

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2022 (2019 Scheme)

Course Code: MET 303**Course Name: THERMAL ENGINEERING**

Max. Marks: 100

Duration: 3 Hours

*Use of Steam tables, Refrigeration tables, and Psychrometric charts are permitted***PART A***(Answer all questions; each question carries 3 marks)*

Marks

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|----|---|---|
| 1 | List one advantage and one disadvantage of the reheat cycle and of the regenerative cycle | 3 |
| 2 | Define Nozzle efficiency and explain the effect of friction on Nozzle efficiency | 3 |
| 3 | What is degree of reaction and what is its value for an impulse turbine? | 3 |
| 4 | Define the following as related to steam turbine. a)Speed ratio b)Stage efficiency c)Diagram efficiency | 3 |
| 5 | Differentiate between supercharging and turbo charging | 3 |
| 6 | What is meant by specific fuel consumption ? | 3 |
| 7 | Explain equivalence ratio and its significance in IC engine combustion | 3 |
| 8 | Explain the effects of any three variables on detonation in SI Engines | 3 |
| 9 | Explain DBT,WBT and DPT | 3 |
| 10 | Explain the working of vapour compression refrigeration system with aid of T-s or P-h diagram | 3 |

PART B*(Answer one full question from each module, each question carries 14 marks)***Module -1**

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|----|---|---|
| 11 | a) In an ideal Rankine cycle saturated vapor enters the turbine at 80 bar and saturated liquid exits the condenser at a pressure of 0.08 bar. The net power output of the cycle is 100 MW. The turbine have an isentropic efficiency of 85%. Pump work can be neglected. Determine for the cycle (i) the thermal efficiency, (ii) the mass flow rate of the steam, and (iii) the rate of heat transfer into the working fluid as it passes through the boiler | 8 |
| | b) With the help of a figure explain the working of Babcock and Wilcox boiler | 6 |

- 12 a) Dry saturated steam enters a frictionless adiabatic nozzle with negligible velocity at a temperature of 300 °C. It is then expanded to a pressure of 40 bar. For a mass flow rate of 4 kg/s, calculate the exit velocity of the steam 8

- b) Explain regenerative cycle with help of T-s diagram 6

Module -2

- 13 a) A Parsons reaction turbine running at 500rpm with 50% reaction develops 100 KW per kg of the steam. The exit angle of the blade is 20 degree and the steam velocity at inlet is 1.5 times blade velocity. Determine (i) Blade velocity (ii) Blade inlet angle 8

- b) What is reheat factor and explain why its value is always greater than 1? 6

- 14 a) The velocity of steam leaving nozzles of an impulse turbine is 1000 m/s and the nozzle angle is 20°. Blade velocity is 400 m/s and blade velocity coefficient is 0.8. Calculate for a mass flow rate of 1 kg/s and symmetrical blading, (i) The blade inlet angle (ii) Driving force on wheel (iii) The axial thrust (iv) Diagram power (v) Diagram efficiency 10

- b) Explain the purpose of governing of steam turbines. List the different types of governing used in steam turbines 4

Module -3

- 15 a) A six cylinder, four stroke Diesel engine develops 150 KW at 2000 rpm. It's brake specific fuel consumption is 300 gm/kWh. Calculate the quantity of fuel to be injected per cycle per cylinder. Specific gravity of the fuel is 0.85 8

- b) How can we find the frictional power of a single cylinder engine? 6

- 16 a) The following observations were made during a trial of a single – cylinder, four-stroke cycle gas engine having cylinder diameter of 18 cm and stroke 24 cm; Speed of engine is 500 rpm, Mean effective pressure = 5 bar, Net load on the brake wheel = 40 kg, Effective diameter of brake wheel = 1 m, Brake specific fuel consumption = 300 g/kWh, Calorific value of fuel at NTP = 30 MJ/kg. Estimate the mechanical and brake thermal efficiencies of the engine. 8

- b) Briefly explain the following: (i) time loss factor (ii) heat loss factor (iii) exhaust blow down factor 6

Module -4

- 17 a) What is meant by delay period ? Discuss the factors that affect the delay period in a C.I. engine.. 10

- b) What is Cetane number? Explain how C.I. engine fuels are rated 4
- 18 a) Name the stages of combustion in a S.I. engine and explain with the aid of a pressure – crank angle diagram 8
- b) List any four emission control method used in I.C. engines and explain any one. 6

Module -5

- 19 a) A Carnot refrigeration cycle absorbs heat at 300 K and rejects it at 600 K. (i) Calculate the coefficient of performance of this refrigeration cycle. (ii) If the cycle is absorbing 1000 kJ/min at 300 K, how many kJ of work is required per minute? (iii) If the work required is 500 kJ/min, what is the temperature of heat rejection if the temperature of heat absorption and heat absorbed remains same (iv) An inventor claims that the cycle is absorbing 2000 kJ/min with the same power input and temperature limits as of question (ii). Is this possible? Explain with reasons. 8
- b) Write any six factors that affects the human comfort 6
- 20 a) Explain the effect of the following factors on COP of vapour compression refrigeration system with the help of T-s diagram and P-h diagram : (i) Subcooling (ii) Superheating (iii) Condenser pressure (iv) Evaporator pressure 8
- b) Show four psychrometric processes on a psychrometric chart 6
