Code No: R22033 **R10** SET - 1

II B. Tech II Semester Regular Examinations, August – 2014
THERMAL ENGINEERING - I
(Com. to ME, AME)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Explain the reasons for the difference between the air-standard cycles and the actual cycles of Internal Combustion Engines.
   b) What is the main loss in a Diesel engine? By means of a P-V diagram indicate the actual and fuel air cycle for a two stroke Diesel engine.

2. a) Explain the operation of "High tension Magneto ignition system" with a sketch.
   b) Draw the typical distillation curve for Diesel fuel and explain the property "Volatility".

3. a) Explain the phenomenon of knock in S.I engine with sketches.
   b) Describe the following combustion chambers of S.I engine with line diagrams:
   i) T-head type ii) F-head type iii) L-head type.

4. a) What is the ignition delay period in C.I.Engine combustion? Explain the physical and chemical delay periods.
   b) Table the important characteristics that tend to reduce knock in C.I engines.

5. During the trail of a single cylinder 4-stroke oil engine, the following results were obtained: cylinder diameter 20 cm, stroke 40 cm, mep 6 bar, torque 407 Nm, speed 250 rpm, oil consumption 4 kg/h, calorific value 43 MJ/kg, cooling water flow rate 4.5 kg/mnt, air used per kg of fuel 30 kg, rise in cooling water temperature 45^0C, temperature of exhaust gases 420^0C, room temperature 20^0C, mean specific heat of exhaust gas 1 kJ/kg K. Find the indicated power, brake power and draw the heat balance sheet for the test in KJ/h.

6. A two stage air compressor with perfect intercooling takes in air at 1 bar pressure and 27^0 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, and (ii) The heat rejected to intercooler.

7. a) Explain the principle of working of centrifugal compressor with the help of h-s diagram. b) Describe the working cycle of the screw compressor, with a sketch.

8. A multistage axial compressor is required for compressing air at 293 K through a pressure ratio of 5 to 1. Each stage is to be 50% reaction and the mean blade speed is 275 m/s, flow coefficient is 5 and stage loading factor is 0.3 are taken for simplicity as constant for all stages.
   Find the flow angles and the number of stages required if the stage efficiency is 88.8%.

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Code No: R22033 **R10** SET - 2

II B. Tech II Semester Regular Examinations, August – 2014
THERMAL ENGINEERING - I
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Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Discuss the effect of "the timing of the intake and exhaust valves" on the volumetric efficiency.
   b) What is optimum spark advance? Show the effect of spark advance on the power output by means of the P-V diagram of an S.I engine.

2. a) Explain the working of a single cylinder Jerk pump type fuel injection system with a sketch.
   b) Explain the principle of direct injection of gasoline into the cylinder of an S.I. Engine with a sketch.

3. a) Describe how the following parameters influence the flame speed in an S.I engine:
   i) Turbulence ii) Compression ratio iii) Fuel-air ratio iv) Engine output v) Engine size.
   b) Define Octane number and explain how the S.I. Engine fuels are rated.

4. a) Compare the phenomenon of knock in S.I. and C.I. Engines, by means of P-θ diagrams.
   b) Discuss the effect of compression ratio on maximum air temperature for C.I Engine combustion by means of a graph.

5. A four stroke, 4 cylinder gasoline engine has a bore of 60 mm and a stroke of 100 mm. On the test it develops a torque of 66.5 Nm when running at 3000 rpm. If the clearance volume in each cylinder is 60 cc, the relative efficiency with respect to brake thermal efficiency is 0.5 and the calorific value of the fuel is 42 MJ/kg, find the fuel consumption in kg/h and the brake mean effective pressure.

6. A two-stage single acting reciprocating air compressor draws in air at a pressure of 1 bar and 17^0C and compresses it to a pressure of 60 bar. After compression in the L.P. cylinder, the air is cooled at constant pressure of 8 bar to a temperature of 37^0C. The low pressure cylinder has a diameter of 150 mm and both the cylinders have 200 mm stroke. If the law of compression is $pv^{1.35} = C$, find the power of the compressor, when it runs at 200 r.p.m. Take R=287 J/kg K.

7. Draw the velocity diagrams for a centrifugal compressor at impeller inlet, impeller outlet, diffuser inlet and outlet and explain the various terms.

8. In an axial flow compressor, the overall stagnation pressure ratio is 4 with an overall stagnation isentropic efficiency of 86%. The inlet stagnation temperature and pressure are 320 K and 1 bar. The mean blade speed is 190 m/s. The degree of reaction is 0.5 at the mean radius with relative air angles of 30^0 and 10^0 at rotor inlet and outlet respectively. The work done factor is 0.88. Calculate the stagnation polytropic efficiency, number of stages, inlet pressure and temperature.

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Code No: R22033 **R10** SET - 3

II B. Tech II Semester Regular Examinations, August – 2014
THERMAL ENGINEERING - I
(Com. to ME, AME)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Explain the loss due to rubbing friction of an I.C.Engine. How will it vary with the engine load.
   b) With the help of a P-V diagram for an S.I. Engine, explain the consequences of the finite time of combustion.

2. a) Sketch and explain the working principle of "pressure cooling system".
   b) Explain the principle of working of Wankel engine.

3. a) By means of P-□ diagram, explain the stages of combustion in an S.I.Engine.
   b) Describe few anti-knock additives for S.I. Engine.

4. a) Explain the principle of operation of "Lanova air-cell combustion chamber" with a sketch and state its advantages.
   b) Define Cetane number and explain how the C.I. Engine fuels are rated.

5. In a test of oil engine, under full load, the following results were obtained: ip 33 kW, brake power 27 kW, oil consumption 8 kg/h, calorific value 43 MJ/kg, cooling water flow rate 7 kg/min, rate of flow of water through gas calorimeter 12 kg/h, rise in cooling water temperature 60^0C, final temperature of exhaust gases 80^0C, room temperature 17^0C, air-fuel ratio on mass basis 20, rise in water temperature through exhaust gas calorimeter 40^0C, mean specific heat of exhaust gas 1 kJ/kg K. Draw the heat balance sheet and find thermal and mechanical efficiencies.

6. A two-stage single acting reciprocating compressor takes in air at the rate of 0.2 m^3/s. The intake pressure and temperature of air are 0.1 MPa and 16^0C. The air is compressed to a final pressure of 0.7 MPa. The intermediate pressure is ideal and intercooling is perfect. The compression index in both the stages is 1.25 and the compressor runs at 600 r.p.m. Neglecting clearance, determine (i) The intermediate pressure, (ii) The total volume of each cylinder, (iii) the power required to drive the compressor, and (iv) the rate of heat rejection in the intercooler. Take C_p = 1.005 kJ/kg K and R = 287 J/kg K.

7. a) Explain the significance of the following dimensionless parameters of centrifugal compressors: i) Flow coefficient ii) Head coefficient iii) Pressure coefficient
   b) What are rotary compressors? Where do vane type compressors find application?

8. A multi stage axial flow compressor delivers 18 kg/s of air. The inlet stagnation condition is 1 bar and 20^0C. The power consumed by the compressor is 4260 kW. Calculate: i) delivery pressure ii) number of stages and iii) overall isentropic efficiency of the compressor. Assume temperature rise in the first stage is 18^0C, the polytropic efficiency of compression is 0.9 and the stage stagnation pressure ratio is constant.

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Code No: R22033 **R10** SET - 4

II B. Tech II Semester Regular Examinations, August – 2014
THERMAL ENGINEERING - I
(Com. to ME, AME)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. a) Define volumetric efficiency and name the variables that affect the volumetric efficiency.
   b) With the help of a P-V diagram for S.I.Engine, discuss the effect of 0^0 and 35^0 spark advances.

2. a) Explain the main metering and idling system of a carburetor for cruising and full throttle operations.
   b) Sketch and explain the working of a gear type lubricating pump.

3. a)Describe the following two general objectives of combustion chamber design for S.I. Engine:
   i) Smooth Engine operation ii) High power output & thermal efficiency. b)
   Explain the factors influencing flame speed in combustion of S.I. engines.

4. a) By means of P-θ diagram, explain the stages of combustion in a C.I.Engine. b) Differentiate between compression and combustion induced swirl.

5. A four stroke cycle gas engine has a bore of 20 cm and a stroke of 40 cm. The compression ratio is 6. In a test on the engine the imep is 5 bar, the air to gas ratio is 6:1 and the calorific value of the gas is 12 MJ/m^3 at NTP. At the beginning of the compression stroke, the temperature is 77^0C and pressure 0.98 bar. Neglecting residual gases, find the indicated power and the thermal efficiency of the engine at 250 rpm.

6. An air compressor takes in air at 0.98 bar and 20^0C and compresses it according to the law $pv^{1.2}$ = C. It is then delivered to a receiver at constant pressure of 9.8 bar. Determine: (i) the temperature at the end of compression; (ii) the work done per kg of air; (iii) the heat transferred during the compression; and (iv) the work done during delivery. Take R = 287 J/kg K and γ= 1.4.

7. a) What is slip factor of centrifugal compressor? With the help of a velocity triangle diagram, show the slip on the tip of radial bladed centrifugal impeller.
   b) Derive an expression for the work supplied in a stage of a centrifugal compressor.

8. In an 8 stage axial flow compressor, the overall stagnation pressure ratio is 5:1 with an overall isentropic efficiency of 90%. The temperature and pressure at inlet are 20^0C and 1 bar. The work is divided equally between the stages. The mean blade shape is 175 m/s and 50% reaction design is used. The axial velocity through the compressor is constant and equal to 100 m/s. Calculate the power required and blade angles.
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