Code No. : **5188**

FACULTY OF ENGINEERING

B.E. 3/4 (Prod.) I Semester (Main) Examination, December 2011
APPLIED THERMODYNAMICS AND HEAT TRANSFER

Time: 3 Hours]

[Max. Marks: 75

Note: Answer **all** questions of Part – **A**. Answer **five** questions from Part – **B**.

PART – A
(25 Marks)

1. Distinguish between "single-stage" and "Multi-stage" air compressors. 2

2. Define "isothermal efficiency" and "mechanical efficiency" as applied to air compressors. 3

3. Distinguish between "2-stroke" and "4-stroke" IC engine. 2

4. Define " b & fc" and "i & fc" as referred to IC engines. 3

5. What is the relevance of "ignition delay" vis-a-vis a S.I. (petrol) engine ? 2

6. Define "cetane number " as applied to a C. I. engine fuel. 3

7. State the Newton's law of connection heat transfer. 2

8. Define "thermal diffusivity" and give its S. I. Unit. 3

9. What is a "white body" ? How does it differ from a "black body" ? 2

10. Distinguish between "parallel-flow" and "counterflow" heat exchangers. 3

PART – B
(50 Marks)

11. Calculate the bore diameter (D) and stroke length (L) of a double-acting, single-stage air compressor of indicated power 37.5 kW. The air is drawn in at 1 bar (abs) and 15°C, while the compression occurs in accordance with the law $pv^{1.2}$ = constant to 6 bar (abs). The speed of the compressor is 100 rpm, while the average piston speed is 150m/min. Neglect the clearance volume. 10

12. Explain an air-standard diesel cycle by providing the pertinent P-V and T-s diagrams of the same and then arrive at the thermal efficiency of the cycle as a function of cut-off ratio and compression-ratio, viz. r_c and r_k, respectively. 10

(This paper contains 2 pages)

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P.T.O.

13. A trial was performed on a 4-stroke cycle engine and it fielded the following :

stroke = 40 cm ; bore = 24 cm ; speed = 250 rmp ; number of explosions = 115 per minute ; imep = 6.65 bar (abs) ; net brake load applied = 850 Newtons ; brake drum radius = 75 cm ; fuel (gas) supplied = 0.21 m^3/ minute at 0°C ; the calorific value of the fuel (gas) = 20000 kJ/m^3 at 0°C ; calculate : i) ip ; ii) bp ; (iii) thermal efficiency on ip basis ; and iv) thermal efficiency on bp basis.   10

14. Explain the phenomena of "normal combustion" and "abnormal combustion" as referred to a spark ignition (petrol) engine. Show these phenomena on P-Q (pressure-crank angle) diagram.   10

15. Consider a rectangular slab of thickness L and thermal conductivity k with its two boundaries held at an identical temperature T_w. Let q_v (W/m^3) denote the rate of volumetric heat generation in the slab. Deduce the relations for (i) temperature distribution in the slab and (ii) rate of heat transfer in the slab, assuming steady. State heat transfer in the slab.   10

16. The wall of an industrial furnace is made up of fireclay brick of 25 cm thickness, which has a thermal conductivity of 1 W/m – k. The outside surface of the wall is insulated with a material of thermal conductivity 0.05 W/m–k. Determine as to how much thicker the insulation layer should be for limiting the rate of heat loss from the furnace wall to 1000 W/m^2, if it is given that the inside and the outside surfaces of the wall are at temperatures of 1030°C and 30°C respectively.   10

17. Write brief notes on the following :   10
    i) Gray and black bodies,
    ii) Planck's law for spectral emissive power of black body
    iii) LMTD of a heat exchanger and
    iv) Critical radius of insulation.