Code No: RT22032 **R13** SET - 1

II B. Tech II Semester Regular Examinations, May/June - 2015
THERMAL ENGINEERING-I
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART – A

1. a) Name four important variables that affect the volumetric efficiency.
   b) What are the three general ranges of throttle operation for an engine and also specify the type of mixture required for each.
   c) Indicate whether the following parameters increase or decrease the knock in SI & CI engines respectively: (i) Speed (ii) Cylinder size (iii) Ignition delay.
   d) Differentiate between absorption type and transmission type dynamometers.
   e) According to ASME, mention the values of pressure ratio for a fan, blower and a compressor.
   f) Define four important dimensionless parameters of axial flow compressor.
   (4M+3M+4M+4M+3M+4M)

PART – B

2. a) What is time loss factor? Discuss the effect of time losses in an actual cycle and explain the reasons for reduction in efficiency.
   b) Why the actual cycle efficiency is much lower than the air-standard cycle efficiency. (8+8)

3. a) What is valve timing of 4 stroke engine? Explain its significance through a diagram.
   b) Describe the working of crankcase scavenged two stroke engine with sketches. (8+8)

4. a) With the help of graphs, explain the factors which influence the flame speed in an S.I.engine.
   b) Explain the phenomenon of Knock in C.I. engines. (8+8)

5. During the trial of a single-cylinder, four-stroke oil engine, the following results were obtained. Cylinder diameter = 20cm, Stroke = 40 cm, Mean effective pressure = 6 bar, Torque = 407 Nm, Speed = 250 rpm, Oil consumption = 4 kg/h, Calorific value of fuel = 43 MJ/kg, Cooling water flow rate = 4.5 kg/min, 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, Specific heat of water = 4.18 kJ/kg K. Find the ip, bp, and draw up a heat balance sheet for the test in kJ/h. (16)

6. The free air delivered by a single stage, double acting air compressor measured at 1.013 bar and 15^0C is 14 m^3/min. The pressure and temperature in the cylinder during induction are 0.95 bar and 32^0C. The delivery pressure is 7 bar and the index of compression and expansion, n = 1.3. If the clearance volume is 5% of the swept volume, calculate the indicated power and volumetric efficiency. (16)

7. An axial flow compressor compresses air from an inlet condition of 1 bar and 290K to a delivery pressure of 5 bar with an overall isentropic efficiency of 87 per cent. The degree of reaction is 0.5 and the blade angles at inlet and outlet are 44^0 and 13^0 respectively. The mean blade speed and axial velocity are constant throughout the compressor. Assuming a blade velocity of 180 m/s, and workdone factor 0.85, calculate the number of stages. (16)
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Code No: RT22032 **R13** SET - 2

II B. Tech II Semester Regular Examinations, May/June - 2015
THERMAL ENGINEERING - I
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART – A

1. a)Explain the phenomenon of loss due to rubbing friction in actual cycle
.
b) A six cylinder four stroke Diesel engine develops 125 KW at 3000 rpm. Its brake specific fuel consumption is 200 gm/kWh. Calculate the quantity of fuel to be injected per cycle per cylinder. Specific gravity of the fuel is 0.85
c) Explain the phenomenon of knocking in SI engine
d) What do mean by heat balance sheet. Explain its significance
e)List out the advantages of reciprocating compressors
f) List out the advantages of axial flow compressors over centrifugal compressors
(3+4+4+3+4+4)

PART – B.

2. a) What is heat loss factor? What is its contribution compared to other losses?
b) With the help of a PV diagram for a CFR engine, explain the effect of heat loss on various engine parameters. (8+8)

3. a) What is air-cooling system and in which type of engine it is normally used?
b) Describe the evaporative cooling system with a neat sketch. (8+8)

4. a) What is Physical delay? Discuss the factors that affect the delay period in a C.I. engine.
b) What is Octane number? Explain how S.I. engine fuels are rated. (8+8)

5. The following results were obtained in a test on a gas engine:
Gas used = 0.16 m^3/min at NTP, Calorific value of gas at NTP = 14 MJ/m^3, Density of gas at NTP = 0.65 kg/m^3, Air used = 1.50 kg/min, Specific heat of exhaust gas = 1.0 kJ/kg K, Temperature of exhaust gas = 400^0C, Room temperature = 20^0C, Cooling water per minute = 6 kg, Specific heat of water = 4.18 kJ/kg K, Rise in temperature of cooling water = 30^0C, ip = 12.5 kW, bp = 10.5 kW. Draw a heat balance sheet for the test on per hour basis in kJ. (16)

6. A single acting two stage reciprocating air compressor compresses 4.5 kg of air per minute from 1.013 bar and 15^0 C through a pressure ratio of 9. The intercooling is perfect and the law of compression and expansion. $pv^{1.3}$ = constant. Assuming the clearance volumes of both stags 5% of their swept volume and the speed of compressor 300 rpm, calculate the indicated power and the cylinder swept volume. Also calculate the heat loss to the cylinder jacket cooling water and the heat loss to the intercooler circulating water. (16)

7. Following particulars relate to a centrifugal compressor:
Inlet diameter of impeller = 61.4 cm, Outlet diameter of impeller – 123 cm, Speed = 5000 rpm, velocity of flow = 61.6 m/s, free air delivered = 1000 m^3/min, pressure ratio = 1.33, index of compression =16. Assuming that all pressure rise takes place in the impeller, find the angles at which air from impeller enters the casing, breadth of the impeller blade at inlet and outlet. (16)
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Code No: RT22032 **R13** SET - 3

II B. Tech II Semester Regular Examinations, May/June - 2015
THERMAL ENGINEERING - I
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART – A

1. a) What is firing order for a multi cylinder engine? Mention the commonly used firing orders for a four cylinder and a six cylinder engines.
   b) Name three combustion chambers of indirect - injection type for a C.I. engine.
   c) Draw the PV diagram for the roots blower type rotary compressor and derive an expression for its efficiency.
   d) Draw the inlet and outlet velocity triangles for an axial flow compressor, indicating the various velocity components. (3M+3M+8M+8M)

PART – B

2. a) What is exhaust blow down? With the help of PV diagram discuss the effect of exhaust valve opening time on blow down.
   b) What is loss due to gas exchange process? Discuss its effects on other parameters like speed, volumetric efficiency etc. (8+8)

3. a) What are the various components to be lubricated in an engine?
   b) Describe the working of pressure feed lubrication system with a neat sketch.(8+8)

4. a) Discuss the effect of various engine variables on SI engine knock.
   b) What is Cetane number? Explain how CI engine fuels are rated. (8+8)

5. A four-stroke gas engine has a cylinder diameter of 25 cm and stroke 45 cm. The effective diameter of the brake is 1.6 m. The observations made in a test of the engine were as follows: Duration of test = 40 min, Total number of revolutions = 8080, Total number of explosions = 3230, Net load on the brake = 90 kg, Mean effective pressure = 5.8 bar, Volume of gas used = 7.5 m^3, Pressure of gas indicated in meter = 136 mm of water gauge, Atmospheric temperature = 17^0C, Calorific value of gas = 19 MJ/m^3 at NTP, Rise in temperature of jacket cooling water = 45^0C, Cooling water supplied = 180 kg. Draw up a heat balance sheet and estimate the indicated thermal efficiency and brake thermal efficiency. Assume atmospheric pressure at 760 mm of Hg. (16)

6. A single – acting reciprocating air compressor delivers air at 70 bar from an induction pressure of 1 bar. The rate of air compressed is 2.4 m^3/min measured at free air conditions of 1.013 bar and 15^0C. Temperature at the end of induction stroke is 32^0C. Calculate the indicated power if the compression is carried out in two stages with an ideal intermediate pressure and perfect intercooling and the index of compression and expansion for both stages is 1.25. (16)

7. The impeller of a radial bladed centrifugal compressor has an outside diameter of 33 cm and rotates at 18600 rpm. The inlet stagnation temperature is 289 K and the isentropic efficiency is 0.85. Neglecting heat losses, calculate the rise in stagnation temperature through the machine. Also calculate the compression ratio. Take ρ = 1.04 and μ= 0.9. (16)
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Code No: RT22032 **R13** SET - 4

II B. Tech II Semester Regular Examinations, May/June - 2015
THERMAL ENGINEERING - I
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART – A

1. a) Represent the contributions of various losses in an actual cycle of an IC engine with PV diagram.
   b) Draw the P – θ diagram for C.I. engine combustion and indicate the stages.
   c) Name the methods that are used for the measurement of friction power of an engine.
   d) Name the sensors that include in an electronic injection system of an I.C. engine.
   e) State six advantages of multistage compression.
   f) Show schematically a centrifugal compressor and indentify the parts.

(5M+3M+2M+4M+4M+4M)

PART – B

2. a) What is loss due to rubbing friction? Explain.
   b) What is the main difference between actual cycle and fuel-air cycle of Diesel engine? Describe fuel-air cycle and actual cycle combustion for a 2 stroke Diesel engine with the help of PV diagram. (8+8)

3. a) Describe the working of S.U.Carburetor with a neat sketch.
   b) List the factors which affect the process of carburetion. (8+8)

4. a) Distinguish between suction, compression & combustion induced turbulence for a C.I. engine.
   b) Describe the following types of SI engine combustion chambers
   i) Overhead valve type combustion chamber. ii) F-head type combustion chamber. (8+8)
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5. The following observations were made during a trial of a single – cylinder, four-stroke cycle gas engine having cylinder diameter of 18 cm and stroke 24 cm:
   Duration of trial = 30 min, Total number of revolution = 9000, Total number of explosion = 4450, Mean effective pressure = 5 bar, Net load on the brake wheel = 40 kg, Effective diameter of brake wheel = 1m, Total gas used at NTP = 2.4 m^3, Calorific value of gas at NTP = 19 MJ/m^3, Total air used = 36 m^3, Pressure of air = 720 mm Hg, Temperature of air = 17^0C, Density of air at NTP = 1.29 kg/m^3, Temperature of exhaust gas = 350^0C, Room temperature = 17^0C, Specific heat of exhaust gas = 1 kg/kg K, Cooling water circulated = 80 kg, Rise in temperature of cooling water = 30^0C. Draw up a heat balance sheet and estimate the mechanical and indicated thermal efficiencies of the engine. Take R = 287 J / kg K. (16)

6. A single cylinder, single acting air compressor has a cylinder diameter of 15.25 cm and a stroke of 22.8 cm. Air is drawn into the cylinder at a pressure of 1.013 bar and a temperature of 15.6^0C. It is compressed adiabatically to 6.1 bar. Calculate the theoretical power required to drive the compressor if it runs at 100 rpm and the mass of air compressed per minute. (16)

7. 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 275 m/s, flow coefficient 0.5, and stage loading factor 0.3, are taken, for simplicity, as constant for all stages. Determine the flow angles and the number of stages required if the stage efficiency is 88.8%. Assume c_p = 1.005 kJ/kg K and γ = 1.4 for air. (16)