Code No: RR212201 **Set No.1**

II B.Tech. I Semester Supplementary Examinations, May -2005
PRIME MOVERS AND MECHANICAL MEASUREMENTS
(Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define specific speed and derive the equation.
   (b) A reaction turbine operating with 93 percent hydraulic efficiency utilizes 900liters/sec of water. Its peripheral velocity at inlet is 24m/sec while velocity of whirl is 18m/sec. If the area of flow at inlet is 0.4sq.m, find the guide vane angle at outlet and the horse power generated by the turbine if the discharge is radial.

2. (a) Explain
      i. Mechanical efficiency
      ii. olumetric efficiency
      iii. Manometric efficiency
      iv. Over all efficiency
   (b) The discharge of a centrifugal pump is 0.38 m^3 / sec and runs at a speed of 500rpm. The head developed is 15 m. The width of the impeller at out let is 5cm and the diameter is 75 cm. The manometric efficiency is 0.8. Estimate the blade angle at outlet.

3. Draw a neat sketch of a nuclear reactor and explain the functions of different components.

4. (a) Explain briefly why in multistage impulse turbines the first stage is often compounded for velocity and remaining having single row wheels.
   (b) For a stage of impulse turbine with single acting wheel and equiangular blades, the nozzle angle is 20^0. The velocity coefficient for the blades is 0.83. What is the maximum blade efficiency? If the blade efficiency is 90% of maximum values, what are the possible ratios of blade speed to steam speed?

5. (a) Explain the working principle of actual gas turbine plant?
   (b) Derive the optimum pressure ratio for maximum efficiency of gas turbine power cycle?

6. An orifice having a diameter of 50mm is known to wear so that the diameter increases by 0.05 mm in each week. It is installed in a 100mm pipe. If the Reynolds number is about 1000,000 estimate the error after 6 weeks operation.

7. (a) Write a brief note on various elastic transducers used in force measurement.
   (b) Explain the principle and working of a strain gauge accelerometer.

8. (a) Sketch the schematic arrangement of an oscilloscope for frequency and phase measurements and explain its working principle.

   (b) An oscilloscope displays a sine wave and the distance between the first and fourth peaks is found to be 5.4cm. If the time base setting is 20 x 10^{-03} make calculations for the periodic time and frequency of the sine wave.

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Answer any FIVE Questions
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1. (a) How do you determine the force exerted by a water jet on an inclined and stationary plate ?
   (b) A 10 cm diameter water jet having a velocity of 12 m / sec impinges on a plane plate at an angle of 60 degrees to the normal to the plate. What will be the impact when the plate is moving at 5 m /sec in the direction of the jet. What is the work done per unit time.

2. (a) How does the pressure at the eye of a centrifugal pump vary with the fluid in contact with the impeller?
   (b) A centrifugal pump impeller has outer diameter of 40 cm and outer width of 6cm. The impeller runs at a speed of 900 rpm and the blades are curved backward with a blade angle of 30^0 at the out let. The discharge delivered is 0.3 m^3/ sec. Determine all the velocities and angles of outlet velocity triangle. Sketch the velocity triangle

3. (a) Differentiate mountings and accessories of a boiler. List out various mountings and accessories that are normally employed in a boiler installation.
   (b) Explain the principle of operation of a fusible plug with a neat sketch.

4. (a) Explain the reason for not using more than two stages in velocity compounded steam turbines.
   (b) The velocity of steam leaving the nozzle of an impulse turbine is 900 m/sec and the nozzle angle is 20^0. The blade velocity is 300 m/sec and the blade velocity Co-efficient is 0.7. Calculate for a mass flow of 1 kg/sec and symmetrical blading
      i. The blade inlet angle
      ii. The driving force on the wheel
      iii. The axial thrust
      iv. The diagram power

5. (a) What are different methods to improve the performance of gas turbine plant?
   (b) Derive the optimum pressure ratio for maximum thermal efficiency of the gas turbine?

6. With a neat sketch explain the principle and construction details of Orifice flow meter. Discuss the advantages and disadvantages of using Orifice Meter as flow measuring instrument.

7. (a) With a neat sketch, explain the working of piezo-electric pickup used in the measurement of force.

   (b) Explain in brief various elementary vibrometers and vibration detectors.

8. (a) Sketch the schematic arrangement of an oscilloscope for frequency and phase measurements and explain its working principle.

   (b) An oscilloscope displays a sine wave and the distance between the first and fourth peaks is found to be 5.4cm. If the time base setting is 20 x 10^{-03} make calculations for the periodic time and frequency of the sine wave.

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Code No: RR212201 **Set No.3**

II B.Tech. I Semester Supplementary Examinations, May -2005
PRIME MOVERS AND MECHANICAL MEASUREMENTS
(Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Bring out the difference between the casings of reaction turbine and impulse turbine
   (b) A Kaplan turbine develops 20000kw at a head of 35m and at a rotational speed of 500 rpm the outer diameter of the blades 2.5m and the diameter of hub is 0.95m. If the overall efficiency is 85% and the hydraulic efficiency is 88% calculate discharge and the blade angle at the inlet.

2. (a) Derive the equation for the work done by the impeller of a centrifugal pum.
   (b) A centrifugal pump delivers water against a net head of 10m at a speed of 1000 rpm. The vanes are curved backward and make an angle of 30 degrees. The impeller outside diameter is 30 cm and has a width of 5 cm at the outlet. Determine the discharge if manometric efficiency is 95%.

3. Explain the principle of operation of Babcock and Wilcox boiler with the help of neat sketch showing various mountings and accessories.

4. (a) Describe the Rankine cycle and show how it differs from Carnot cycle.
   (b) Dry-saturated steam is supplied to a turbine at 14 bar. The condenser pressure being 0.05 bar. Find :
      i. Rankine efficiency neglecting pump work
      ii. Ideal steam rate in Kg/kw-hr
      iii. Actual steam rate if engine efficiency is 54%

5. (a) Derive the thermal efficiency of gas turbine power cycle?
   (b) In a gas turbine cycle, the pressure ratio is 6 and max. cycle temperature is 650^0C. Air enters the compressor at 15^0C and flow rate of air is 12 kg/s. Take for compression process, c_p = 1.005 kJ/kg K andγ = 1.4 and for expansion process, c_p = 1.12 kJ/kg K and γ = 1.32. Determine the power developed and thermal efficiency.

6. Explain with a neat sketch the constructional details of a Flow nozzle? Discuss the advantages and disadvantages of using Flow Nozzle as a flow-measuring instrument.

7. (a) Define mass standard.
   (b) Explain the principle of variable reluctance pickup used in the measurement of vibration.

(c) Explain how a proving ring is used to measure force.

8. (a) Explain with a neat sketch a band brake type dynamometer.

(b) Derive the relationship between the torque on the shaft and the force applied for braking.

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Code No: RR212201 **Set No.4**

II B.Tech. I Semester Supplementary Examinations, May -2005
PRIME MOVERS AND MECHANICAL MEASUREMENTS
(Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the working of Pelton wheel turbine and derive the equation for the power developed by the runner.
   (b) At a hydropower plant the turbine operates under a head of 100m and consumes water at the rate of 12 m^3 / sec. If the turbine runs at 240 rpm and gives an efficiency of 90%, find the specific speed of the turbine.
2. (a) Explain the working of a centrifugal pump with the help of a neat sketch
   (b) The outer diameter of an impeller of a centrifugal pump is 45cm. The blade angle at outlet is 90 degrees. The speed of impeller is 1500 rpm. The pump works at a manometric efficiency of 0.75. Calculate the head developed.
3. What are high-pressure boilers? How do they differ in construction and working principle from ordinary boilers? Explain the advantages gained by employing forced circulation in these high-pressure boilers.
4. (a) Show that the thermal efficiency of a regenerative cycle is always higher than that of a simple Rankine cycle.
   (b) A Carnot engine works between the pressures of 28 bar and 0.15 bar using steam as working fluid. Dry-saturated steam is supplied to the engine. Find the work done and thermal efficiency of the engine. Also find the dryness fraction of steam at the end of isentropic expansion and at the beginning of isentropic compression.
5. (a) Derive the thermal efficiency of gas turbine power cycle?
   (b) In a gas turbine cycle, the pressure ratio is 6 and max. cycle temperature is 650^0C. Air enters the compressor at 15^0C and flow rate of air is 12 kg/s. Take for compression process, c_p = 1.005 kJ/kg K andγ = 1.4 and for expansion process, c_p = 1.12 kJ/kg K and γ = 1.32. Determine the power developed and thermal efficiency.
6. With a neat sketch explain the principle and construction details of Orifice flow meter. Discuss the advantages and disadvantages of using Orifice Meter as flow measuring instrument.
7. (a) What are various elementary accelerometers. Explain the principle of each.
   (b) Explain the method of measuring force using a strain gauge
8. (a) Explain the working principle of mechanical torsion meter with neat sketch.

(b) A shaft transmits a maximum power of 50kW when running at a constant Speed of 1500rpm. Measurement of torque are made by a pair of strain gauges, which are bonded on to a specially machined portion of the shaft. Each gauge has a nominal resistance of R = 120Ohms. Gauge factor F = 2.0 are connected electrically to the two arms of a half-activated wheetstone-bridge circuit which is energized with an excitation voltage of 6Volts. If the gauges have a maximum strain of 0.0015, calculate the shaft diameter the modulus of elasticity of the shaft material is 200GN/m^2.

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