Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_

**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)



**End Semester Examination – April/May – 2017**

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| **Code :** | **14ME2015** | **Duration :** | **3hrs** |
| **Sub. Name :** | **THERMAL ENGINEERING - I** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| Q. No. | Sub Div. | Questions | Course  Outcome | Marks |
| 1. | a. | Explain the construction and working of a Lancashire boiler with the help of suitable sketches. | CO1 | 12 |
| b. | A coal fired boiler plant consumes 400 kg of coal per hour. The boiler evaporates 3200 kg of water at 44.5oC into superheated steam at a pressure of 12 bar and 274.5oC. If the calorific value of fuel is 32760 kJ/kg of coal, calculate equivalent evaporation from and at 100oC and thermal efficiency of the boiler. | CO1 | 8 |
| (OR) | | | | |
| 2. |  | In a boiler the following observations were made: pressure of steam =10 bar, steam condensed = 540 kg/h, fuel used = 65 kg/h, moisture in fuel = 2 % by mass, mass of dry fuel gases = 9 kg/kg of fuel, lower calorific value of fuel = 32000 KJ/Kg, temperature of the fuel gases = 325oC, temperature of boiler house = 28oC, feed water temperature = 50oC, mean specific heat of fuel gases = 1 kJ/kgK, dryness fraction of steam = 0.95. Draw up a heat balance sheet for the boiler. | CO1 | 20 |
| 3. | a. | Dry saturated steam at 5 bar with negligible velocity expands is entropically in a convergent nozzle to 1 bar and dryness fraction 0.94. Determine the velocity of steam leaving the nozzle. | CO2 | 8 |
|  | b. | Derive an expression for maximum discharge through convergent divergent nozzle for steam. | CO2 | 12 |
| (OR) | | | | |
| 4. | a. | Explain metastable flow of steam through a nozzle. | CO2 | 8 |
|  | b. | Dry saturated steam at a pressure of 8 bar enters a convergent-divergent nozzle and leaves at a pressure of 1.5 bar; If the flow is is entropic and the corresponding expansion index is 1.135, find the ratio of cross-sectional area at exit and throat for maximum discharge. | CO2 | 12 |
| 5. | a. | Distinguish between impulse and reaction turbines. | CO3 | 8 |
|  | b. | The velocity of steam leaving the nozzles of an impulse turbine is 1200 m/s and the nozzle angle is 20o. The blade velocity is 375m/s and the blade velocity coefficient is 0.75. Assuming no loss due to shock at inlet, calculate for a mass flow of 0.5 kg/s and symmetrical blading a) blade inlet angle b) driving force on wheel c) axial thrust on the wheel and d) power developed by the turbine. | CO3 | 12 |
| (OR) | | | | |
| 6. | a. | Explain the term ‘compounding of steam turbine’ and discuss pressure-velocity compounding of turbine with neat sketch. | CO3 | 12 |
|  | b. | Brief on the classification of steam turbines. | CO3 | 8 |
| 7. | a. | Explain multi-stage air compression and list its advantages. | CO4 | 10 |
|  | b. | A single acting reciprocating air compressor has cylinder diameter and stroke of 200 mm and 300 mm respectively. The compressor sucks air at 1 bar and 27oC and delivers at 8 bar while running at 100 rpm. Find indicated power of the compressor, mass of air delivered by the compressor per minute and temperature of the air delivered by the compressor. The compression follows the law pV1.25 = C. Take R as 287 J/kg K. | CO4 | 10 |
| (OR) | | | | |
| 8. |  | With neat sketches of T-s and p-v diagram for a single stage reciprocating air compressor without clearance, derive the expression for the work done when compression is isothermal and isentropic. | CO4 | 20 |
|  | | **Compulsory:** |  |  |
| 9. |  | With a neat sketch, explain the working principle of vapour compression refrigeration system and show the thermodynamic processes on T-s and p-h diagram. | CO5 | 20 |

ALL THE BEST