University of Mumbai
Examinations summer 2022
Time: 2hour 30 minutes Max. Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks	20
1.	Which of the following is an intensive property?	
Option A:	Mass	
Option B:	Volume	
Option C:	Energy	
Option D:	Density	
2.	An isentropic process is always	
Option A:	Irreversible and adiabatic	
Option B:	Reversible ad isothermal	
Option C:	Frictionless and irreversible	
Option D:	Reversible and adiabatic	
3.	The efficiency of an ideal Carnot engine depends upon	
Option A:	Working substance	
Option B:	Temperature of the source only	
Option C:	Temperature of sink only	
Option D:	Temperature of source and sink	
4.	Kelvin-Planck's law deals with	
Option A:	Conservation of energy	
Option B:	Conservation of heat	
Option C:	Conversion of heat into work	
Option D:	Conversion of work into heat	
5.	For same compression ratio	
Option A:	thermal efficiency of Otto cycle is greater than that of Diesel cycle	
Option B:	thermal efficiency of Otto cycle is less than that of Diesel cycle	
Option C:	thermal efficiency of Otto cycle is same as that for Diesel cycle	
Option D:	Thermal efficiency of Otto cycle cannot be predicted.	
6.	In Rankine cycle the work output from the turbine is given by	
Option A:	change of internal energy between inlet and outlet	
Option B:	change of enthalpy between inlet and outlet	
Option C:	change of entropy between inlet and outlet	
Option D:	change of temperature between inlet and outlet.	
7.	In constant volume process, Workdone is	
Option A:	Zero	
Option B:	infinity	
Option C:	can't be calculated	
Option D:	constant	
8.	Dual cycle is combination of which of these two cycles?	
Option A:	Otto & Diesel	
Option B:	Otto & Brayton	

Option C:	Brayton & Diesel	
Option D:	Joule & Brayton	
9.	Out of the following this is not a condition of steam?	
Option A:	Dry	
Option B:	Wet	
Option C:	plasma	
Option D:	Superheated	
10.	In multistage compressor, compression is carried out _____.	
Option A:	in the same stage	
Option B:	in two stages	
Option C:	in three stages	
Option D:	in more than one stage	
Q2	Solve any Two	20
a)	(i) Explain Zeroth law of thermodynamics (ii) Prove that energy is a property of the system.	
b)	A single acting single cylinder reciprocating air compressor has a cylinder diameter of 200 mm and a stroke of 300 mm. Air enters the cylinder at 1 bar & 27°C. It is then compressed polytropically to 8 bar according to the law $PV^{1.3}=C$. If the speed of the compressor is 250 rpm, Calculate the mass of air compressed per minute and the power required in kW for driving the compressor.	
c)	A system at 500 K receives 7200 kJ/min from a source at 1000 K. The temperature of atmosphere is 300 K. Assuming that the temperatures of system and source remain constant during heat transfer find out : (i) The entropy produced during heat transfer ; (ii) The decrease in available energy after heat transfer.	
Q3	Solve any Two	20
a)	(i) A reversible heat pump is used to maintain a temperature of 0°C in a Refrigerator when it rejects the heat to the surroundings at 25°C. If the heat removal rate from the refrigerator is 1440 kJ/min, determine the COP of the machine and work input required. (ii) If the required input to run the pump is developed by a reversible engine which receives heat at 380°C and rejects heat to atmosphere, then determine the overall COP of the system.	
b)	(i) Explain Rankine cycle with the help of PV and TS diagram. (ii) Explain Carnot cycle.	
c)	A cylinder contains 0.45 m^3 of a gas at 1×10^5 N/m² and 80°C. The gas is compressed to a volume of 0.13 m^3, 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 $\gamma = 1.4$, R = 294.2 J/kg°C.	
Q4	Solve any Two	20
a)	(i) Write Maxwell Relations (ii) Explain why multistaging of the air compressor is done?	
b)	(i) Write the assumptions of air standard cycle.	

		(ii) Explain the formation of superheated steam from ice at −10°C with the help of T-Q diagram.
	c)	The swept volume of a diesel engine working on dual cycle is 0.0053 m³ and clearance volume is 0.00035 m³. The maximum pressure is 65 bar. Fuel injection ends at 5 per cent of the stroke. The temperature and pressure at the start of the compression are 80°C and 0.9 bar. Determine the air standard efficiency of the cycle. Take γ for air = 1.4.