Buckingham's method.			
PART A (2 Marks)			
Q. No.	Questions	CO	BT Level	Competence
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1	Describe the term dimensional analysis.	2	1	Remember
2	Define fundamental quantity	2	1	Remember
3	Define derived quantity.	2	1	Remember
4	Enumerate the symbol and dimensions for following physical quantity. (i) Length, (ii) Mass, (iii) Time.	2	1	Remember
5	Enumerate the symbol and dimensions for following physical quantity. (i) Area, (ii) Volume, (iii) Time.	2	1	Remember
6	Quote the symbol and dimensions for following physical quantity. (i) Velocity, (ii) Angular velocity, (iii) Acceleration.	2	1	Remember
7	Name the symbol and dimensions for following physical quantity. (i) Angular Acceleration, (ii) Discharge.	2	1	Remember
8	Quote the symbol and dimensions for following physical quantity. (i) Acceleration due to gravity, (ii) Kinematic Viscosity.	2	1	Remember
9	Name the symbol and dimensions for following physical quantity. (i) Force, (ii) Weight. (iii) Density.	2	1	Remember
10	Quote the symbol and dimensions for following physical quantity. (i) Specific Weight, (ii) Dynamic Viscosity. (iii) Pressure Intensity.	2	1	Remember
11	Enumerate the symbol and dimensions for following physical quantity. (i) Modulus of Elasticity, (ii) Surface Tension. (iii) Shear	2	1	Remember
12	Enumerate the symbol and dimensions for following physical quantity. (i) Work, (ii) Power.	2	1	Remember
13	Write the symbol and dimensions for following physical quantity. (i) Torque, (ii) Momentum.	2	1	Remember
14	Define Dimensional Homogeneity.	2	1	Remember
15	List out the methods of dimensional analysis	2	1	Remember
16	List out the advantages of Dimensional analysis.	2	2	Understand

17	Describe the Rayleigh's method for dimensional analysis.	2	2	Understand
18	Summarize the Buckingham's π – theorem.	2	2	Understand
19	Apply dimensional homogeneity for the equation v = u + at.	2	2	Understand
20	What does repeating variables mean?	2	1	Remember
21	How to calculate the number of π terms while applying Buckingham's π theorem.	2	1	Remember
22	How are the repeating variables selected for dimensional analysis?	2	1	Remember
23	What are the significances of Buckingham's π theorem?	2	1	Remember
24	What are the needs of dimensional analysis?	2	1	Remember
25	Compare Rayleigh's method with Buckingham's method.	2	2	Understand

PART B (16 Marks)				
Q. No.	Questions	CO	BT Level	Competence
1	(i) Demonstrate the criteria for selecting repeating variable in this dimensional analysis? (7)	2	3	Apply
	(ii) Relate whether the following equation is dimensionally homogeneous. T = 2$\pi\sqrt{(L/g)}$. (6)	2	3	Apply
2	Categorize the selecting repeating variable in dimensional analysis.	2	3	Apply
3	(i) Demonstrate the Rayleigh's method of dimensional analysis with an example. (9)	2	3	Apply
	(ii) Point out the advantages of dimensional analysis. (4)	2	3	Apply
4	Determine the dimension of the quantities given below : (i) Angular velocity, (ii) Angular acceleration, (iii) Discharge, (iv) kinematic viscosity, (v) force, (vi) Specific weight and (vii) Dynamic viscosity, (viii) velocity, (ix) Work and (x) Power.	2	4	Analyze
5	The time period (t) of a pendulum depends upon the length (L) of the pendulum and acceleration due to gravity (g). Derive an expression for the time period.	2	3	Apply
6	Determine an expression for the drag force on the smooth sphere of diameter D, moving with a uniform velocity V in a fluid of density ρ and dynamic viscosity μ.	2	4	Analyze

7	Determine the expression for the power P, developed by a pump when P depends upon the head H, the discharge Q and specific weight w of the fluid.	2	3	Apply
8	The efficiency η of a fan depends on the density ρ, the viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and the discharge Q. Compute η in terms of dimensionless parameters.	2	4	Analyze
9	The resisting force (R) of a supersonic plane during flight can be considered as dependent upon the length of the air craft 'l', velocity 'V', air viscosity 'μ', air density 'ρ' and bulk modulus of air is 'K'. Compute the functional relationship between these variables and the resisting force. By using Rayleigh's method.	2	3	Apply
10	A partial sub- merged body is towed in water. The resistance R to its motion depends on the density ρ, the viscosity μ of water, length l of the body, velocity v of the body and the acceleration due to gravity g. Develop that the resistance to the motion can be expressed in the form $$R = \rho L^2 V^2 \, \phi\left[\left(\frac{\mu}{\rho VL}\right)\cdot\left(\frac{lg}{V^2}\right)\right].$$ By using Rayleigh's method.	2	3	Apply
11	The efficiency η of a fan depends on the density ρ, the viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and the discharge Q. Develop η in terms of dimensionless parameters. By using Buckingham's π-theorem.	2	4	Analyze
12	Using Buckingham's π-theorem, Compute that the velocity through a circular orifice is given by $$V = \sqrt{2gH} \; \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right],$$ Where H is the head causing flow, D is the diameter of the orifice, μ is the co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity.	2	3	Apply

13	The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ, and roughness k. Using Buckingham's π-theorem, Compute an expression for Δp.	2	3	Apply
14	The pressure difference Δp in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity μ, density ρ. Using Buckingham's π-theorem, determine an expression for Δp.	2	3	Apply
15	Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity ω, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ, and elasticity of the fluid medium which can be denoted by the speed of sound in medium C.	2	3	Apply
16	Compute the expression for the power P, developed by a pump when P depends upon the head H, the discharge Q and the specific weight w of the fluid.	2	3	Apply
17	Demonstrate the procedure for solving problems by Buckingham's π-theorem.	2	3	Apply
18	A partial sub- merged body is towed in water. The resistance R to its motion depends on the density ρ, the viscosity μ of water, length l of the body, velocity v of the body and the acceleration due to gravity g. Compute that the resistance to the motion can be expressed in the form by using Buckingham's π-theorem $$R = \rho L^2 V^2 \ \phi\left[\left(\frac{\mu}{\rho VL}\right)\cdot\left(\frac{lg}{V^2}\right)\right].$$	2	3	Apply

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UNIT III - PUMPS AND TURBINES

Introduction - types of pumps - reciprocating pump - construction details - co-efficient of discharge – slip - power required - centrifugal pump – classification - working principle - specific speed – turbines – classification – working principle

PART A (2 Marks)

Q. No.	Questions	CO	BT Level	Competence
1	Define the reciprocating pump.	3	1	Remember
2	List out the main parts of the reciprocating pump.	3	2	Understand
3	Describe the slip in the reciprocating pump.	3	2	Understand
4	State the indicator diagram in the reciprocating pump.	3	1	Remember
5	Define Pumps.	3	1	Remember
6	Recall suction head.	3	1	Remember
7	Define delivery head.	3	1	Remember
8	Define Impeller.	3	1	Remember
9	Describe the Casing in the centrifugal pump.	3	2	Understand
10	List out the types of casings commonly adopted in pumps.	3	2	Understand
11	Illustrate the vortex casing.	3	2	Understand
12	Illustrate the velocity triangles at inlet and outlet tips of the vanes fixed to an impeller.	3	2	Understand
13	State centrifugal pump.	3	1	Remember
14	List out the parts of a centrifugal pump.	3	2	Understand
15	Recall Static head.	3	1	Remember
16	Define Manometric Head.	3	1	Remember
17	Recall Manometric Efficiency.	3	1	Remember

18	Recall the mechanical efficiency of the centrifugal pumps.	3	1	Remember
19	Define overall efficiency in centrifugal pumps.	3	1	Remember
20	Recall the Specific speed of a centrifugal pump.	3	1	Remember
21	Describe the phenomenon of cavitation.	3	2	Understand
22	List out the effect of cavitation.	3	2	Understand
23	Define Air vessels.	3	1	Remember
24	Compare the centrifugal and reciprocating pumps.	3	2	Understand
25	Construct the reciprocating pump.	3	2	Understand

PART B (16 Marks)

Q. No.	Questions	CO	BT Level	Competence
1	Construct and explain the working principle of a reciprocating pump.	3	3	Apply
2	The length and diameter of a suction pipe of a single-acting reciprocating pump are 5 m and 10 cm respectively. The pump has a plunger of diameter 15 cm and a stroke length of 35 cm. The centre of the pump is 3 m above the water surface in the pump. The atmospheric pressure head is 10.3 m of water and pump is running at 35 r.p.m. Determine: (i) Pressure head due to acceleration at the beginning of the suction stroke. (ii) Maximum pressure head due to acceleration, and (iii) Pressure head in the cylinder at the beginning and at the end of the stroke.	3	3	Apply
3	(i) Construct and explain the velocity triangle of the centrifugal pump. (8)	3	3	Apply
	(ii)Construct and discuss the performance curves of the centrifugal pump. (5)	3	3	Apply
4	A single-acting reciprocating pump, running at 50 rpm, delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and the stroke of 400 mm. Determine (i) the theoretical discharge of the pump, (ii) the coefficient of discharge, and (iii) the Slip and the percentage slip of the pump.	3	4	Analyze

5	A double-acting reciprocating piston pump is pumping water (diameter of the piston 250 mm, diameter of piston rod, which is on one side of the piston 50 mm, piston stroke 380 mm). The suction and discharge heads are 4.5 m and 18.6 m respectively. Calculte the work done by the piston during the outward stroke. Would the work do change for the inward stroke?	3	3	Apply
6	Develop short notes on the following i)Indicator diagram of single-acting reciprocating pump. **(5)** ii)Priming of the pump. **(4)** iii)Specific speed of the pump. **(4)**	3	3	Apply
7	The cylinder bore diameter of a single-acting reciprocating pump is 150 mm and its stroke is 300 mm. The pump runs at 50 r.p.m. and lifts water through a height of 25 m. The delivery pipe is 22m long and 100 mm in diameter. Determine the theoretical discharge and the theoretical power required to run the pump. If the actual discharge is 4.2 litres/sec, find the percentage slip. Also determine the acceleration head at the beginning and middle of the delivery stroke.	3	3	Apply
8	A single-acting reciprocating pump has a piston diameter of 12.5 cm and a stroke length of 30 cm. The center of the pump is 4 m above the water level in the sump. The diameter and length of the suction pipe are 7.5 cm and 7 m respectively. The separation occurs if the absolute pressure head in the cylinder during the suction stroke falls below 2.5 m of water. Calculate the maximum speed at which the pump can run without separation. Take atmosphere pressure head = 10.3 m of water.	3	3	Apply
9	Develop the expression for the following: i)Specific speed of the pump. **(4)** ii)Power required to drive reciprocating pump. **(4)** iii)Coefficient of discharge in reciprocating pump. **(5)**	3	3	Apply

10	A Pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 liters/sec under a head of 30 m. The buckets deflect the jet through an angle of 160°. Identify the power given by the water to the runner and the hydraulic efficiency of the turbine. Assume the coefficient of velocity as 0.98.	3	3	Apply
11	Pelton wheel is to be designed for the following specifications: Shaft power = 11,7772 kW, Head = 380 m, Speed = r.p.m., Overall efficiency = 86%, Jet diameter is not to exceed one-sixth of the wheel diameter. Determine (i) The wheel diameter, (ii) The number of jets required, and (iii) the diameter of the jet.	3	3	Apply
12	A double-acting reciprocating pump, running at 40 r.p.m. is discharging 1 m^3 of water per minute. The pump has a stroke length of 400 mm. The diameter of the piston is 200 mm. The delivery and suction heads are 20 m and 5 m respectively. Determine the power required to drive the pump and the slip of the pump.	3	4	Analyze
13	Construct and explain the working principle of the centrifugal pump with a neat sketch.	3	3	Apply
14	Point out the classification of turbines and explain the working of the Pelton wheel with a neat sketch.	3	3	Apply
15	Demonstrate the construction and working of the Francis turbine with neat sketch	3	3	Apply
16	Compare and contrast Francis turbine and Pelton wheel with simple sketches.	3	3	Apply
17	Demonstrate the working principle of Kaplan turbine with neat sketch.	3	3	Apply
18	A Pelton wheel is having a mean bucket diameter of 1m and is running at 1000 r.p.m. The net head on the Pelton wheel is 700 m. if the side clearance angle is 15° and discharge through the nozzle is 0.1 m^3/s, determine: (i) power available at the nozzle, and (ii) Hydraulic efficiency of the turbine.	3	3	Apply

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UNIT IV - LAWS OF THERMODYNAMICS AND BASIC IC ENGINE CYCLES

Systems, Zeroth law, first law of thermodynamics - concept of internal energy and enthalpy - applications of closed and open systems - second law of thermodynamics. Basic IC engine, 2 stroke and 4 stroke engine and gas turbine cycle- Brayton cycle.

PART A (2 Marks)

Q. No.	Questions	CO	BT Level	Competence
1	State system.	4	1	Remember
2	Define boundary.	4	1	Remember
3	List out the laws of thermodynamics.	4	2	Understand
4	Recall the zeroth law of thermodynamics	4	1	Remember
5	Define the first law of thermodynamics	4	1	Remember
6	State the second law of thermodynamics	4	1	Remember
7	Recall the third law of thermodynamics	4	1	Remember
8	State closed system.	4	1	Remember
9	Define open system.	4	1	Remember
10	Recall Isolated system.	4	1	Remember
11	Define Adiabatic system.	4	1	Remember
12	State Homogeneous system.	4	1	Remember
13	Define a Heterogeneous system.	4	1	Remember
14	Describe Point function.	4	1	Remember
15	Describe path function.	4	2	Understand
16	Describe the specific heats.	4	2	Understand
17	Describe the ratio of specific heats.	4	2	Understand
18	Describe the term enthalpy	4	2	Understand
19	Relate state, process and cycle.	4	1	Remember

20	List out the various non – flow processes.	4	2	Understand
21	Define heat engine.	4	1	Remember
22	List the classification of heat engines.	4	2	Understand
23	Label the application of I.C. engines	4	1	Remember
24	List the classification of I.C. engines-based combustion.	4	2	Understand
25	Label the eight major parts of I.C. Engines.	4	2	Understand

PART B (16 Marks)

Q. No.	Questions	CO	BT Level	Competence
1	1 kg of gaseous CO_2 contained in a closed system undergoes a reversible process at constant pressure. During this process 42 kJ of internal energy is decreased. Determine the work done during the process. Take c_p = 840 J/kg°C and c_v = 600 J/kg°C.	4	4	Analyze
2	90 kJ of heat are supplied to a system at a constant volume. The system rejects 95 kJ of heat at constant pressure and 18 kJ of work is done on it. The system is brought to original state by adiabatic process. Determine : (i) The adiabatic work ; (ii) The values of internal energy at all end states if initial value is 105 kJ.	4	4	Analyze
3	A cylinder contains 0.45 m³ of a gas at 1×10^5 N/m² and 80°C. The gas is compressed to a volume of 0.13 m³, the final pressure being 5×10^5 N/m². Determine : (i) The mass of gas ; (ii) The value of index 'n' for compression ; (iii) The increase in internal energy of the gas ; (iv) The heat received or rejected by the gas during compression. Take γ = 1.4, R = 294.2 J/kg°C.	4	3	Apply

		4	4	
4	Air at 1.02 bar, 22°C, initially occupying a cylinder volume of 0.015 m3, is compressed reversibly and adiabatically by a piston to a pressure of 6.8 bar. Calculate: (i) The final temperature ; (ii) The final volume ; (iii) The work done.	4	4	Analyze
5	Categorize the Classification of IC Engines.	4	4	Analyze
6	Demonstrate the basic idea of the IC engine with a neat sketch and its different parts of IC engines.	4	3	Apply
7	Demonstrate the construction, operation of four stroke petrol engine with a neat sketch	4	3	Apply
8	Demonstrate the technical terms connected with I.C. engines with a neat sketch.	4	3	Apply
9	Construct the theoretical and actual p-V diagram of four stroke Otto cycle engine.	4	3	Apply
10	Construct the theoretical and actual p-V diagram of four stroke diesel cycle engine.	4	3	Apply
11	Construct the actual valve time diagram for four-stroke diesel cycle engine.	4	3	Apply
12	Demonstrate the construction, operation of two stroke petrol engine with a neat sketch and p-V diagram for the same.	4	3	Apply
13	Distinguish the comparison between four-stroke and two-stroke cycle engines.	4	3	Apply
14	Point out the comparison between S.I. and C.I. engines.	4	3	Apply
15	Point out the comparison between petrol and diesel engines.	4	3	Apply
16	In a gas turbine unit, the gases flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of gases at the inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively, and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate : (i) The rate at which heat is rejected to the turbine, and (ii) The area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m³/kg.	4	3	Apply

17	Demonstrate the combustion phenomenon in C.I. engines.	4	3	Apply

| 18 | A fluid system, contained in a piston and cylinder machine, passes through a complete cycle of four processes. The sum of all heat transferred during a cycle is – 340 kJ. The system completes 200 cycles per min. | 4 | 3 | Apply |

Complete the following table showing the method for each item, and compute the net rate of work output in kW.

Process	Q (kJ/min)	W (kJ/min)	ΔE (kJ/min)
1-2	0	4340	?
2-3	42000	0	?
3-4	-4200	?	-73200
4-1	?	?	?

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	UNIT V - THERMODYNAMICS OF REFRIGERATORS AND HEAT PUMPS			
	Properties of steam - Rankine cycle - Boilers and its accessories - Basic thermodynamics of refrigerators and heat pumps.			
	PART A (2 Marks)			
Q. No.	**Questions**	**CO**	**BT Level**	**Competence**
1	Draw the schematic diagram for Rankine cycle.	5	2	Understand
2	Construct the p-V diagram for Rankine cycle.	5	2	Understand
3	Draw the T-s diagram for Rankine cycle.	5	2	Understand
4	Construct the h-s diagram for Rankine cycle.	5	2	Understand
5	List out the process involved in Rankine cycle.	5	2	Understand
6	When the steam is called as saturated and when it is called super-heated?	5	1	Remember
7	Define the terms sensible heat and latent heat of vaporization of water.	5	1	Remember
8	Write a short note on Mollier Chart.	5	1	Remember
9	Define pure substance.	5	1	Remember
10	What is the purpose of condenser in steam power plant?	5	1	Remember
11	Identify the thermodynamic definitions of heat pump and refrigerator.	5	1	Remember
12	Explain the term dryness fraction.	5	2	Understand
13	Differentiate between refrigeration & air conditioning.	5	2	Understand
14	Calculate the volume occupied by 5 kg of dry saturated steam at 10 bar.	5	2	Understand
15	Discuss latent heat of vaporization.	5	1	Remember
16	State the limitations of first law of thermodynamics.	5	1	Remember
17	List the suitable example for reversible and irreversible process.	5	1	Remember
18	What is the function of steam superheater?	5	1	Remember

19	Recall source and sink thermodynamically.	5	2	Understand
20	Calculate the Entropy of the wet steam with dryness fraction of 0.8 at 10 bar.	5	2	Understand
21	Explain the working of heat engine with the help of block diagram.	5	2	Understand
22	Explain the effect of reheating in Rankine cycle.	5	2	Understand
23	Define boiler. How it is classified?	5	1	Remember
24	Give the possible ways to increase the thermal efficiency of Rankine	5	2	Understand
25	List out boiler mountings and accessories.	5	1	Remember

PART B (16 Marks)

Q. No.	Questions	CO	BT Level	Competence
1	The following data refer to a simple steam power plant :	5	3	Apply

S. No.	Location	Pressure	Quality/ Temp.	Velocity
1.	Inlet to turbine	6 MPa (= 60 bar)	380°C	—
2.	Exit from turbine inlet to condenser	10 kPa (= 0.1 bar)	0.9	200 m/s
3.	Exit from condenser and inlet to pump	9 kPa (= 0.09 bar)	Saturated liquid	—
4.	Exit from pump and inlet to boiler	7 MPa (= 70 bar)	—	—
5.	Exit from boiler Rate of steam flow = 10000 kg/h.	6.5 MPa (= 65 bar)	400°C	—

Calculate :

(i) Power output of the turbine.

(ii) Heat transfer per hour in the boiler and condenser separately.

(iii) Mass of cooling water circulated per hour in the condenser. Choose the inlet temperature of cooling water 20°C and 30°C at exit from the condenser.

| 2 | In a steam power cycle, the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work. | 5 | 4 | Analyze |

3	In a steam turbine steam at 20 bar, 360°C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes, Calculate per kg of steam the net work and the cycle efficiency.	5	4	Analyze
4	A simple Rankine cycle works between pressures 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption.	5	4	Analyze
5	In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine : (i) The pump work, (ii) The turbine work, (iii) The Rankine efficiency, (iv) The condenser heat flow, (v) The dryness at the end of expansion. Assume flow rate of 9.5 kg/s.	5	4	Analyze
6	A 35 kW (I.P.) system engines consumes 284 kg/h at 15 bar and 250°C. If condenser pressure is 0.14 bar, determine : (i) Final condition of steam ; (ii) Rankine efficiency ; (iii) Relative efficiency.	5	3	Apply
7	Calculate the enthalpy, internal energy and entropy of 1 kg of steam at a pressure of 10 bar i) when steam is dry saturated, ii) when steam is 0.75 dry and iii) when steam is superheated to 250°C. Use steam tables and neglect the volume of water.	5	3	Apply
8	(i)Analyze the construction and working of a Water tube boiler with a neat sketch. **(9)** (ii)Analyze boilers with examples. **(4)**	5	3	Apply
9	(i)Develop the characteristics of high-pressure boilers. **(4)** (ii)Develop the construction and working of any one high-pressure boiler with a neat sketch. **(9)**	5	3	Apply

10	The steam conditions at inlet to the turbine are 42 bar and 500°C, and the condenser pressure is 0.035bar. Assume that the steam is just dry saturated on leaving the first turbine, and is reheated to its initial temperature. Calculated the Rankine cycle efficiency and specific steam consumption with reheating by neglecting the pump work using Mollier chart.	5	3	Apply
11	Illustrate the Rankine cycle with p – V and h – S diagram and derive the efficiency of steam power plant.	5	3	Apply
12	One kg of steam at 10 bar exists at the following conditions: Wet and 0.8 dry, dry and saturated and at a temperature of 199.9°C. Interpret the data using steam tables and find the enthalpy, specific volume, density, internal energy and entropy at each case. Take specific heat of super-heated steam = 2.25 kJ/kg K.	5	4	Analyze
13	Consider a team power plant operating on the ideal Rankine cycle. Steam enters the turbine at 3 MPa and 623 K and is condensed in the condenser at a pressure of 10 kPa. Determine (i) the thermal efficiency of this power plant, (ii) the thermal efficiency if steam is superheated to 873 K instead of 623 K.	5	4	Analyze
14	Steam at 30 bar and 350°C is expanded in a non-flow isothermal process to a pressure of 1 bar. The temperature and the pressure of the surroundings are 25°C and 100 kPa respectively. Determine the maximum work that can be obtained from this process per kg of steam. Also find the maximum useful work.	5	3	Apply
15	A simple Rankine Cycle works between pressure 28 bar and 0.06 bar, the initial condition of steam being dry Saturated. Calculate the Cycle Efficiency, Work Ratio and SFC.	5	3	Apply
16	(i)Categorize boiler accessories with examples.　　　　(5) (ii)Categorize the function of the pressure gauge and fusible plug.	5	4	Analyze
17	(i)Calculate the internal energy and enthalpy of steam when the steam conditions at 10 bar are i) 0.8% dry and ii) 320°C.　　(8) (ii) Identify the function of the economizer and superheater used in boilers.　　　　(5)	5	3	Apply

| 18 | In a steam power plant the condition of steam at inlet to the steam turbine is 20 bar and 300˚C and the condenser pressure is 0.1 bar. Two feed water heaters operate at optimum temperatures. Determine (1) The quality of steam at turbine exhaust (2) Network per kg of steam (3) Cycle efficiency (4) The steam rate. Neglect pump work. | 5 | 4 | Analyze |