

**B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024**

Third Semester

**Electronics and Instrumentation Engineering**

(Common to Instrumentation and Control Engineering)

**20ESME301 - APPLIED THERMODYNAMICS AND FLUID MECHANICS**

Regulations - 2020

(Use of Steam Tables and Mollier Diagram is permitted)

Duration: 3 Hours

Max. Marks: 100

**PART - A (MCQ) (20 × 1 = 20 Marks)**

Answer ALL Questions

	<i>Marks</i>	<i>K-Level</i>	<i>CO</i>
1. A control volume refers to (a) A fixed region in space (c) An isolated system	1	K1	CO1
(b) A specified mass (d) A reversible process only			
2. Work done in a free expansion process (a) Zero (b) Minimum	1	K2	CO1
(c) Maximum (d) Positive			
3. Second law of thermodynamics defines (a) Heat (b) Work	1	K2	CO1
(c) Enthalpy (d) Entropy			
4. For a reversible process the change in entropy of the system and surroundings (a) Zero (b) unity	1	K2	CO1
(c) Negative (d) Positive			
5. For the same temperature limits and heat input, the most efficient cycle is (a) Carnot (b) Otto	1	K1	CO2
(c) Diesel (d) Brayton			
6. In Diesel cycle, heat added at (a) Constant temperature (c) Constant pressure	1	K1	CO2
(b) Constant volume (d) Constant enthalpy			
7. Air standard efficiency of an IC engine depends on (a) Compression ratio (b) Speed of engine	1	K1	CO2
(c) Fuel used (d) Torque			
8. Which one is the water tube boiler? (a) Cochran boiler (b) Lancashire boiler	1	K1	CO3
(c) Babcock Wilcox boiler (d) None of the above			
9. Which of the following is not a boiler mounting? (a) Blow off cock (b) Feed check valve	1	K1	CO3
(c) Economizer (d) Fusible plug			
10. A device which is used to remove the impurities from the boiler is called (a) Economizer (b) Feed pump	1	K1	CO3
(c) Injector (d) Blow off cock			
11. Which of the following is used to heat the feed water by using waste heat of flue gases? (a) Air preheater (b) Superheater	1	K1	CO3
(c) Economizer (d) Steam separator			
12. Which among the following is not a fundamental dimension? (a) [L] (b) [M]	1	K1	CO4
(c) [T] (d) [kg]			
13. The velocity of fluid at which laminar flow changes to turbulent flow is known as (a) Linear velocity (b) Mean velocity	1	K1	CO4
(c) Maximum velocity (d) Critical velocity			
14. Reynolds number is the ratio of inertia force to (a) Gravitational force (b) Surface tension force	1	K2	CO4
(c) Elasticity force (d) Viscous force			
15. Bernoulli equation states that the total head _____ (a) Total head is variable (b) Velocity head is constant	1	K2	CO5
(c) Potential head is constant (d) Remains constant if there are no irreversibility			
16. Newton's law of viscosity is a relationship between _____ (a) Pressure, velocity and temperature (b) Shear stress and rate of shear strain	1	K1	CO5
(c) Shear stress and velocity (d) Rate of shear strain and temperature			
17. Poise is a unit of (a) dynamic viscosity (b) kinematic viscosity	1	K1	CO5
(c) vapour pressure (d) surface tension			

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|--|---|----|-----|
| 18. If the specific speed of turbine is 6 then the turbine should be   | 1 | K2 | CO6 |
| (a) Francis                      (b) Kaplan                      (c) Pelton wheel                      (d) Thomson |   |    |     |
| 19. A Francis turbine is   | 1 | K1 | CO6 |
| (a) Inward flow reaction turbine                      (b) Inward flow impulse turbine                              |   |    |     |
| (c) outward flow reaction turbine                      (d) outward flow impulse turbine                            |   |    |     |
| 20. Centrifugal pump is a  | 1 | K1 | CO6 |
| (a) Turbomachinery                      (b) Flow regulating device   |   |    |     |
| (c) Drafting device                      (d) Intercooling device   |   |    |     |

**PART - B (10 × 2 = 20 Marks)**

Answer ALL Questions

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|---|---|----|-----|
| 21. State the first law of thermodynamics.  | 2 | K2 | CO1 |
| 22. What is meant by thermodynamic equilibrium?   | 2 | K1 | CO1 |
| 23. Draw the P-V and T-S diagram of diesel cycle.   | 2 | K2 | CO2 |
| 24. Differentiate boiler mountings and accessories.   | 2 | K1 | CO3 |
| 25. What is the need for dimensional analysis in fluid mechanics?                               | 2 | K1 | CO4 |
| 26. State Buckingham's $\pi$ theorem.   | 2 | K1 | CO4 |
| 27. Write the unit of Kinematic viscosity and dynamic viscosity.                                | 2 | K1 | CO5 |
| 28. State the assumptions used in deriving Bernoulli's equation.                                | 2 | K2 | CO5 |
| 29. What is priming? Why is priming needed in centrifugal pumps and not in reciprocating pumps? | 2 | K2 | CO6 |
| 30. What is the function of draft-tube?   | 2 | K2 | CO6 |

**PART - C (6 × 10 = 60 Marks)**

Answer ALL Questions

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| 31. a) Air undergoes a cyclic process in a cylinder and piston arrangement. Atmospheric air at 1 bar and 27°C is compressed adiabatically to 10 bar, expanded isothermally to initial pressure and brought to initial condition at constant pressure. Find the change in internal energy, change enthalpy, heat transfer and work transfer for each process for the cycle. | 10 | K3 | CO1 |
|--|----|----|-----|

**OR**

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|---|----|----|-----|
| b) A Carnot cycle is operating between the source temperature of 300°C and the sink temperature of -23°C. If the system receives 100 kJ from the source, calculate (i) efficiency of the system; (ii) the net-work transfer; and (iii) heat rejected to the sink. | 10 | K3 | CO1 |
|---|----|----|-----|

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|--|----|----|-----|
| 32. a) A diesel engine operating on air standard diesel cycle has 20 cm bore and 30 cm stroke. The clearance volume is 420 cm <sup>3</sup> . If the fuel is injected at 5% of stroke find the air standard efficiency. | 10 | K2 | CO2 |
|--|----|----|-----|

**OR**

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|---|----|----|-----|
| b) Derive the expression for air standard efficiency of Otto cycle with p-V and T-S diagrams. | 10 | K2 | CO2 |
|---|----|----|-----|

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|---|----|----|-----|
| 33. a) Explain with neat sketch simple Rankine cycle and working of steam boiler plant. | 10 | K2 | CO3 |
|---|----|----|-----|

**OR**

- |   |    |    |     |
|---|----|----|-----|
| b) Explain in detail about important accessories and mountings of a boiler. | 10 | K2 | CO3 |
|---|----|----|-----|

- |   |    |    |     |
|---|----|----|-----|
| 34. a) The resistance R experienced by a partially submerged body depends upon the velocity V, length of the body L, viscosity $\mu$ , density of fluid $\rho$ and gravitational acceleration g. Obtain a dimensionless expression for R. | 10 | K3 | CO4 |
|---|----|----|-----|

**OR**

b) Compute the expression for the drag force on smooth sphere of diameter  $D$ , moving with uniform velocity  $v$ , in fluid density  $\rho$  and dynamics viscosity  $\mu$ . 10 K3 CO4

35. a) The diameters of a pipe at the sections 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe section 1 is 5 m/s. Also determine the velocity at section 2. 10 K3 CO5

**OR**

b) A hydraulic press has a ram of 30 cm diameter and a plunger of 5 cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 400 N. 10 K3 CO5

36. a) Explain with neat sketch the working principle of Pelton turbine. 10 K2 CO6

**OR**

b) Explain the construction and working principle of centrifugal pump with neat sketch. 10 K2 CO6