16117

3 Hours / 100 Marks   Seat No. ☐☐☐☐☐☐☐☐

Instructions :	(1)	**All** questions are **compulsory**.
	(2)	Answer **each** next main question on a **new** page.
	(3)	Illustrate your answers with neat sketches **wherever** necessary.
	(4)	Figures to the **right** indicate **full** marks.
	(5)	Assume suitable data, if **necessary**.
	(6)	Use of Non-programmable Electronic Pocket Calculator is **permissible**.
	(7)	Use of Steam tables, logarithmic, Mollier's chart is **permitted**.

Marks

1. A) Attempt **any three**.   **12**

   a) State four assumptions made for air standard cycle.

   b) A two stage air compressor with perfect intercooling takes in air at 1 bar pressure and 27 °C. The law of compression in both the stages is $Pv^{1.3}$ = constant. The compressed air is delivered at 9 bar from the H.P. Cylinder to an air receiver. Calculate per kg. of air

      i) The minimum work done.

      ii) The heat rejected to the intercooler.

   c) Compare SI and CI engine on the basis of

      i) fuel used,   ii) Compression ratio,   iii) Weight,   iv) Noise and vibration.

   d) Explain with neat sketch working of lobe type air compressor.

   B) Attempt **any one**.   **6**

   a) A four cylinder engine running at 1200 rpm delivers 20 kW. The average torque when one cylinder was cut is 110 N.m. Find the indicated thermal efficiency if the calorific value of the fuel is 43 MJ/Kg and the engine uses 360 gm. of gasoline (fuel) per kW. hr.

   b) Explain with neat sketch working of non dispersive infra red (NDIR) gas analyser.

2. Attempt **any two**.   **16**

   a) Differentiate vapour compression and vapour absorption refrigeration system.

      (min. eight points of difference)

   b) A single stage reciprocating air compressor has a swept volume of $2000\,cm^3$ and runs at 800 rpm. It operates on a pressure ratio of 8 with a clearance 5% of the swept volume. Assume NTP room conditions at inlet ($p = 101.3\,kPa\ t = 15°C$) and polytropic compression and expansion with $n = 1.25$ calculate

      i) Indicated power,   ii) Volumetric efficiency,   iii) Mass flow rate

     iv) Isothermal efficiency.

   c) A four stroke gas engine has a cylinder diameter of 25 cm and stroke 45 cm. The effective diameter of brake is 1.6 m. The observations made in a test of the engine were as follows.

      Duration of test = 40 min.

      Total no. of revolutions = 8080

      Total no. of explosions = 3230

      Net load on brake = 90 kg

      Mean effective pressure = 5.8 bar

      Volume of gas used = $7.5\,m^3$

      Pressure of gas = 136 mm of water

      Atm. temp. = 17°C

      Calorific value of gas = $19\,MJ/m^3$ at NTP

      Rise in temp. of jacket cooling water = 45°C

      Cooling water supplied = 180 kg

      Draw heat balance sheet and estimate indicated thermal efficiency and brake thermal efficiency. Assume atmospheric pr. as 760 mm of Hg.

3. Attempt **any four**.   **16**

   a) List any four pollutants in exhaust gases of I.C. engine with their effects.

   b) Compare closed cycle and open cycle gas turbine.

   c) Define i) Humidity ratio,   ii) Specific humidity.

   d) Name four sensors used in I.C. engine and explain working of any one.

   e) What is scavenging in I.C. engine ? State its types.

4. A) Attempt **any three**.   **12**

     a) Explain the process of combustion in diesel engine.

     b) Explain battery ignition in S.I. engine.

     c) State the norms of Bharat stage III and IV.

     d) State different methods for improving thermal efficiency of gas turbine and explain any one.

   B) Attempt **any one**.   **6**

     a) Define – (i) Indicated power, (ii) Mechanical efficiency, (iii) BSFC.

     b) List the additives of lubricant used in S.I engine and state their advantages.

5. Attempt **any two**.   **16**

   a) Explain with neat sketch construction and working of ice plant.

   b) A single cylinder reciprocating compressor has a bore of 120 mm and a stroke of 150 mm. and is driven at a speed of 1200 rpm. It is compressing CO_2 gas from a pressure of 120 Kpa and temp. of 20°C to a temp. of 215°C. Assuming polytropic compression with $n = 1.3$, no clearance and volumetric efficiency of 100% calculate (i) pressure ratio, (ii) Indicated power, (iii) shaft power with mech. efficiency 80%, (iv) mass flow rate.

   c) Explain with neat sketch construction and working of constant volume gas turbine.

6. Attempt **any four**.   **16**

   a) What is the necessity of purification of air in compressor and how it is done ?

   b) A diesel engine has a compression ratio of 14 and cut-off takes place at 6% of stroke. Find the air standard efficiency.

   c) Define (i) Dew point temp.

          (ii) Wet bulb temp.

   d) Explain the principle of Ram jet with neat sketch.

   e) Draw neat sketch of split air conditioner and name the parts.

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