KINGS

COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Question Bank

Sub. Code/Name: ME1351 - THERMAL ENGINEERING **Year/Sem: III/VI**

UNIT-I
THERMODYNAMIC CYCLES
Part-A (2 Marks)

1. What is a thermodynamic cycle?
2. What is meant by air standard cycle?
3.. Name the various “gas power cycles".
4. What are the assumptions made for air standard cycle analysis
5. Mention the various processes of the Otto cycle.
.
6. Mention the various processes of diesel cycle.
7. Mention the various processes of dual cycle.
8. Mention the various processes of the Brayton cycle.
9. Define air standard cycle efficiency.
10. Define mean effective pressure as applied to gas power cycles. How it is related to indicate power of an I.C engine?
11. Define the following terms. (i) Compression ratio (ii) Cut off ratio , (iii) .Expansion ratio

Part-B (16Marks)

1. Drive and expression for the air standard efficiency of Otto cycle in terms of volume ratio. (16)
2. Drive an expression for the air standard efficiency of Diesel cycle. . (16)
3. Drive an expression for the air standard efficiency of Dual cycle. . (16)
4. Explain the working of 4 stroke cycle Diesel engine. Draw the theoretical and actual PV diagram.
5. Drive the expression for air standard efficiency of Brayton cycle in terms of pressure ratio (16)
6. A Dual combustion air standard cycle has a compression ratio of 10. The constant pressure part of combustion takes place at 40 bar. The highest and the lowest temperature of the cycle

are 1725 degree C and 27 ^{0} C respectively. The pressure at the beginning of compression is 1 bar. Calculate (I) the pressure and temperature at' key points of the cycle. (ii) The heat supplied at constant volume, (iii) the heat supplied at constant pressure. (Iv) The heat rejected. (v) the work output. (vi) the efficiency and (vii) mep. (16)

7. An Engine-working on Otto cycle has a volume of 0.45 m^3 , pressure 1 bar and temperature 30^o,C at the beginning of compression stroke. At the end of compression stroke, the pressure is 11 bar and 210 KJ of heat is added at constant volume. Determine (i) Pressure, temperature and volumes at salient points in the cycle.' (ii) Efficiency. (16)
8. (I)Explain the working of 4-stroke cycle Diesel engine. Draw the theoretical and actual valve-timing diagram for the engine. explain the reasons for the difference.
9. (II) Air enters the compressor of a gas turbine at 100 KPa and 25 ^{o}C. For a pressure ratio of 5 and a maximum temperature of 850℃. Determine the thermal efficiency using the Brayton cycle. (16)

   The following data in referred for an air standard diesel cycle compression ratio = 15 heat added = 200 Kj/Kg- minimum temperature in the cycle = 25℃ Suction pressure = 1 bar Calculate

   1. Pressure and temperature at the Salient point.
   2. Thermal efficiency
   3. Mean effective pressure,
   4. Power output of the cycle If flow rate 'of air is 2 Kg/s (16)

UNIT-2
I.C ENGINE
Part-A (2 Marks)

01. Classify IC engine according to cycle of lubrication system and field of application.

02. List the various components of IC engines.

03. Name the basic thermodynamic cycles of the two types of internal combustion reciprocating engines.
04. Mention the important requites of liner material.

05. State the purpose of providing piston in IC engines.

06. Define the terms as applied to reciprocating I.C. engines "Mean effective pressure" and "Compression ratio".

07. What is meant by highest useful compression ratio?

08. What are the types of piston rings?

09. What is the use of connecting rod?

10. What is the use of flywheel?

Part-B (16Marks)

1. Explain full pressure lubrication system I.C Engine . (16)
2. Explain the water cooling system in I.C Engine . (16)
3. Explain the 2 types of Ignition system In 5.1 Engine . (16)
4. Draw and explain the valve timing diagram of 4 stroke Diesel Engine . (16)
5. Draw and explain the port timing diagram of 2stroke Petrol Engine . (16)
6. Explain with neat sketch the exhaust gas analysis . (16)
7. The following results refer to a test on a petrol engine Indicated power = 30 Kw, Brake power = 26 Kw

   Engine speed = 1000 rpm
   Fuel brake power/ hour = 0.35 kg
   Calorific value of fuel = 43900kj/kg
   Calculate The indicated Thermal efficiency
   The brakeThermal efficiency
   The Mechanical efficiency (16)

8. A four cylinder 2 stroke cycle petrol engine develops 23.5 kw brake power at 2500 rpm. The mean effective pressure on each piston in 8. 5 bar and mechanical efficiency in 85% Calculate the diameter and stroke of each cylinder assuming the length of stroke equal to 1.5 times the diameter of cylinder. (16)

9. The following data to a particular twin cylinder two stroke diesel engine. Bore 15 cm stroke. 20 cm. speed 400 rpm. Indicated mean effective pressure 4 bar, dead weight on the brake drum 650 N. spring balance reading 25 N Diameter of the brake drum 1 m .Fuel consumption 0.075 kg/min and calorific value of the fuel is 44500 kj/J kg.

Determine

1. Indicated Power
2. Brake Power
3. Mechanical efficiency
4. Indicated thermal efficiency
5. Brake thermal efficiency (16)

UNIT-3 STEAM NOZZLE&TURBINE
Part-A (2 Marks)

01. What are the various types of nozzles and their functions?

02. Define nozzle efficiency and critical pressure ratio.

03. Explain the phenomenon of super saturated expansion in steam nozzle. or
What is metastable flow?

04. State the function of fixed blades.

05. Classify steam turbines.

06. How does impulse work?
.

07. What is meant by carry over loss?

08. State the function of moving blades...."

09. What is the fundamental difference between the operation of impulse and reaction steam turbines?

10. What are the different methods of governing steam turbines?

11. How is throttle governing done?

12. Where nozzle control governing is used?

13.. Where by - pass governing is more suitable?

14. What are the different losses in steam turbines?

PART- B (16Marks)

1. An impulse turbine having a set of 16 nozzles receives steam at 20 bar, 400° C. The pressure of steam at exist is 12 bar. if the total discharge Is 260 Kg/min and nozzle efficiency is 90% . Find the cross sectional area of each nozzle, if the steam has velocity of 80m/s at entry to the nozzle, find the percentage Increase In discharge. (16)

2. Dry saturated steam at a pressure of 8 bar enters the convergent divergent nozzle and leaves it at a pressure 1.5 bar. If the flow isentropic and if the corresponding index of expansion is 1.133, find the ratio of 0.3 are at exit and throat for max. discharge. (16)

3. Steam enters a group of nozzles of a steam turbine at 12 bar and 220^0 C and leaves at 1.2 bar. The steam turbine develops 220 Kw with a specific steam consumption of 13.5 Kg/ Kw. Hr. If the diameter of nozzle at throat Is 7mm . Calculate the number of nozzle (16)

4. Drive an expression for critical pressure ratio in terms of the index of expansion (16)

5. Explain the method of governing in steam turbine. (16)

6. Explain various type of compounding in Turbine (16)

7. A 50% reaction turbine running at 400 rpm has the exit angle of blades as 20° and the velocity of steam relative to the blade at the exit is 1.35 times mean speed of the blade. The steam flow rate is 8.33 kg/s and at a particular stage the specific volume is 1.38m3/kg .Calculate, suitable blade height, assuming the rotor mean diameter 12 times the blade height, and diagram work. (16)

8. The blade angle of a single ring of an impulse turbine is 300m/s and the nozzle angle is 20^0.The isentropic heat drop is 473kJ/kg and nozzle efficiency is 85%.Given the blade velocity coefficient is 0.7 and the blades are symmetrical, Draw the velocity diagram and calculate for a mass flow of 1 kg/s i) axial thrust on balding ii) steam consumption per BP hour if the mechanical efficiency is 90% iii) blade efficiency and stage efficiency. (16)

UNIT-4
AIR COMPRESSORS
Part-A (2 Marks)

01. What is meant by single acting compressor?

02.What is meant by double acting compressor?

03. What is meant by single stage compressor?

04. What is meant hy multistage compressor?

05. Define isentropic efficiency

06. Define mean effective pressure. How is it related to in power of an I.C engine.

07. What is meant by free air delivered?

08. Explain how flow of air is controlled in a reciprocating compressor?

09. What factors limit the delivery pressure in reciprocating compressor?
.

10. Name the methods adopted for increasing isothermal efficiency of reciprocating air compressor.

11. Why clearance is necessary and what is its effect on the performance of reciprocating compressor?

12. What is compression ratio?

13. What is meant by inter cooler?

Part-B (16 Marks)

1. Drive an expression for the work done by single stage single acting reciprocating air compressor. (16)

2. Drive an expression for the volumetric efficiency of reciprocating air compressors (16)

3. Explain the construction and working of a root blower (16)

.

4. Explain the construction and working of a centrifugal compressor (16)

5. Explain the construction and working of a sliding vane compressor and axial flow compressor(16)

6. A single stage single acting air compressor is used to compress air from 1 bar and 22° C to 6 bar according to the law $PV^{1.25} = C$. The compressor runs at 125 rpm and the ratio of stroke length to bore of a cylinder is 1.5. If the power required by the compressor is 20 kW, determine the size of the cylinder . (16)

7. A single stage single acting air compressor is used to compress air from 1.013 bar and 25° C to 7 bar according to law $PV^{1.3} = C$.The bore and stroke of a cylinder are 120mm and 150mm respectively. The compressor runs at 250 rpm .If clearance volume of the cylinder is 5% of stroke volume and the mechanical efficiency of the compressor is 85%, determine volumetric efficiency, power, and mass of air delivered per minute. (16)

8. A two stage singe acting air compressor compresses $2m^3$ airs from 1 bar and 20° C to 15 bar. The air from the low pressure compressor is cooled to 25° C in the intercooler. Calculate the minimum power required to run the compressor if the compression follows $PV^{1.25}=C$ and the compressor runs at 400 rpm. (16)

UNIT-5
REFRIGERATION AND AIR CONDITIONING
Part-A (2 Marks)

01. Name four important properties of a good refrigerant

02. What is the difference between air conditioning and refrigeration?

.

03. What is the function of the throttling valve in vapour compression refrigeration system?

.

04. In a vapour compression refrigeration system, where the highest temperature will occur?
After compression.

05. The vapour absorption system can use low-grade heat energy in the generator. Is true of false?
True.

06. Name any four commonly used refrigerants.

07. Explain unit of Refrigeration.

08. Why throttle valve is used in place of expansion cylinder for vapour compression refrigerant machine.

09. What are the effect pf super heat and suhcooling on .the vapour compression cycle?

10. What are the properties of good refrigerant?

11. How are air-conditioning systems classified?

12. How does humidity affect human comfort?
.

13.. What are the various sources of heat gain of an air-conditioned space?

14. What do you mean by the term infiltration in heat load calculations?

Part-B (16 Marks)

1. Draw neat sketch of simple vapor compression refrigeration system and explain. (16)

2. Explain with sketch the working principle of aqua Ammonia refrigeration system. (16)

3. Explain with sketch the working principle of water-Lithium bromide refrigeration system. (16)

4. Briefly explain the cooling load calculation in air conditioning system. (16)

5. Explain winter, summer, and year round Alc system. (16)

6. Explain unitary Alc and central Alc system. (16)

7. Explain any four psychometric processes with sketch. (16)

8. A refrigeration system of 10.5 tonnes capacity at an evaporator temperature of -12℃ and a condenser temperature of 27℃ is needed in a food storage locker. The refrigerant Ammonia is sub cooled by 6℃ before entering the expansion valve. The compression in the compressor is of adiabatic type. Find 1. Condition of vapor at outlet of the compressor.2. Condition of vapor at the entrance of the Evaporator 3.COP &power required. (16)

9. A sling psychrometer in a lab test recorded the following readings DBT=35℃,WBT=25℃
   Calculate the following
   1. Specific humidity
   2. Relative humidity
   3. Vapor density in air
   4. Dew point temperature
   5. Enthalpy of mixing per kg of air .take atmospheric pressure=1.0132 bar. (16)