| Reg. No. | | | | | | | | | | | | | | | |
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| Question Paper Code | 14747 |
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**B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026**

Third Semester

Electronics and Instrumentation Engineering

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

Regulations - 2020

(Use of *Steam Tables, Psychrometric Chart and Molier Chart is permitted*)

Duration: 3 Hours | Max. Marks: 100

**PART – A (i) (MCQ)**
**(16 × 1 = 16 Marks)**
Answer ALL Questions

| | | Marks | K – Level | CO |
|---|---|---|---|---|
| 1. | A change in the state of gas during which the volume of gas remains constant is called…….change<br>a) Isothermal b) Isobaric<br>c) Poly tropic d) Isochoric | 1 | K1 | CO1 |
| 2. | When there is no temperature difference between the part of system or between the system and surroundings then it is said to be in a state of<br>a) Electrical Equilibrium b) Chemical Equilibrium<br>c) Thermal Equilibrium d) Mechanical Equilibrium | 1 | K2 | CO1 |
| 3. | Which of the following represents the energy in storage?<br>a) Heat b) Internal Energy<br>c) Work d) None | 1 | K2 | CO1 |
| 4. | A cycle consisting of one constant pressure, one constant volume and two isentropic processes is known as<br>a) Carnot cycle b) Otto cycle<br>c) Stirling cycle d) Diesel cycle | 1 | K1 | CO2 |
| 5. | In Diesel cycle, heat added at<br>a) Constant temperature b) Constant volume<br>c) Constant pressure d) Constant enthalpy | 1 | K1 | CO2 |
| 6. | For the constant pressure and heat input, the air standard efficiency of gas power cycle is in the order<br>a) Diesel cycle, Otto cycle, Dual cycle b) Dual cycle, Otto cycle, Diesel cycle<br>c) Otto cycle, Diesel cycle, Dual cycle d) Dual cycle, Diesel cycle, Otto cycle | 1 | K2 | CO2 |
| 7. | Lancashire boiler has _____ internal flue tubes.<br>a) One b) Two<br>c) Three d) Four | 1 | K1 | CO3 |
| 8. | Which of the following is a boiler mounting?<br>a) Feed pump b) Economizer<br>c) Water level gauge d) Superheater | 1 | K1 | CO3 |
| 9. | How many level indicators are there in the water level indicator of a boiler?<br>a) 1 b) 2<br>c) 3 d) 4 | 1 | K1 | CO3 |

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| 10. | A model of with the same shape is known as | | *1* | *K1* | *CO4* |
| | a) Conditional similarity | b) Geometric similarity | | | |
| | c) Dynamic similarity | d) Kinematic similarity | | | |
| 11. | All the parameters in similitude are described using | | *1* | *K1* | *CO4* |
| | a) Diesel mechanics | b) Aircraft mechanics | | | |
| | c) Continuum mechanics | d) Solid mechanics | | | |
| 12. | Which of the following is not a primary quantity? | | *1* | *K2* | *CO4* |
| | a) Time | b) Temperature | | | |
| | c) Mass | d) None of the above | | | |
| 13. | Which of the following assumption is incorrect in the derivation of Bernoulli's equation? | | *1* | *K2* | *CO5* |
| | a) The flow is rotational | b) The flow is steady | | | |
| | c) The flow is incompressible | d) The fluid is ideal | | | |
| 14. | In which of the following unit, kinematic viscosity of the fluid is measured? | | *1* | *K2* | *CO5* |
| | a) Poise | b) $m/s^2$ | | | |
| | c) Stokes | d) m/s | | | |
| 15. | Centrifugal pump is a | | *1* | *K1* | *CO6* |
| | a) Drafting device | b) Flow regulating device | | | |
| | c) Turbo-machinery | d) Inter-cooling device | | | |
| 16. | What does PSP stand for? | | *1* | *K1* | *CO6* |
| | a) Pump start procedure | b) Positive start pump | | | |
| | c) Pump start pointer | d) Positive start pointer | | | |

**PART – A (ii) (Short Answer Questions)**
**(6 × 3 = 18 Marks)**
Answer ALL Questions

| | | | | |
|---|---|---|---|---|
| 17. | Write the expression for COP of a heat pump and a refrigerator. | *3* | *K2* | *CO1* |
| 18. | For same compression ratio, Which air standard cycle offers higher efficiency? Justify your answer. | *3* | *K2* | *CO2* |
| 19. | Explain the functions of: (i) Feed check value (ii) Water level indicator. | *3* | *K2* | *CO3* |
| 20. | Use dimensional analysis to compare Buckingham π theorem and Rayleigh method and state the advantages of Buckingham π theorem over Rayleigh method. | *3* | *K3* | *CO4* |
| 21. | Apply the continuity equation to fluid flow and explain how it is used to relate velocity and cross-sectional area in a flowing fluid. | *3* | *K3* | *CO5* |
| 22. | Apply the concept of priming in pumps to explain its purpose and importance in ensuring proper pump operation before starting. | *3* | *K3* | *CO6* |

**PART - B (Descriptive Answer Questions)**
**(6 × 11 = 66 Marks)**
Answer ALL Questions

| | | | | | |
|---|---|---|---|---|---|
| 23. | a) | Apply the steady flow energy equation to an air compressor in which air flows at 0.5 kg/s entering at 7 m/s, 100 kPa, and 0.95 $m^3/kg$ and leaving at 5 m/s, 700 kPa, and 0.19 $m^3/kg$, with an increase in internal energy of 90 kJ/kg and heat loss to cooling water at 58 kW, to Discover the rate of shaft work input to the compressor. | *11* | *K3* | *CO1* |

**OR**

| | | | | | |
|---|---|---|---|---|---|
| | b) | Apply the concept of reversible heat engines arranged in series to discover the intermediate temperature between A and B, and calculate the efficiency of each engine, when engine A receives 200 kJ of heat at 421 ºC, rejects heat to engine B, engine B operates with a sink at 4.4 ºC, and the work output of A is twice that of B. | *11* | *K3* | *CO1* |
| 24. | a) | Calculate the air standard efficiencies for the Otto and Diesel cycles on the basis of equal compression ratio of 10 and equal heat rejection of 840 kJ/kg. The suction conditions are 1 bar and 328 K. | *11* | *K3* | *CO2* |
| | | **OR** | | | |
| | b) | Derive the expression for air standard efficiency of Otto cycle with p-V and T-S diagrams. | *11* | *K3* | *CO2* |
| 25. | a) | Explain with neat sketches the following boiler accessories: (a) Injector; (b) Super heater; (c) Air preheated; (d) Economizer. | *11* | *K3* | *CO3* |
| | | **OR** | | | |
| | b) | A boiler generates 14000 kg of steam at 7 bars during a period of 24 hrs and consume 1250 kg of coal whose CV = 30000 kJ/kg. Taking the enthalpy of steam coming out of boiler = 2507.7 kJ/kg and water is supplied to the boiler at $40^0$C. Calculate: (a) Efficiency of the boiler (b) Equivalent evaporation per kg of coal. | *11* | *K3* | *CO3* |
| 26. | a) | Efficiency $\eta$ of a fan depends on the density $\rho$, the dynamic viscosity of the fluid $\mu$, the angular velocity $\omega$, diameter D of the rotor and the discharge Q. Express $\eta$ in terms of dimensional parameters. | *11* | *K3* | *CO4* |
| | | **OR** | | | |
| | b) | The pressure drop in an aero-plane model of size 1/10 of its prototype is 80 $N/cm^2$. The model is tested in water. Calculate the corresponding pressure drop in the prototype. Take density of air = 1.24 $kg/m^3$. The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise. | *11* | *K3* | *CO4* |
| 27. | a) | Apply the basic fluid properties to determine the specific weight, density, and specific gravity of a liquid when 1 liter of the liquid weighs 7 N. | *11* | *K3* | *CO5* |
| | | **OR** | | | |
| | b) | Derive an expression for Bernoulli's equation from first principle and state the assumption made for such a derivation. | *11* | *K3* | *CO5* |
| 28. | a) | Apply the working principle of a double-acting reciprocating pump to explain its operation using a neat diagram and describe how fluid is delivered during both suction and delivery strokes. | *11* | *K3* | *CO6* |
| | | **OR** | | | |
| | b) | Design a Pelton wheel for a head of 80 m and speed 300 rpm. The Pelton wheel develops 103 kW S.P. Take $C_v$ = 0.98, Speed ratio = 0.45 and overall efficiency = 0.80. | *11* | *K3* | *CO6* |