

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

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

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. [6+10]
2. (a) What is the hydraulic function of a air vessel?
(b) A single acting reciprocating pump without air vessel has a plunger of 8cm diameter and a stroke of 12cm. It draws water from a sump 3m below the pump through a suction pipe 3 cm diameter and 5m long. It delivers water to a tank 12m above the pump through a delivery pipe 2cm diameter and 15m long. If separation occurs at a pressure of 67 KN /m² below atmospheric pressure, find the maximum speed at which the pump may be operated without separation. [6+10]
3. Explain in detail the different aspects upon which boilers are classified. [16]
4. (a) What are the difficulties experienced in carrying out Carnot cycle for a steam engine.
(b) Determine the efficiency of a Carnot Vapour cycle in which steam at 40bar is supplied to the prime mover and the condenser pressure is 0.08bar. Also find the quality of steam at the exit to the condenser if the fluid is to enter the boiler as saturated liquid. [6+10]
5. A gas turbine draws air at atmospheric pressure and 299 K. There are two stages of compression with an intercooler and the pressure ratio is 8:1 in each stage. The maximum temperature of the cycle is 800 K. Determine the thermal efficiency and work ratio if efficiency of turbine and compressor are 0.86 and 0.83 respectively. [16]
6. With reference to the mechanism of a Bourdon-tube pressure gauge explain how the tube functions and why the curved tube tends to straighten out when the pressure is applied inside? Mention the materials used for the tube and operating range of the particular material. [16]
7. (a) Explain the method of measuring force using hydraulic load cell.

- (b) Explain the principle and working of seismic displacement sensing accelerometer. [8+8]
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. [8+8]

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

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Explain the working of Francis turbine. Derive the equation for power developed by the runner.
(b) A Pelton wheel has a mean bucket speed of 12m/ sec and is supplied with water at the rate of 750 litres /sec under a head of 35 m. If the buckets deflect the jet through an angle of 160 degrees, find the power and the efficiency of the turbine. Take the coefficient of velocity as 0.98. [10+6]
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.[10+6]
3. Describe the working principle of feed check valve and stop valve with the help of neat sketches. [16]
4. (a) Explain the methods used to reduce the rotor speed of a steam turbine
(b) A single stage impulse turbine 1 m in diameter rotates at 3000 rpm. Steam is supplied from the nozzle with a velocity of 300 m/sec and nozzle angle is 20° . The blades are equiangular. Assuming the friction loss in the blade passage is 35% of the kinetic energy corresponding to the relative velocity at inlet to the blade. Find the power developed by the turbine. The axial thrust on bearing of the turbine is 150 N. [6+10]
5. (a) Explain the working principle of constant volume heat addition gas turbine power cycle
(b) Derive the optimum pressure ratio of gas turbine power cycle for the maximum thermal efficiency? [8+8]
6. Explain the principle of variable head meters? What is meant by the designation Variable head? [16]
7. (a) What are various elementary accelerometers. Explain the principle of each.
(b) Explain the method of measuring force using a strain gauge. [8+8]
8. (a) What are LISSAJOU patterns? How are they obtained and used for the measurement of frequency and phase shift?
(b) Differentiate between frequency and time period and explain pulse and sinusoidal wave forms with neat sketch. [8+8]

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

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

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. [6+10]
2. (a) What is the pressure head in cylinder during suction stroke in reciprocating pump fitted with air vessel?
(b) A centrifugal pump requires a minimum starting speed of 1100 rpm. If the outer and inner diameters of the impeller are 45 cm and 25 cm respectively, what will be the net head developed. [6+6]
3. Draw the neat diagram of hyperbolic cooling tower and discuss its merits and demerits. [16]
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° . 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? [6+10]
5. (a) What are the advantages and disadvantages of reheating gas turbine power cycle?
(b) Show that the thermal efficiency of a gas turbine power cycle depends only on pressure ratio. [6+10]
6. What is meant by calibration? Discuss in brief the calibration of Flow measuring devices? [16]
7. (a) List the basic types of lever balances and compare between them.
(b) Explain the principle and working of seismic displacement sensing accelerometer. [8+8]
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 $R = 120\Omega$. 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/m². [8+8]

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

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Why is the Francis turbine called reaction turbine. Explain.
(b) A Kaplan turbine has a runner diameter of 4m and a hub diameter of 1.2 m. The discharge through the turbine is 70 cum /sec. The hydraulic and mechanical efficiencies can be assumed to be 0.9 and 0.96 respectively. Assuming an absence of whirl at the outlet and the discharge is free, estimate the net available head on the turbine and the power developed. [6+10]
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.[10+6]
3. (a) What are the essential features of a good boiler?
(b) Compare the water tube and fire tube boilers on different aspects. [8+8]
4. In a certain stage of an impulse turbine, the nozzle angle is 20° with the plane of the wheel. The mean diameter of the blade ring is 2.8 m and it develops 60 kW at 3000 rev/min. Four nozzles each of 10mm exit diameter expand steam isentropically from 15 bar and 250°C to 0.5 bar. The axial thrust is 3.3 N. Calculate
(a) blade angles at entrance and exit of the moving blades
(b) power lost in blade friction
(c) stage efficiency. [16]
5. (a) Compare the open cycle gas turbine with closed cycle gas turbine?
(b) A gas turbine cycle receives air at 1 bar and 298 K and compressed to a pressure of 8 bar and heated to a temp of 1173 K. Calculate the power developed by the cycle if mass of air flow rate is 4.0 kg/s. [6+10]
6. A horizontal venturimeter with 15cm inlet and 7.5cm throat is used for measuring the flow of cooling water in a manufacturing process. The differential pressure between the inlet and throat is 17.5 cm when measured using a mercury U-tube manometer. Calculate the water flow rate if the discharge coefficient for the venturimeter of 0.97. Density of water = 1000kg/m^3 , Specific gravity of mercury =13.6. [16]
7. (a) Explain why vibration measurement is important.

- (b) With a neat sketch, explain the working of pneumatic load cell. [6+10]
8. (a) What are LISSAJOU patterns? How are they obtained and used for the measurement of frequency and phase shift?
- (b) Differentiate between frequency and time period and explain pulse and sinusoidal wave forms with neat sketch. [8+8]
