(Production Engineering)(SEM-IV)(Choice Based) / DEC.2019/13.12.2019

(Time: 3 Hours) **Marks: 80**

Note: 1. Question number 1 is **compulsory**
2. Solve any **THREE** questions from remaining **FIVE**questions
3. **Assume** suitable data if required.
4. Assumptions made should be clearly stated.

Q.1 Attempt ***any FOUR*** of the following:

(a) Explain Bernoulli's Theorem with suitable example. **05**

(b) Convert the following : **05**

(i) -200 mm of H_g into kPa absolute
(ii) 125990 Pa (abs) into meter of oil column gauge. Specific gravity of oil is 0.8

(c) Explain various modes of heat transfer with suitable example. **05**

(d) Enlist different methods employed for improvement of thermal efficiency of open cycle gas turbine plant. Discuss briefly any one of them with flow and T-S diagram. **05**

(e) Define FAD and volumetric efficiency. What are the factors that affect volumetric efficiency of reciprocating compressor? **05**

(f) Explain various losses in pipe flow **05**

Q.2 **(a)** Explain the phenomenon of body floating on liquid. Find the kinematic viscosity in stokes of liquid, which occupy 1.1 litre/kg and viscosity is 0.011 poise. **06**

(b) An isosceles triangular plate of base 3 m and height 4 m is immersed vertically in oil of specific gravity 0.9. The base of the plate coincides with the free surface of the oil. Determine **06**

(i) Resultant force acting on the plate. (ii) Centre of pressure on the plate.

(c) Compare heat transfer area of air cooled and water cooled condenser if both are having 5 kW heat duty and LMTD of 20 K. Assume $U_{watercooled}$ = 2 kW/m^{2}K and $U_{aircooled}$ = 20 W/m^{2}K **08**

Q.3 **(a)** Derive Euler's equation of motion along stream line and hence derive Bernoulli's equation. List the assumptions also. **10**

(b) Two pipes of diameter 400 mm and 200 mm are each 300 mm long. When the pipes are connected in series the discharge through the pipeline is 0.10 m^3/s, find the loss of head incurred. What would be the loss of head in the system to pass the same total discharge when the pipes are connected in parallel? Take friction factor= 0.0075 for each pipe **10**

Q.4 (a) A horizontal venturi meter with inlet and throat diameters 300 mm and 100 mm respectively is used to measure the flow of water. The pressure intensity at inlet is 130 KN/m^2 while the vacuum pressure head at the throat is 350 mm of mercury. Assuming that 3% of head is lost in between the inlet and throat , find i)The value of coefficient of discharge ii) Rate of flow. **10**

(b) A single acting two stage compressor with complete intercooling deliver 6 kg/min of air at 16 bar and 15°C. The expansion and compression follow the law $PV^{1.3}$ =C. Calculate: **10**

i) Power required to run compressor at 420 rpm.

ii) Isothermal efficiency. iii) Free air delivered.

iv) If the clearance ratio for HP and LP cylinder are 0.06 and 0.04 ,calculate volumetric efficiency and swept volume for each cylinder.

Assume R= 0.287 kJ/kg.K ; C_v= 0.71 kJ/kg.K

Q.5 (a) A gas turbine unit receives air at 1 bar and 300 K and compresses it adiabatically to 6.2 bar. The compressor efficiency is 88%. The fuel has heating value of 44186 kJ/kg and the fuel-air ratio is 0.017 kJ/kg of air.The turbine internal efficiency is 90%. **08**
For products of combustion, C_p = 1.147 kJ/kg K and Υ = 1.333
Calculate:

i) The work of turbine per kg of air
ii) Work of compressor per kg of air
iii) Thermal efficiency

(b) Find the heat flux across the slab of thickness 0.1 m when its one surface is at 250°C and the other surface is at 30°C. Take the thermal conductivity of the material as 388 W/m.K. **04**

(c) Derive the expression for LMTD in parallel flow heat exchanger. State your assumptions **08**

6 (a) A viscous flow is taking place in a pipe of 100 mm diameter. The maximum velocity is 2 m/s. Find the mean velocity and radius at which it occurs. Also calculate the velocity at 30 mm from the pipe wall. **05**

(b) Write short notes on ***any Three*** following :- **15**

(i) Velocity potential and stream function
(ii) Surface tension and capillarity
(iii) Major and minor losses in pipes.
(iv) Forced and natural convection.
(v) Laminar and Turbulent flow

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