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

II B. Tech I Semester Supplementary Examinations, June - 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) State the purposes of lubrication. [4]

b) Define a steam turbine and state its fields of applications. [4]

c) Write a short note on fuels used for gas turbines. [4]

d) Identify the two important functions of the volute casing of a centrifugal pump. [4]

e) For preparing the operating characteristics curves of hydraulic turbines, the speed and head are maintained constant. Why cannot the discharge also be kept constant? [4]

f) Define Diversity factor. [2]

PART –B

2. a) Compare the relative advantages and disadvantages of four-stroke and two-stroke cycle engines. [8]

b) Discuss with suitable sketches Magneto-ignition system used in petrol engines. [8]

3. a) Describe the different operations of Rankine cycle. Derive also the expression for its efficiency [8]

b) In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 30 bar and the exhaust pressure is 0.25 bar. Determine: [8]

i) The pump work
ii) Turbine work
iii) Rankine efficiency
iv) Condenser heat flow
v) Dryness at the end of expansion.
vi) Assume flow rate of 10 kg/s.
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Code No: RT21022 **R13** SET - 1

4. a) Describe with neat sketches the working of a simple constant pressure open cycle gas turbine. [8]

   b) In an open cycle constant pressure gas turbine air enters the compressor at 1 bar and 300K. The pressure of air after the compression is 4 bar. The isentropic efficiencies of compressor and turbine are 78% and 85% respectively. The air-fuel ratio is 80:1. Calculate the power developed and thermal efficiency of the cycle if the flow rate of air is 2.5 kg/s. Take c_p= 1.005kJ/kg K, γ=1.4 for air and c_{pg}=1.147kJ/kg K and γ=1.33 for gases. R=0.287kJ/kg K. calorific value of fuel=42000kJ/kg. [8]

5. a) Using the impulse-momentum principle, derive an expression for the force exerted by a moving jet of fluid on a stationary curve. [8]

   b) Water impinged on a series of curved vanes entering at $30^0$and leaving at 120^0 to the direction of motion of vanes. The velocity of water at entry is 30 m/s and the vane velocity both at its inlet and exit tips is 15m/s. Determine the vane angles for no shock conditions, the work done per unit weight of fluid and the hydraulic efficiency of the system. Neglect friction effects. [8]

6. a) What is the purpose of constructing the main characteristic curves of hydraulic turbine against variable speed? [8]

   b) Explain with a sketch the governing mechanism of a reaction turbine. [8]

7. It is observed that a run-of-river plant operates as peak load plant with a weekly load factor of 25%, all this capacity being firm capacity. Determine the minimum flow in river so that power plant may act as a base load plant. The following data is supplied: rated installed capacity of generating plant= 10 MW; operating head= 16 m; plant efficiency= 86%. If the steam flow is 15 m^3/s, find the daily load factor of the plant. [16]

Code No: RT21022 **R13** SET - 2

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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) Why do we feel the necessity of cooling an I.C. engine? [4]
   b) Discuss the advantages of a steam turbine over the steam engines. [4]
   c) Enumerate the various uses of gas turbines. [4]
   d) List out all the losses that occur in a centrifugal pump and define the pump efficiencies. [4]
   e) What are the requirements of a good turbine governor? [4]
   f) Define Utilization factor. [2]

PART –B

2. a) Discuss the differences between theoretical and actual valve timing diagrams of a diesel engine. [8]
   b) Describe a simple carburetor with a neat sketch and also state its limitations. [8]
3. a) Explain with the help of neat diagram a `Regeneration cycle`. Derive an expression for its thermal efficiency. [8]
   b) A simple Rankine cycle works between pressure of 30 bar and 0.04 bar, the initial condition of steam being dry saturated, calculate the cycle efficiency, work ratio and specific steam consumption. [8]
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Code No: RT21022 **R13** SET - 2

4. a) Describe with neat diagram a closed cycle gas turbine. State also its merits and demerits. [8]

   b) A gas turbine has a pressure ratio of 6/1 and a maximum cycle temperature of 600^0C. the isentropic efficiencies of the compressor and turbine are 0.82 and 0.85 respectively. Calculate the power output in kilowatts of an electric generator geared to the turbine when the air enters the compressor at 15^0C at the rate of 15kg/s. Take c_p=1.005kJ/kg K, γ=1.4 for the compression process and c_{pg}=1.11kJ/kg K and γ=1.333 for the expansion process. [8]

5. a) A centrifugal pump with radial inflow, rim velocity 19.62 m/s and manometric efficiency 80% develops a manometric head of 16m. what is the velocity of whirl at exit? [8]

   b) Describe with the help of diagrams the variable speed and constant speed performance curves of a centrifugal pump. [8]

6. a) Draw a neat sketch of Pelton wheel installation and briefly indicate the functions of each component? [8]

   b) Draw a neat diagram of the operating characteristics curves of Pelton, Francis, Kaplan and Propeller turbines. Discuss then practical importance of these curves. [8]

7. From the investigation of a hydro site the following data is available: [16]

   Available head= 50m; catchment area=50 sq. km; rainfall=150 cm per year; 70% of rainfall can be utilized; turbine efficiency=91%; penstock efficiency=75%;load factor=60%. Determine the suitable capacity of a turbo-generator.

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II B. Tech I Semester Supplementary Examinations, June - 2015
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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) State the function of a carburetor in petrol engine. [4]

   b) State the methods of increasing the thermal efficiency of a Rankine cycle. [4]

   c) What do you mean by the term `gas turbine`? how are gas turbines classified? [4]

   d) The work done by fluid on a curved vane per second is 1000 Joules. If the angular velocity is 20 radians per second, what is the torque? [4]

   e) Discuss the distinction between impulse and reaction turbines. [4]

   f) Define Capacity factor. [2]

PART –B

2. a) State the relative advantages and disadvantages of battery and magneto-ignition systems. [6]

   b) Explain briefly the following methods of cooling I.C. engines: [10]

   i) Air cooling
   ii) Liquid cooling

3. a) What do you mean by compounding of steam turbines? Discuss various methods of compounding steam turbines. [8]

   b) A steam power plant works between 40 bar and 0.05 bar. If the steam supplied is dry saturated and the cycle of operation is Rankine, find: [8]

   i) Cycle efficiency

   ii) Specific steam consumption
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Code No: RT21022 **R13** SET - 3

4. a) Explain with a neat sketch the working of a constant volume combustion turbine. [8]

   b) The gas turbine has an overall pressure ratio of 5:1 and a maximum cycle temperature of 550^0C. the turbine drives the compressor and an electric generator, the mechanical efficiency of the drive being 97%. The ambient temperature is 20^0C and the isentropic efficiencies for the compressor and turbine are 0.8 and 0.83 respectively. Calculate the power output in kilowatts for an air flow of 15 kg/s. calculate also the thermal efficiency and the work ratio. Neglect changes in kinetic energy and the loss of pressure in combustion chamber. [8]

5. a) Describe with a sketch the installation and operation of a centrifugal pump. [8]

   b) A horizontal jet of water of 5 cm diameter and velocity 40m/s is deflected through an angle of 135^0 by a stationary curved vane. Assuming shockless and frictionless flow, determine the magnitude and direction of the resultant force on the vane. [8]

6. a) Explain with the help of a diagram, the essential features of Kaplan turbine installation. [8]

   b) With the help of velocity triangles derive expressions for power developed, hydraulic efficiency and overall efficiency of a Kaplan runner. [8]

7. The following data is available for a hydro power plant: [16]

   Available head=140m; catchment area=200 sq. km; annual average rainfall=145 cm; turbine efficiency=85%; generator efficiency=90%; percolation and evaporation losses=16%. Determine

   i) Power developed and

   ii) Suggest type of turbine to be used if runner speed is to be kept below 240 r.p.m.

Code No: RT21022 **R13** SET - 4

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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) Discuss the relative advantages and disadvantages of Air cooling and Water cooling systems? [4]

   b) State the advantages of regenerative cycle and simple Rankine cycle. [4]

   c) State the merits of gas turbines over I.C. engines and steam turbines. Discuss also the demerits of gas turbines. [4]

   d) A fluid jet striking a normal fixed plate exerts a force of 10 N on the plate. If the same jet strikes a fixed curved vane and gets deflected through an angle of 135^0, what is the force exerted on the vane? [4]

   e) Mention two most striking characteristics of : Pelton wheel, Francis turbine and Kaplan turbine. [4]

   f) Define load factor. [2]

PART –B

2. a) Discuss with the help of suitable sketches the following: [10]

      i) Wet pump lubrication
      ii) Dry pump lubrication

   b) Discuss the differences between ideal and actual valve timing diagrams of a petrol engine. [6]
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Code No: RT21022 **R13** SET - 4

3. a) Explain the difference between an impulse turbine and a reaction turbine. [8]

   b) A steam power plant working on Rankine cycle has the range of operation from 40 bar dry saturated to 0.05 bar. Determine: [8]

      i) The cycle efficiency
      ii) Work ratio
      iii) Specific fuel consumption

4. a) Discuss briefly the methods employed for improvement of thermal efficiency of open cycle gas turbine plant. [8]

   b) In an air standard gas turbine engine, air at a temperature of 15^0C and a pressure of 1.01 bar enters the compressor, where it compressed through a pressure ratio of 5. Air enters the turbine at a temperature of 815^0C and expands to original pressure of 1.01 bar. Determine the ratio of turbine work to compressor work and the thermal efficiency when the engine operates on ideal Brayton cycle. Take γ=1.4, c_p=1.005kJ/kg K. [8]

5. a) List out the difficulties that are generally encountered in operating centrifugal pumps. [8]

   b) Derive equations for the force of impact of a fluid jet on a series of normal flat vanes mounted on a wheel. The vane velocity is less than jet velocity. Prove that the maximum possible hydraulic efficiency is 50%. [8]

6. a) What are the functions governing a hydraulic turbine? Explain with a sketch the governing mechanism of an impulse turbine. [8]

   b) Explain with sketches the salient features of main characteristic curves of different types of hydraulic turbines. [8]

7. Calculate the power developed in MW from a hydro- electric power plant with the following data: [16]

Available head	50m
Catchment area	250 sq. km
Average annual rainfall	120 cm
Rainfall lost due to evaporation	20%
Turbine efficiency	82%
Generator efficiency	84%
Head lost in penstock	4%