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| **AALIM MUHAMMED SALEGH COLLEGE OF ENGINEERING****DEPARTMENT OF MECHANICAL ENGINEERING****QUESTION BANK****DEPARTMENT: MECH SEMESTER: III****SUBJECT CODE / Name: CE6451 - FLUID MECHANICS AND MACHINERY** |
| **PART – B (16 MARKS)** |
| **UNIT- I**  |
| 1. | Calculate the density, specific weight, weight of one litre of petrol which has specific gravity of 0.737. |
| 2. | Determine the bulk modulus of elasticity of a liquid, if the pressure of the liquid is increased from 90 N/cm2 to 150 N/cm2. The volume of the liquid decreases by 0.15 percent. |
| 3. | A U-tube manometer used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to the atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases. |
| 4. | The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft diameter of 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. |
| 5. | Find out the differential reading ‘h’ of an inverted U-tube manometer containing oil of specific gravity 0.7 as the manometric fluid when connected across pipes A and B, Conveying liquids glycerol and water having specific gravities 1.2 and 1.0 at pipes A and B respectively and immiscible with manometric fluid. Pipes A and B are located at the same level and assume the pressures at A and B to be equal. The rise of Glycerol is 30cm above from the centre of pipe. |
| 6. | Calculate the specific weight, density and specific gravity of one litre of a liquid which weighs 7N. |
| 7. | Calculate the capillary effect in millimeters in a glass tube of 4 mm diameter, when immersed in (i) water, and (ii) mercury. The temperature of the liquid is 20˚C and the values of the surface tension of water and mercury at 20˚C in contact with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero that for mercury 130˚. Take density of water at 20˚C as equal to 998 kg/m3. |
| 8. | A differential manometer is connected at two points A and B of two pipes as shown in figure 8 (a). The pipe A contains a liquid specific gravity =1.5 while pipe B contains a liquid of specific gravity = 0.9. The pressure at A and B are 1 kgf/cm2 and 1.8 kgf/cm2 respectively. Find the difference in mercury level in the differential manometer.Figure.8 a |
| 9. | Describe the types of fluids. |
| 10. | If the velocity distribution over a plate is given by *u* = (2/3) y−y² in which *u* is the velocity in meter per second at a distance y meter above the plate, determine the shear stress at y=0 and y=0.15m. The dynamic viscosity of fluid is 8.63 poises. |
| 11. | State and prove Pascal’s law. |
| 12. | Define compressibility and surface tension of fluid. |
| 13. | A Newtonian fluid is filled in clearance between a shaft and a concentric sleeve. The sleeve attains a speed of 50 cm\s, when a force of 40 N is applied to a sleeve parallel to a shaft. Determine the speed of shaft, if a force of 200 N is applied. |
| 14. | Define (1) Absolute pressure (2) Gauge pressure (3) Vacuum pressure  |
| 15. | Calculate the capillarity effect in millimeters in a glass tube of 4 mm diameter, when immersed in (1) water (2) mercury the temperature of the liquid is 20˚ C and the values of surface tension of water and mercury at 20˚ C in contact with air are 0.0735 N/m and 0.51 N/m respectively. The contact angle for water is θ = 0 and for mercury is θ = 130. Take the standard values of specific weight for water & mercury. |
| **UNIT- II** |
| 1. | Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.8m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE. |
| 2. | Explain the types of flow. |
| 3. | A 30cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s. |
| 4. | Derive the Euler’s equation for the flow of an incompressible frictionless fluid from consideration of momentum & also derive an expression for Bernoulli’s equation. |
| 5. | A pipe (1) 450 mm in diameter branches into two pipes (2) and (3) of diameters 300 mm and 200 mm respectively. If the average velocity in 450 mm diameter pipe is 3 m/s, find : (i) discharge through 450 mm dia. Pipe and (ii) velocity in 200 mm diameter pipe if the average velocity in 300 mm pipe is 2.5 m/s. |
| 6. | Derive the continuity equations for a 3 –dimensional flow in Cartesian coordinates |
| 7. | Using Buckingham’s π-theorem, shown that the discharge Q consumed by an oil ring is given by Q=Nd3Φ[μ/ρNd2,σ/ρN2d3,w/ρN2d] where d is the diameter of the ring, N is rotational speed, ρ is density, μ is viscosity, σ is surface tension and w is the specific weight of oil. |
| 8. | The pressure difference Δp in a pipe of diameter (D) and length (L) due to turbulent flow depends on the velocity (V), viscosity (μ), density (ρ) and roughness (K). Obtain an expression for Δp.  |
| 9. | The efficiency (ђ) of a fan depends on the density (ρ), the dynamic viscosity (μ), angular velocity (ω), diameter (D) of the motor and the discharge (Q). Express the efficiency (ђ) in terms of dimensional parameters. |
| 10. | Find an expression for the drag force an smooth sphere of diameter D moving with uniform velocity V in fluid density ρ and dynamic viscosity μ. |
| **UNIT- III** |
| 1. | Calculate: (i) the pressure gradient along flow, (ii) the average velocity, and (iii) the discharge for an oil of viscosity 0.02 Ns/m2  flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/s. |
| 2. | The rate of flow of water through a horizontal pipe is 0.3 m³/s. The diameter of the pipe is suddenly enlarged from 25 cm to 50 cm. The pressure intensity in the smaller pipe is 14 N/m². Determine (i) Loss of head due to sudden enlargement. (ii) Pressure intensity in the large pipe and (iii) Power lost due to enlargement. |
| 3. | A pipe line of length 2000 m is used for power transmission. If 110.3625 kW power is to be transmitted through the pipe in which water having a pressure of 490.5 N/cm2 at inlet is flowing. Find the diameter of the pipe and efficiency of transmission if the pressure drop over the length of pipe is 98.1 N/cm2. Take f = 0.0065 |
| 4. | Derive the Darcy – Weisbach equation to find the loss of head due to friction in pipes. |
| 5. | An oil of viscosity 0.1 Ns/m2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and of length 300 m. The rate of flow of fluid through the pipe is 3.5 litres/s. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. |
| 6. | The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300m, 170m, and 210m and of diameters 300mm, 200mm, 400m respectively, is 12m. Determine the rate of flow of water if coefficients of friction are 0.005, 0.0052, 0.0048 respectively, considering (i) minor losses (ii) neglecting minor losses. |
| 7. | A flat plate (1.5 m X 1.5 m) moves at 50 km / h in a stationary air density 1.15 kg/m³. If the coefficient of drag and lift are 0.15 and 0.75 respectively, determine (i) the lift force (ii) the drag force (iii) the resultant force and (iv) the power required to set the plate in motion. |
| 8. | A main pipe divides into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000m and 1 m respectively, while the length and diameter of 2nd parallel pipe are 2000 mm and 0.8 m. find the rate of flow in each parallel pipe, if total flow in the main is 3 m3/s .the coefficient of friction for each parallel pipe is same and equal to 0.005. |
| 9. | What are the major losses and minor losses in a pipe? |
| 10. | Find the head lost due to the friction in the pipe of diameter 300 mm and length 50 m, through which water is flowing with a velocity of 3 m/s. (i) Darcy formula (ii) chezy’s formula for which C = 60. Take kinematic viscosityof water = 0.01 stokes. |
| 11. | Differentiate laminar and turbulent flow and their respective Reynolds number |
| 12. | Derive Darcy Weisback equation for friction losses in the pipe. |
| **UNIT-IV** |
| 1. | Explain the construction and working principle of a Kaplan turbine with a neat sketch. |
| 2. | A Pelton wheel is to be designed for the following specifications:Shaft power = 11,772 kW; Head = 380 meters; Speed = 750 rpm; Overall efficiency = 86%; Jet diameter is not to exceed one- sixth of the wheel diameter. Determine:  |
|  |  (i) The wheel diameter,  |
|  |  (ii) The no. of jets required, and  |
|  |  (iii) Diameter of the jet, Take Kv1 = 0.985 and Ku1 = 0.45  |
| 3. | Explain the construction and working principle of Pelton wheel turbine with a neat sketch. |
| 4. | A Francis turbine with an overall efficiency of 75% is required to produce 148.25 kW power. It is working under a head of 7.62 m. The peripheral velocity = 0.26 (2gH)^1/2 and the radial velocity of flow at inlet is 0.96 (2gH)^1/2. The wheel runs at 150 rpm and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, determine: 1. The guide blade angle,
2. The wheel vane angle at inlet,
3. Diameter of the wheel at inlet, and
4. Width of the wheel at inlet.
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| 5. | Define hydro turbines and classify the same. Explain the construction and working of any one of the hydro turbine with a neat sketch. |
| 6. | A Kaplan turbine runner is to be designed to develop 7357.5 kW shaft power. The net available head is 5.50 m. Assume that the speed ratio is 2.09 and flow ratio is 0.68, and the overall efficiency is 60%. The diameter of the boss is 1/3rd of the diameter of the runner. Find the diameter of the runner, its speed and its specific speed. |
| 7. | Explain the construction and working principle of Francis turbine with a neat sketch  |
| 8. | A Kaplan turbine develops 20000KW at a head of 35 m and at rotational speed of 420 rpm. The outer diameter of the blades is 2.5 m and the hub diameter is 0.85m. If the overall efficiency is 85% and the hydraulic efficiency is 88%. Calculate the discharge, the inlet flow angle and the blade angle at the inlet. |
| 9. | A Francis turbine with an Overall efficiency of 75% is required to produce 148.25 KW power. It is working under a head of 7.62 m. the peripheral velocity = 0.26 √2gh and the radial velocity of flow at inlet is 0.96 √2gh. The wheel runs at 150 r.p.m. and the hydraulic losses in the turbine are 22% of the available energy. Assume radial discharge, Determine,1. Guide angle of blade.
2. Wheel vane angle at inlet
3. Diameter of the wheel at inlet
4. Width of the wheel at inlet
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| **UNIT- V**  |
| 1. | The following observations are made while conducting performance test on Centrifugal pump. Determine the overall efficiency of the pump. Discharge of water is 1.8 m3/s. Diameters of suction and delivery pipes are 15 cm and 10 cm respectively. The suction and delivery gauge readings are *25* cm of mercury and 175 kN/m2 respectively. The height of delivery gauge over suction gauge is 0.5m. The output ofdriving motor is 9.555 kW. |
| 2. | Explain the construction and working principle of external gear pump with a neat sketch. Give its merits and demerits.  |
| 3. | A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm work against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm, determine: (i) Vane angle at inlet (ii) Work done by impeller on water per second |
| 4. | Explain the construction and working principle of a single acting and double acting reciprocating pump with indicator diagram.  |
| 5. | Explain Priming of a centrifugal pump. |
| 6. | A centrifugal pump has a 25 cm diameter impeller and an outlet width of 5 cm and runs at 1100 rpm delivering water against a head of 11 m. The vanes are curved backward 30° with the periphery at outlet. The manometric efficiency of the pump is 90%. Calculate the discharge. |
| 7. | Explain the construction and working principle of a submersible pump with a neat sketch. Mention its merits and demerits. |
| 8. | Determine the volume flow rate for a centrifugal pump with given data’s.* Tip diameter = 1.1 m
* Hub diameter = 0.8 m
* Operating speed = 1200 rpm.
* Blade angle at inlet = 30°
* Blade angle at outlet = 60°.

Draw inlet velocity and outlet velocity polygons. |
| 9. | A double-acting reciprocating pump is running at 30 rpm. Its bore and stroke are 250 mm and 400 mm respectively. The pump lifts water from a sump 3.8 m below and delivers it to a tank located at 65 m above the axis of the pump. The length of suction and delivery pipes is 6 m and 150 m respectively. The diameter of the delivery pipe is 100mm. If an air vessel of adequate capacity has been fitted on the delivery side of the pump, determine: (1) the minimum diameter of the suction pipe to prevent separation of flow, assuming the minimum head to prevent occurrence of separation is 2.5m, (2) the maximum gross head against which the pump has to work and the corresponding power of motor. Assume the mechanical efficiency 78% and slip = 1.5 %; Hatm = 10.0 m; F = 0.012. |
| 10. | What is an air vessel? what are the uses and advantages of fitting air vessels in a reciprocating pump |
| 11. | Explain the operation of a centrifugal pump with the help of a neat sketch. Write short notes on different types of casing used in centrifugal pumps. |
| 12. | Define cavitation. What are the effects of cavitation |
| 13. | A double acting reciprocating pump, running at 40 r.p.m, is discharging 1.0 m³ of water per minute. The pump has a stroke of 400 mm. The diameter of the piston is 200 mm. The delivery and suction heads are 20 m and 5 m respectively. Find the slip of the pump and power required to drive the pump. |