B.E. DEGREE EXAMINATIONS: APRIL / MAY 2009

Third Semester

MECHATRONICS ENGINEERING

U07MH302 Fluid Mechanics and Machinery

Time: Three Hours

Maximum Marks: 100

Answer ALL the Questions:-

PART A (20 x 1 = 20 Marks)

1. Fluids which do not follow the linear relationship between shear stress and rate of deformation are termed as ------------------------ fluids.

    (a) newtonian   (b) non newtonian   (c) dilatent   (d) Ideal

2. The capillary rise of water in the glass tube is given by----------

    (a) $2\sigma/wd$ (b) $3\sigma/wd$ (c) $4\sigma/wd$ (d) $6\sigma/w$

    (where σ- surface tension, w-weight density and d-diameter of glass tube)

3. The specific weight of water is equal to---------------

    (a) $1000 \ kg/m^3$ (b) $1000 \ N/m^3$ (c) $9810 \ kg/m^3$ (d) $9810 \ N/m^3$

4. Piezometers measure ------------- pressure only

    (a) absolute   (b) gauge   (c) atmospheric   (d) vacuum

5. In fluid mechanics, the continuity equation is a mathematical statement embodying the principle of

    (a) conservation of mass   (b) conservation of momentum

    (c) conservation of energy   (d) conservation of momentum and energy.

6. If velocity potential (Φ) satisfies the Laplace equation, it represents the possible -------- flow.

    (a) unsteady, compressible, rotational   (b) steady,compressible,irrotational

    (c) unsteady, incompressible, rotational   (d) steady, incompressible, irrotational

7. If the Reynold's number is less than 2000, the flow in a pipe is-----------

    (a) laminar flow   (b) turbulent flow   (c) transition flow   (d) laminar or turbulent

8. A pitot tube is used for measuring-----------

    (a) Velocity of flow   (b) pressure of flow   (c) flow rate   (d) total energy

9. The maximum velocity in a circular pipe when flow is laminar occurs at-----------

    (a) the top of the pipe   (b) the bottom of the pipe

    (c) the centre of the pipe   (d) not necessarily at the center.

10. Darcy-weisbach equation is used to find loss of head due to -----------------------

    (a) sudden enlargement   (b) sudden contraction   (c) friction   (d) bend

11. Loss of head at exit of a pipe is given as------------

    (a) $v^2/2g$ (b) v^2/g (c) v^3/g (d) $v^3/2g$ (where v- velocity at outlet of pipe

12. For viscous flow, the co-efficient of friction is given by --------------------------

    (a) f = 8/Re   (b) f=16/Re   (c) f=32/Re   (d) f=60/Re

    (Where f-co-efficient of friction and Re-Reynolds number)

13. The hydraulic machines, which convert hydraulic energy into mechanical energy are

    called------------------------

    (a) pumps   (b) turbines   (c) compressor   (d) fluid coupling

14. If the specific speed of the turbine is 550 (SI Unit), then the type of turbine is-------------

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    (a) Pelton wheel with 2 jets   (b) francis turbine

    (c) pelton wheel with single jet   (d) Kaplan or propeller turbine.

15. The pelton wheel is running at 1000 r.p.m, the net head on the turbine is 700m and the

    discharge through the nozzle is 0.1m3/s. The power available at the nozzle is equal to

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    (a) 686KW   (b) 686W   (c) 868W   (d) 868KW

16. The ratio of the power available at the shaft of the turbine to the power delivered to the

    runner is defined as-----------------------

    (a) Mechanical efficiency   (b) overall efficiency

    (c) volumetric efficiency   (d) hydraulic efficiency.

17. The expression for discharge/s through a double acting reciprocating pump is given by

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    (a) Q= ALN/60   (b) Q= 2ALN/60   (c) Q =ALN   (d) Q=2ALN

    (Where A- Area, L- Length and N- Speed of the pump)

18. The percentage of work saved per stroke incase of single-acting reciprocating pump

    fitted with air vessel.

    (a) 84.8%   (b) 94.5%   (c) 54.6%   (d) 40.2%

19. The difference between the theoretical discharge and actual discharge of the

    reciprocating pump is called ------------------

    (a) Slip   (b) % Slip

    (c) co-efficient of discharge   (d) efficiency of the pump

20. The phenomenon of formation of vapour bubbles and sudden collapsing of vapor

    bubbles is called ----------------

    (a) cavitation   (b) scale formation   (c) vapor pressure   (d) eddy formation

21. (a) Two large plane surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerin. What force is required to drag a very thin plate of surface area 0.5 square meter between the two large plane surfaces at a speed of 0.6m/s, if:

    (i) the thin plate is in the middle of the two plane surfaces, and

    (ii) the thin plate is at a distance of 0.8 cm from one end of the surfaces? Take

dynamic viscosity of glycerin = $8.10 \times 10^{-1} N.s/m^2$

(OR)

21. (b) (i) Define the term pressure. Obtain an expression for the pressure intensity at a point in a fluid. (12)

    (ii) What are the different types of mechanical pressure gauges? (4)

22. (a) (i) Define the terms: Local acceleration and convective acceleration. (4)

    (ii) The velocity vector in a fluid flow is given $V = 4x^3 i - 10x^2y j + 2t k$. Find the velocity and acceleration of a fluid particle at (2,1,3) at time t=1sec (12)

(OR)

22. (b) (i) Derive an expression for the discharge through a venturimeter. (8)

    (ii) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of sp.gr. 0.8. The discharge of oil through venturimeter is 60 lit/s. Find the reading of the oil-mercury differential manometer. Take Cd = 0.98 (8)

23. (a) Show that the difference of pressure head for a given length of two parallel plates which are fixed and through which viscous fluid is flowing is given by $h_f = 12\mu\bar{U}L/\rho g t^2$

(Where μ - viscosity of fluid, $\bar{U}$-average velocity, t-distance between the two parallel plates, L-length of the plates, ρ-mass density of fluid)

(OR)

23. (b) (i) Three pipes of lengths 800m, 500m and 400m and of diameters 500mm, 400mm and 300mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700m. Find the diameter of the single pipe (6)

    (ii) A main pipe divides into two parallel pipes which again forms one pipe. The length and diameter of first parallel pipe are 2000m and 1m respectively while the length and diameter of second parallel pipe are 2000m and 0.8m. Find the rate of flow in each parallel pipe, if the total flow in the main is 3m³/s. Take co-efficient of friction for each parallel pipe is same and equal to 0.005. (10)

24.(a) (i) How will you classify turbines? (6)

(ii) A pelton wheel has a mean bucket speed of 10 metres per second with a jet of water flowing at the rate of 700litres/s under a head of 30metres. The buckets deflect the jet through an angle of 160^0. Calculate the power given by water to the runner and hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. (10)

(OR)

24. (b) (i) A turbine is to operate under a head of 25m at 200r.p.m. The discharge is 9 m^3/s. If the efficiency is 90%, determine specific speed of the machine, power generated and identify the type of turbine. (6)

(ii) A Kaplan turbine runner is to be designed to develop 7357.5 KW shaft power. The net available head is 5.5m. Assume that the speed ratio is 2.09 and flow ratio is 0.68 and overall efficiency is 60%. The diameter of the boss is $1/3^{rd}$ of the diameter of the runner. Find the diameter of the runner, its speed and its specific speed. (10)

25. (a) (i) A single acting reciprocating pump, running at 50 r.p.m., delivers 0.01m^3/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine the theoretical discharge of the pump, co-efficient of discharge, slip and % slip of the pump. (10)

(ii) Differentiate between centrifugal pumps and reciprocating pumps. (6)

(OR)

25. (b) (i) The outer diameter of an impeller of a centrifugal pump is 400mm and outlet width 50mm. The pump is running at 800 r.p.m, and is working against a total head of 15m.The vane angle at outlet is $40^o$and manometric efficiency is 75% determine velocity of flow at outlet, velocity of water leaving the vane, angle made by the absolute velocity at outlet with the direction of motion at outlet and discharge. (10)

(ii) What are the effects of cavitation? Give the necessary precautions against cavitation. (6)

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