Code No: RT21022 **R13** SET - 1

II B. Tech I Semester Regular Examinations, Dec - 2015
THERMAL AND HYDRO PRIME MOVERS
(Electrical and Electronics 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 about fuel supply system of an IC engine.
   b) Using a pressure volume diagram indicate all the processes in a Otto cycle and write the expression for thermal efficiency
   c) Draw the velocity diagram of a simple impulse turbine.
   d) Explain the working principle of centrifugal pump.
   e) Differentiate two stroke and four stroke engines.
   f) Write a short note on direct injection engine.

PART -B

2. a) What is the function of ignition system? Explain the important qualities of a good ignitions system in SI engine
   b) With a neat sketch explain the valve timing diagram of a four stroke SI engine

3. a) With a neat sketch explain the working of a simple Rankine cycle with reheating system.
   b) In a 50% reaction turbine stage running at 3000rpm, the exit angles are 30^0 and the inlet angles are 50^0. The mean diameter is 1m.The steam flow rate is 10000 kg/minute and the stage efficiency is 85%.
   Determine:
   i) Power output of the stage.
   ii) The specific enthalpy drop in the stage.

4. a) Explain the working principle of gas turbine along with p-v and T-s diagrams.
   b) A Gas turbine plant works between the temperature limits of 1152^0K and 288^0 K Isentropic efficiency for compressor and turbines are 0.85 and 0.8 respectively. Determine the optimum pressure ratio for maximum work output and also for maximum Cycle thermal efficiency.
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5. a) Differentiate between centrifugal and reciprocating pumps.

   b) A jet of water of diameter 100mm moving with a velocity of 25m/sec strikes a curved fixed symmetrical plate at the center. Find the force exerted by the jet of water in the direction of the jet, if the jet is deflected through an angle of 120^0 at the outlet of the curved plate.

6. a) Why we call kaplan turbine as propeller turbine, explain its working with neat sketch.

   b) A pelton wheel has a mean bucket speed of 35 m/s with a jet of water flowing at the rate of 1 m^3/s under a head of 270 m. The buckets deflect the jet through an angle of 170^0. Calculate the power delivered to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity at 0.98.

7. a) Explain the importance of mass curve ?

   b) A run of river hydro electric power station is proposed across a river at a site where a net head of 25 m is available on the turbine. The river carries a sustained minimum flow of 30 m^3/s in dry weather and behind the power station sufficient pondage is provided to supply daily peak load of demand with a load factor 71%. Assuming the plant efficiency is 56.4%, determine the maximum generating capacity of the generator to be installed at the power house. If the daily load pattern indicates 21.5 hours average load and 2.5 hours of peak load, determine the volume of pondage to be provided to supply the daily demand.

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(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

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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 importance of cooling and lubrication.
   b) Using a pressure volume diagram indicate all the processes in a diesel cycle and write the expression for thermal efficiency
   c) Classify steam turbines.
   d) Derive Impulse momentum equation.
   e) Explain the working principle of Kaplan turbine.
   f) Differentiate air standard cycle and actual cycle in an IC engine..

PART –B

2. a) Explain the factors that affect the performance of an IC engine.
   b) With a neat sketch explain the port timing diagram of a two stroke SI engine

3. a) Derive an expression for optimum stage efficiency of a reaction turbine
   b) Draw the velocity diagrams of a simple impulse turbine and reaction turbine and explain their significance.

4. a) Describe the differences between closed cycle gas turbine and open cycle gas turbine.
   b) The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature of 20^0C. The pressure of the air after compression is 4 bar. The isentropic efficiencies of compressor and turbine are 80% and 85% respectively. The air-fuel ratio used is 90:1. If flow rate of air is 3 kg/s. Find: (i) power developed (ii) thermal efficiency of the cycle.
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5. a) Derive an expression for the force exerted on a flat vertical plate moving in the direction of jet.
   b) A jet of water of diameter 65 mm moving with a velocity of 30m/s, strikes a curved fixed plate tangentially at one end at an angle of 30^0 to the horizontal. The jet leaves the plate at an angle of 18^0 to the horizontal. Find the force exerted by the jet on the plate in the horizontal and vertical directions.

6. a) What is governing of a turbine? Explain the mechanism to govern any turbine with a neat sketch.
   b) A hydraulic turbine develops 8000 KW under a head of 30 m at 250 rpm. What is the specific speed of the turbine? What would be the speed and power under a head of 18m?

7. a) What are the elements of a hydro electric power plant? Explain the working of hydro electric power station with neat diagram.
   b) The runoff data in mm^3 per month of a river at a particular site for each successive month is tabulated as given below.

1.8	2.4	3.9	10	15	17	9	4	3.5	2.4	1.8	1.8

   Determine the minimum capacity of a reservoir required to allow the above volume of water to the drawn off at a uniform rate assuming that the is no loss of water oven the spillway

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Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
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PART –A

1. a) Write a short note on mist lubrication.
   b) Explain about reheating and regeneration.
   c) Write a short note on blade and stage efficiency.
   d) Differentiate impulse and reaction turbines.
   e) Compared to petrol engine, diesel engine has high efficiency explain.
   f) Explain load duration curve.

PART -B

2. a) With neat sketches explain the working principle of four stroke spark ignition engine
   b) What are the different methods used to calculate the frictional power of an IC engine. Explain any one method in detail.

3. a) What is compounding? Explain the velocity-compounded impulse steam turbine showing pressure and velocity variations along the axis of the turbine.
   b) Explain the factors that effect the efficiency and output of a Rankine cycle.

4. a) What are different operating variables that affect the thermal efficiency of gas turbine power plant? Explain.
   b) In a gas turbine the compressor is driven by the high pressure turbine. The exhaust from the high pressure turbine goes to a free low pressure turbine which runs the load. The air flow rate is 20 kg/s and the minimum and maximum temperatures are respectively 300K and 1000K. The compressor pressure ratio is 4. Calculate the pressure ratio of the low pressure turbine and the temperature of exhaust gases from the unit. The compressor and turbine are isentropic. Cp of air and exhaust gases = 1 kJ/kgk and $\gamma = 1.4$.
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5. a) Classify centrifugal pumps and explain the working of pumps in series and pumps in parallel connections with neat sketches.
   b) A jet of water of diameter 5 cm moving with a velocity of 40 m/s strikes a curved fixed symmetrical plate at the center. Find the force exerted by the jet of water in the direction of the jet, if the jet is deflected through an angle of 120^0 at the outlet of the curved plate.

6. a) What is the purpose of draft tube in reaction turbines? Explain different types of draft tubes with their applications..
   b) A Francis turbine works under a head of 8.5 m at a speed of 300 rpm. A power of 100 KW is developed with a discharge of $3m^3$/sec. The runner diameter is 2.2 m. Find the speed, discharge and power if the head is increased to 18m.

7. a) Distinguish between a base load power plant and peak load power plant.
   b) A run of river hydel power plant with an installed capacity of 15000 kW operates at 20% load factor when it serves as a peak load station. What should be the minimum discharge in the stream so that it may serve as a base load station. The plant efficiency can be taken as 80% when working under a head of 15m. Also calculate the maximum load factor of the plant when the discharge in h stream is 30 m^3/s.

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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 different methods to evaluate the frictional power of an IC engine.
   b) Derive an expression for thermal efficiency of a otto cycle.
   c) Explain about modified rankine cycle.
   d) Differentiate open and closed cycle gas turbine plants.
   e) How a turbine is differed from a pump. Explain.
   f) Explain about carnot cycle.

PART -B

2. a) With neat sketches explain the working principle of four stroke compression ignition engine.
   b) What is the importance of a lubrication system in an IC engine? With a neat sketch explain the working of splash lubrication system.

3. a) Describe the different processes of Rankine cycle. Derive the expression for its efficiency and indicate the processes on P-v and T-s diagrams
   b) In a single-stage impulse turbine, the steam jet leaves the nozzles at 20º to the plane of the wheel at a speed of 670 m/s and it enters the moving blades at an angle of 35º to the drum axis. The moving blades are symmetrical in shape. Determine the blade velocity and diagram efficiency.

4. a) Explain the working of a gas turbine plant with inter cooler, reheating and regenerative systems.
   b) A simple gas turbine cycle works with a pressure ratio of 8. The compressor and turbine inlet temperatures are 300 K and 800 K respectively. If the volume flow rate of air is 250 m^3/s, compute the power output and thermal efficiency.
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5. a) Why do we call reciprocating pumps as positive displacement pumps? Explain the working of reciprocating pump with a neat sketch.
   b) A jet of water moving at 15 m/s impinges on a concave shaped vane to deflect the jet through 120^0 when stationary. If the vane is moving at 5m/s, find the angle of jet so that there is no shock at inlet. Also compute the absolute velocity of jet at exit both in magnitude and direction and the work done per second per N of water. Assume that the vane is smooth.

6. a) Explain the working of a Pelton wheel with neat sketches?
   b) Explain the performance characteristic curves of a hydraulic turbine.

7. a) Explain load factor, Utilization factor and capacity factor. Derive the relation between these factors.
   b) A 300 Mw thermal power station is to supply power to a system having maximum and minimum demand of 240 mw and 200 mw respectively in year. Assuming the load curve to the a straight line, estimate i) Load factor ii) Capacity Factor.