Paper Code: EME-401	**Roll No.**									

B.Tech.
(SEM IV) Back Paper EXAMINATION, 2015-16
APPLIED THERMODYNAMICS

[Time: 3 hrs.] **[Max. Marks: 100]**

Note : (i) Attempt **all** questions. All questions carry equal marks.
(ii) Use of steam table and Mollier chart is permitted.
(iii) Assume suitably, any missing data.

Q1 Attempt any two parts of the following:- **[10x2=20]**

(a) Answer the following
(i) Define Joule-Thompson coefficient. Show that its value is zero for perfect gas.
(ii) Propane is burned with stoichiometric air. Find the exhaust composition and dew point temperature of the products of combustion if the products are at 1 bar.

(b) Define formation reaction and reference standard state? Carbon reacts with oxygen to form carbon dioxide in a steady flow chamber. Reactants and products are at 25 °C and 1 atm. Find the energy involved and type of reaction. Assume enthalpy of formation of CO_2 gas as (-) 393520 kJ/kmol.

(c) Answer the following
(i) Write Maxwell's equations and its use
(ii) Define coefficient of volume expansion, adiabatic compressibility and isothermal compressibility

Q2 Attempt any two of the following. **[10x2=20]**

(a) Obtain an expression for draught produced in mm of water column for a chimney of height H. Also show the pressure distribution through the different components in the flue gas path in forced and induced draught.

(b) Explain the working of fusible plug with neat sketch. Determine the temperature of the flue gases and draught produced for maximum discharge through chimney of 70 m height. Boiler is operating at air fuel ratio of 20 and ambient temperature is 27 °C.

(c) Answer the following
(i) State briefly the sources and effects of air leakage into a condenser.
(ii) Make comparison between fire tube boiler and water tube boiler.

Q3 Attempt any two of the following. **[10x2=20]**

(a) Answer the following parts:-
(i) Discuss the methods to reduce the initial condensation in steam engine.
(ii) Discus the phenomenon of choking in nozzle

(b) Why governing of steam engine is needed. Show that for throttle governed steam engine, steam consumption (kg/hr) can be expressed as M= A+B*IHP where A & B are constant and IHP is indicated horse power.

(c) 5 kg/s of dry saturated steam enters the nozzle at 50 bar and expanded isentropically to a pressure of 0.2 bar. Find the throat and exit area of the nozzle.

Q4 Attempt any two of the following. **[10x2=20]**

(a) A single stage impulse turbine rotor has a mean diameter of 2 m running at 3000 rpm. Saturated steam at 10 bar pressure is expanded in a convergent divergent nozzle to a pressure of 3 bar. Nozzle efficiency is 80%. The steam leaves the nozzle at 20°. The rotor blade angles of turbine are equiangular and blade friction factor is 0.86. Steam enters the nozzle with a velocity of 100 m/s. The thrust on the end bearing of rotor is 240 N. Find the power developed in kW by the rotor by drawing the velocity diagram.

(b) Draw Rankine cycle on P-v, T-s and h-s chart. In a 50 MW steam turbine power plant, steam is generated in boiler at 90 bar and 500 °C. After expansion in the turbine to 10 bar a portion of steam is bled for regenerative feed water heating (open heater) and the remaining steam is passed to reheater from where it returns to the turbine at 500 °C and further expanded to a condenser pressure of 0.1 bar. Find the thermal efficiency, heat rejected in the condenser and steam rate.

(c) Answer the following

(i) Compare the impulse and reaction turbine.

(ii) Discuss the pressure compounding of steam turbine.

Q5 Attempt any two of the following. **[10x2=20]**

(a) Derive the expression for thermal efficiency in terms of pressure ratio for the Brayton cycle with perfect regeneration.

(b) Air at temperature of 15 C and 1 bar enters a gas turbine plant working at pressure ratio of 6. Compression is isentropic and takes place in two stages with perfect inter-cooling. Turbine inlet temperature is 1000 C. isentropic efficiency of turbine is 0.85 and calorific value of fuel used is 42 MJ/kg. Find thermal efficiency and Air fuel ratio of the gas turbine plant.

(c) Answer the following

(i) Make comparison between Turbojet and Turboprop engine.

(ii) Compare closed cycle and open cycle gas turbine.