Code No: R1621025 **R16** SET - 1

II B. Tech I Semester Regular Examinations, October/November - 2017
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 **Four** Questions from **Part-B**

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PART –A

1. a) State the function of a carburetor in a petrol engine. (2M)
   b) A quantity of steam at 10bar and 0.85 dryness occupies 0.15m^3. The steam is heated at constant pressure to raise its temperature up to 300^{0}C. determine the change in internal energy and the heat supplied (3M)
   c) Define work ratio and thermal efficiency of a gas turbine plant. (2M)
   d) Identify the two important functions of the volute casing of a centrifugal pump. (2M)
   e) Define volumetric efficiency of a turbine. (3M)
   f) Define and explain the significance of Diversity factor. (2M)

PART -B

2. a) Compare the relative advantages and disadvantages of four-stroke and two-stroke cycle engines. (7M)
   b) Discuss with suitable sketch the magneto-ignition system used in petrol engines. (7M)

3. a) Explain with the help of neat sketch a single-stage impulse turbine. Also explain the pressure and velocity variations along the axial direction. (7M)
   b) Explain with the help of a neat sketch, Reheat-Rankine cycle. Derive its expression for the efficiency. (7M)

4. a) Describe with neat sketches the working of a simple constant pressure open cycle gas turbine. (5M)
   b) In a gas turbine plant, air is compressed from 1bar and 15^{0}C through a pressure ratio of 4:1. It is then heated to 650^{0}C in a combustion chamber and expanded back to a pressure of 1bar in a turbine. Calculate the cycle efficiency and work ratio, if a perfect heat exchanger is used. Assume isentropic efficiency of the turbine and compressor as 85% and 80% respectively. (9M)

5. a) Using the impulse-momentum principle, derive an expression for the force exerted by a moving jet of fluid on a stationary curved vane. (7M)
   b) A jet of water moves smoothly over the surface of a curved vane. Analyse the forces acting on the vane and determine the resultant force in magnitude and direction. Assume shockless flow at entry and exit. (7M)
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6. a) Draw a net sketch of a Pelton wheel installation and briefly indicate the functions of each component? (8M)
   b) Distinguish in detail between impulse and reaction turbines. (6M)

7. a) Explain elaborately about pumped storage plants. (5M)
   b) A run-of-river hydel power plant with an installed capacity of 15000kW 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 the base load station? The plant efficiency may be taken as 80% when working under a head of 15m. Also calculate the maximum load factor of the plant when the discharge in the stream is $30m^3/s$. (9M)

Code No: R1621025 **R16** SET - 2

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

1. a) State the purposes of lubrication. (2M)
   b) One kg of steam at 18bar and 280^0C undergoes a constant pressure process until the quality of steam becomes 0.5 dry. Find the work done, the heat transferred and the change in entropy. (3M)
   c) Explain and draw the T-s diagram representing the actual gas turbine cycle. (3M)
   d) Define manometric efficiency of a centrifugal pump. (2M)
   e) What do you understand by mechanical efficiency of a turbine. (2M)
   f) Define and explain the significance of Utilization factor. (2M)

PART -B

2. a) Discuss the difference between theoretical and actual valve timing diagrams of a diesel engine. (6M)
   b) Explain briefly the following methods of cooling I.C. engines: i) Air cooling; ii) Liquid cooling. State their advantages and disadvantages. (8M)

3. a) Explain velocity compounded impulse steam turbine showing pressure and velocity variations along the axis of the turbine. (6M)
   b) Describe briefly the Rankine cycle using superheated steam and show in what respect this cycle differs from Carnot cycle between the same temperatures. (8M)

4. a) Derive the expression for the optimum pressure ratio giving the mass, specific output in a simple gas turbine cycle. (6M)
   b) A gas turbine plant works in temperature limits of 300K and 900K and the pressure limits are 1bar and 4bar. The internal efficiency of the compressor is 0.8 and that of the turbine is 0.85. Estimate the thermal efficiency of the plant and the power available in kilowatts, if the air consumption is 1 kg/s. the heating value of the fuel is 42000kJ/kg. (8M)

5. a) A horizontal jet of water strikes a flat vane inclined to the jet at an angle θ. Obtain the components of the force of impact of jet in the direction of jet and normal to it if the vane is stationary. (7M)
   b) Describe with a sketch the installation and operation of a centrifugal pump. (7M)

6. a) Explain with the help of a diagram, the essential features of a Kaplan turbine installation. (7M)
   b) What are the functions governing a hydraulic turbine? Explain with a sketch the governing mechanism of an impulse turbine. (7M)

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7. a) Explain firm power and secondary power in detail (5M)

   b) Two turbo-generators each of capacity 25000kW have been installed at a hydel power station. During a certain period the load on the hydel plant varies from 15000kW to 40000kW. Calculate i) The load factor; ii)The plant factor and iii)The utilization factor (9M)

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

1. a) Why do we feel the necessity of cooling an I.C. engine? (2M)
   b) Steam at a pressure of 6bar and dryness 0.8 is heated at a constant volume to a pressure of 7bar. Determine the final dryness fraction and heat absorbed by 1kg of steam. (3M)
   c) Enumerate the various uses of gas turbines. (2M)
   d) What are the operating characteristics of a centrifugal pump? (2M)
   e) Define hydraulic efficiency of a turbine. (3M)
   f) Define and explain the significance of Capacity factor. (2M)

PART -B

2. a) State the relative advantages and disadvantages of battery and magneto-ignition systems. (7M)
   b) Discuss with the help of suitable sketch the dry pump lubrication (7M)

3. a) Explain the pressure compounded impulse steam turbine showing pressure and velocity variations along the axis of the turbine. (6M)
   b) Prove that the efficiency of a Rankine cycle using superheated steam is greater than the efficiency of a corresponding Rankine cycle using steam without superheat. Both the cycles operate between the same boiler and condenser pressure limits. (8M)

4. a) Describe with neat diagram a closed cycle gas turbine. State also its merits and demerits. (6M)
   b) A gas turbine unit receives air at 100kPa and 300K and compresses it adiabatically to 620kPa with efficiency of the compressor 88%. The fuel has a heating value of 44180kJ/kg and the fuel/air ratio is 0.017kg fuel/kg air. The turbine internal efficiency is 90%. Calculate the compressor work, turbine work and thermal efficiency. (8M)

5. a) Derive equations for the force of impact of a fluid jet on a series of normal flat vanes mounted on a wheel. Consider that the vane velocity is less than the jet velocity (5M)
   b) How are centrifugal pumps classified? Describe with sketches the operation of a (9M)
      i) Multi-stage pump
      ii) Double suction pump
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6. a) With the help of velocity triangles derive expressions for power developed, hydraulic efficiency and overall efficiency of a Francis runner (6M)
   b) What are the requirements of a good turbine governor? Explain with a sketch the governing mechanism of a reaction turbine. (8M)

7. a) What do you understand by hydro electric power plant? What are its elements? Discuss them one by one with neat sketches. (7M)
   b) Explain briefly how the power available for a hydel project can be estimated. (7M)

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

1. a) Explain the following terms as applied to I. C. engines: compression ratio and piston speed. (2M)
   b) Steam at a pressure of 5bar and a temperature of 200^0C expands isentropically to a pressure 0.7bar. Find the final dryness of steam by using steam tables. (2M)
   c) What do you mean by term `gas turbine`? How are gas turbines classified? (3M)
   d) Why the centrifugal pump impeller vanes backward curved? (2M)
   e) Define overall efficiency of a turbine. (3M)
   f) Define and explain the significance of load factor. (2M)

PART -B

2. a) Describe a simple carburetor with a neat sketch and also state its limitations. (7M)
   b) Discuss with the help of suitable sketch, the wet pump lubrication (7M)

3. a) Draw the Rankine cycle on T-s diagram using dry saturated steam and obtain an expression for the Rankine cycle efficiency. (6M)
   b) In a De Laval turbine, the steam issues from the nozzles with a velocity of 850m/s. the nozzle angle is 20^0. Mean blade velocity is 350m/s. The blade are equiangular. The mass flow rate is 1000kg/min. friction factor is 0.8. determine (8M)
      i) Blade efficiency
      ii) Stage efficiency, if nozzle efficiency is 93%.

4. a) Discuss briefly the methods employed for improvement of thermal efficiency of open cycle gas turbine plant. (6M)
   b) A gas turbine takes in air at 27^0C and 1 bar. The pressure ratio is 4 and the maximum temperature in the cycle is 560^0C. The compressor and turbine efficiencies are 0.83 and 0.85 respectively. Determine the overall efficiency if the refrigerator effectiveness is 0.75. (8M)

5. a) A horizontal jet of water strikes a flat vane inclined to the jet at an angle θ. Obtain the components of the force of impact of jet in the direction of jet and normal to it if the vane moves in the direction of the jet with a certain velocity less than the jet velocity. (7M)
   b) Describe with the help of diagrams the variable speed and constant speed performance curves of a centrifugal pump. (7M)
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6. a) With the help of velocity triangles derive expressions for power developed, hydraulic efficiency and overall efficiency of a Kaplan runner (8M)
   b) Distinguish between operating speed and runaway speed of a hydraulic turbine. How are they evaluated? (6M)

7. a) Explain in detail about load-duration curve? How is it prepared? (7M)
   b) Show that capacity factor is equal to the product of the load factor and the utilization factor. (7M)