Code No. : 5188/S

FACULTY OF ENGINEERING
B.E. 3/4 (Prod.) I Semester (Suppl.) Examination, June 2012
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. Mention any four applications of compressed air in practice. **2**
2. Define "clearance factor" and "volumetric efficiency" as referred to an air compressor. **3**
3. Distinguish between "SI (Petrol)" and "CI (diesel)" I.C. engines. **2**
4. Mention the usefulness of drawing up a "heat balance sheet" on an IC engine. **3**
5. Define "Octane number rating" of an S.I. engine fuel. **2**
6. Define "ignition delay" as referred to a C.I. engine. **3**
7. State the Fourier's law of conduction heat transfer. **2**
8. Define the significance of "critical radius" as referred to a "hollow cylindrical shell". **3**
9. Define "white body" and give one example for the same. **2**
10. Write the Wien's law for spectral emissive power (E_λ) of a black body and mention various terms in it. **3**

PART – B **(50 Marks)**

11. A single acting, single-stage recifrocating air compressor is needed to compress 72 m^3 of air per minute from 1 ata pressure and 15°C temperature of 8 ata pressure. Calculate the temperature at the end of compression, work done, hp required and heat rejected during each of the following processes :
    i) isothermal
    ii) isentropic and
    iii) plytrofic compression with $pv^{1.25}$ = constant as the governing law. **10**

12. With the help of neat P-v and T-s diagrams, explain an air-standard ottocycle and deduce an appropriate expression for its thermal efficiency as a function of compression ratio (r_k). 10

13. The following data is obtained during a trial on a 2-stroke gas engine : diameter of piston = 150 mm ; stroke length = 180 mm ; clearance volume = 0.89 liters ; speed = 225 rpm ; imep = 6.2 bar (abs) ; gas consumption = 6.2 m^3/hour ; calorific value of the gaseous fuel = 16000 kJ/m^3. Calculate :
    i) air-standard efficiency,
    ii) indicated power developed by the engine in kW ;
    iii) indicated thermal efficiency of the engine. 10

14. With the aid of pertinent pressure-crank angle ($p - \theta$) diagrams, explain both the processes of normal and abnormal combustion vis-a-vis a Compression Ignition (C.I.) diesel engine. 10

15. Assuming that thermal conductivity, k(T), varies with temperature, T, as $k(T) = k_0[1+\beta T)$, where β is the coefficient of thermal conductivity, while k_0 is the thermal conductivity at 0°C, deduce a relation for steady-state heat transfer rate, q, through a slab of thickness L, whose two surfaces are held at T_1 and T_2 temperatures, respectively, at x = 0 and x = L. 10

16. A double-pane window [height = 1.2 m and width = 2 m) consists of two 3 mm thick layers of glass of thermal conductivity 0.78 W/m–k that are separated by a 12 mm wide stagnant air gap of thermal conductivity 0.026 W/m–k. The room air is maintained at 24°C, while the outdoor ambient is at – 5°C. The correction heat transfer coefficients on the inside and the outside surfaces of the window are given to be 10 and 25 W/m^2–k, respectively. Calculate the steady-state rate of heat transfer through the double-paned window and also calculate the temperature of the inner surface of the window. 10

17. Write short notes on :
    i) Spectral and total emissive powers
    ii) Stefan-Boltzoman law
    iii) Black body and
    iv) Emissivity. 10