٤ ميكانيكا قوى

Tanta University
Second Term Exam
Time Allowed: 3hrs

Hydraulic and Pneumatic Circuits
Course Code: MEP4229
Total Assessment Marks: 90
4th Year Mechanical Power Engineering

Faculty of Engineering
Mech. Power Eng. Dept
June 1, 2019

Please, answer the following questions:

Question (1) **(25Marks)**

1. Discuss with the help of free sketch the working principle of oscillatory vane motor.

2. What is the purpose of cushion devices in hydraulic cylinders? Discuss the principle of operation.

3. A pump delivers oil at a rate of 1.15L/s into the blank end of the 76.2mm diameter hydraulic cylinder. The piston contains a 25.4mm diameter cushion plunger that is 19.05mm long. The cylinder drives a 6672N weight which slides on a flat horizontal surface having a coefficient of friction (μ) equal to 0.12, see Fig. 1. The pressure relief valve setting equals 51.7bar. Find the maximum pressure developed by the cushion.

Question (2) **(30Marks)**

1. What is the purpose of a pressure relief valve? What are its types? Discuss the working principle of each type with the help of free sketch drawing.

2. Discuss with the help of free sketch the working principle of pilot check valve. Give an example of its function in hydraulic systems.

3. The system shown in Fig. 1 has a hydraulic cylinder with a suspended load W. The cylinder piston and rod diameters are 50.8mm and 25.4mm, respectively. The pressure-relief valve setting is 5150kPa. Determine the pressure P_2 for a constant cylinder extension speed:
   a) $W = 8890$ N
   b) $W = 0$ (load is removed)
   c) Determine the cylinder extension speeds for parts (a) and (b) if the flow-control valve has a capacity coefficient of 0.72 LPM/$\sqrt{\text{kPa}}$. The fluid is hydraulic oil with a specific gravity of 0.90

Question (3) **(35Marks)**

1. For the double pump system shown in Fig. 3 for the application of a sheet metal punch press, what should be the pressure settings of the unloading valve and pressure relief valve under the following conditions:
   - Sheet metal punching operation requires a force of 2000lb
   - Hydraulic cylinder has a 1.5-in piston diameter and 0.5-in rod diameter
   - During rapid extension of the cylinder, a frictional pressure loss of 100psi occurs in the line from the high flow pump to the blank end of the cylinder. During the same time a 50psi pressure loss occurs in the return line from the rod end of the cylinder to the oil tank. Frictional pressure losses in these lines are negligible small during the punching operation.
   - Assume the unloading valve and pressure relief valve pressure settings (for their full pump flow requirements) should be 50% higher than the pressure required to overcome frictional pressure losses and the cylinder punching load respectively.

2. For question (3_1), the poppet of the pressure relief valve must move 0.1 in from its fully closed position in order to pass the full pump flow at the PRV setting (full pump flow pressure). The poppet has a $0.75in^2$ area on which system pressure acts. Assume that the relief valve cracking pressure should be 10% higher than the pressure required to overcome the hydraulic cylinder punching operation, find the required:
   a) Spring constant of the compression spring in the PRV
   b) Initial compression of the spring from its free length condition and set by the spring adjustment mechanism of the PRV (poppet held against its seat by spring)

3. Figure 4 shows a fail-safe circuit with overload protection. The purpose of the circuit is to prevent the cylinder from accidentally falling on an operator as well as prevent overloading of the system.
   a) Identify marked valves in the circuit
   b) How could the cylinder be extended? re-draw the circuit in this case
   c) What is the purpose of using valve (5) in the given circuit?
   d) Throughout the cylinder extension, the cylinder is over-loaded. Discuss and illustrate by re-drawing the circuit how could the system be protected against overloading.

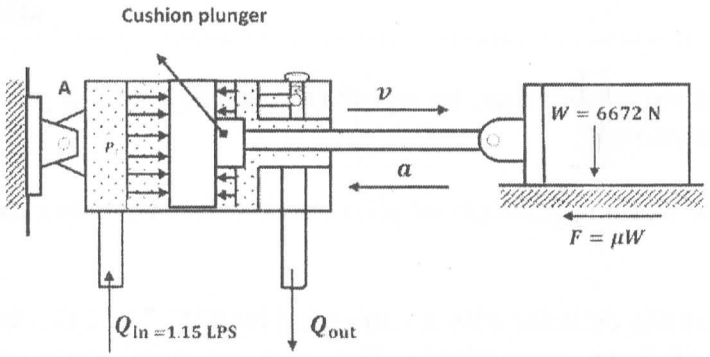

Fig.1 Cylinder with cushion device for question (1_3)

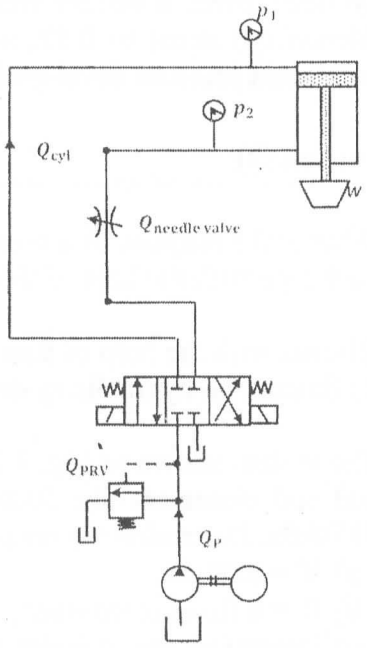

Fig. 2 Circuit for question (2_3)

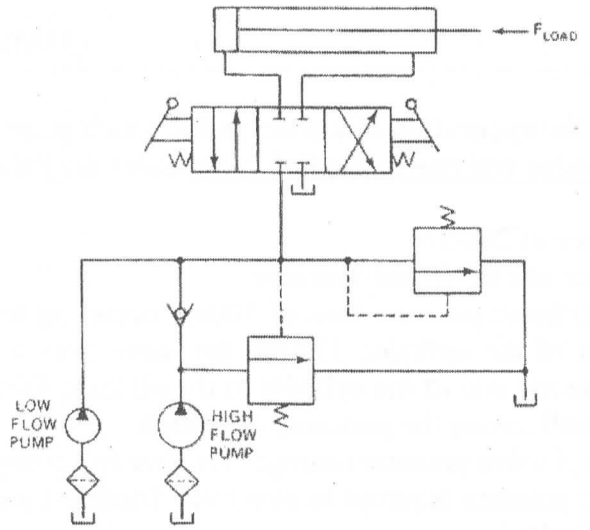

Fig. 3 Double pump circuit for question (3_1)

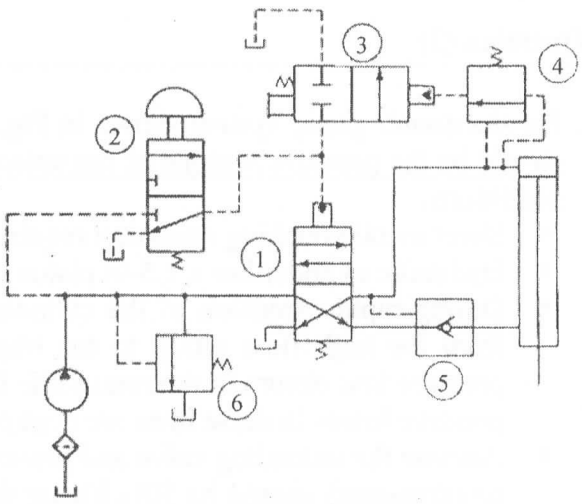

Fig. 4 Fail-safe circuit for question (3_2)

Best of Luck *Dr. Omar Mehrez*

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C.١٩-٦-٣

Tanta University **Faculty of Engineering** **Mechanical Power Department** **4th Year Power Mechanics** **Examiner: Dr., M.I.Amro**	**Subject: elective course (5)** **Gas Turbine Engines Code:MEP4232** **Final Exam, Full Marks: 75 points** **Time allowed: 3 Hours** **Date:3-6-2019**

Answer as much as you can. **Assume any missing data**

Question (1) (25 marks)

1-a) In an axial flow gas turbine, obtain all the gas angles in terms of degree of reaction, flow coefficient and blade loading coefficient. (5 Marks)

1-b) Draw h-s diagram for impulse turbine and reaction turbine with degree of reaction 0%, 50% and 100%. Show the difference between the rotor blade shape of impulse and reaction turbine (5 Marks)

1-c) Draw and describes the velocity triangles and (T-S) diagram for the axial flow turbine indicating the values of pressure and velocity at all points (5 Marks)

1-d) In a single-stage axial flow gas turbine, gas enters the turbine at a stagnation temperature and pressure of 1150K and 8 bar, respectively. Isentropic efficiency of stage is equal to 0.88, mean blade speed is 300 m/s, and rotational speed is 240 rps. The gas leaves the stage with velocity 390 m/s. Assuming inlet and outlet velocities are same and axial, find the blade height at the outlet conditions when the mass flow of gas is 34 kg/s, and temperature drop in the stage is 145 K. (10 Marks)

Question (2) (15 marks)

a) Explain and draw a neat sketch of: (i) turbojet engine, (ii) turbofan engine, and (iii) turboprop engine. Compare the thrust force for each engine. (5Marks)

b) A turbojet aircraft is flying with a velocity of 320 m/s at an altitude of 9150 m where atmospheric pressure P_a=32 kPa and temperature t_a = -32°C. The pressure ratio across the compressor is 12, and the temperature at the turbine inlet is 1400 K. Air enters the compressor at a rate of 60 kg/s, and the jet fuel has a heating value of 42,700 kJ/kg. Assuming ideal operation for all components and constant specific heats, determine:

- The velocity of the exhaust gases.
- The thrust force and propulsive power developed,
- The propulsive efficiency, and,
- The rate of fuel consumption. (10 Marks)

Question (3) (20 marks)

a) Define degree of reaction for axial flow compressor, derive an expression for it and show that for 50% reaction the blades are symmetrical (5 Marks)

b) Draw the combined velocity diagram and the (T-S) diagram for axial flow compressor stage, indicating the values of pressure and velocity at different points? (5 Marks)

c) An axial flow compressor has a tip diameter of 0.95m and a hub diameter of 0.85 m. The absolute velocity of air makes an angle of 28^{O} measured from the axial direction and relative velocity angle is 56^{O}. The absolute velocity outlet angle is 56^{O} and the relative velocity outlet angle is 28^{O}. The rotor rotates at 5000 rpm and the density of air is 1.2 kg/m^3. Determine:

1. The axial velocity.
2. The mass flow rate.
3. The power required.
4. The flow angles at the hub.
5. The degree of reaction at the hub. .

(10 Marks)

Question (4) (15 Marks)

a) Draw and explain temperature-entropy (T-S) diagram for the real cycle of jet engines. (5 Marks)

b) A gas-turbine power plant operates on the regenerative Brayton cycle between the pressure limits of 100 and 700 kPa. Air enters the compressor at 30°C at a rate of 12.6 kg/s and leaves at 260°C. It is then heated in a regenerator to 400°C by the hot combustion gases leaving the turbine. A diesel fuel with a heating value of 42,000 kJ/kg is burned in the combustion chamber with a combustion efficiency of 97 %. The combustion gases leave the combustion chamber at 871°C and enter the turbine whose isentropic efficiency is 85 %. Treating combustion gases as air ,determine (a) the isentropic efficiency of the compressor,(b) the effectiveness of the regenerator,(c) the air–fuel ratio in the combustion chamber, (d) the net power output and the back work ratio, and (e) the thermal efficiency (10 Marks)

With Best Wishes Dr. Mohamed Amro

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Tanta University | Department: Mechanical Power Engineering | Faculty of Engineering

Total Marks: 85

Course Title: Power Plants	Course Code : MEP 4231	Year : 4th
Date: June 8th 2019 (Second Term)	Allowed Time : 3 hrs	No. of Pages: (2)

Remarks: (Answer all questions. Assuming any missing data)

Problem number (1) (20 Marks)

A. With schematic diagram, distinguish between residential cooling and Heating with Solar Energy and the Magneto hydrodynamic (MHD) generator systems. 5 Marks

B. Suggest a modern electrical generating plant that could be used for efficient pulverized coal fueled combustion; support your suggestion with suitable drawing? 5 Marks

C. With the schematic drawing compare between LA MONT and BENSON boilers and list the features of each boiler. 5 Marks

D. Describe the major difference between direct and indirect method for calculation of the Boiler efficiency, list the merits and demerits of direct method, if the boiler efficiency equal 92% with an error of 3.5% in direct method, calculate the significant change in efficiency by using direct and indirect method. 5 Marks

Problem number (2) (25 Marks)

A. Briefly describe with drawing if possible the main usefulness criteria that will be added to the power plan if the condensers system is designed well? 5 Marks

B. What did we mean by the following expressions: "Boiler Horsepower" , "Factor of Evaporation", "Evaporative Capacity", and "Boiler Heat Losses"? 5 Marks

C. The good boiler device needs some requirements. Describe the different requirements that must be considered for a good performance boiler? 5 Marks

D. A new housing development is to be added to the line of a public utility. There are 1000 apartments, each having a connected load of 4 k W, also stores and services are included of the characteristics shown in the following table :

Store or Service	Connected Load (kw)	Demand factor %	Store or Service	Connected Load (kw)	Demand factor %
1 Laundry	20	68	2 drugstore	10 each	79
2 mosques	10 each	56	2 grocery store	5 each	73
1 restaurants	60	52	1 shoe store	2	67
1 bookstore	5	66	1 clothing store	4	53
1 dry-goods store	7	76	1 theater	100	49

The demand factor of the apartments is 45 percent. The group diversity factor of the residential load for this system is 3.5, and the peak diversity factor is 1.4. The commercial load group diversity factor is 1.5, and the peak diversity factor is 1.1.

Find the increase in peak demand on the total system delivery for the station bus resulting from addition of this development on the distribution system. Assuming line losses at 5 percent of the delivery energy.

10Marks

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P. T. O.

Tanta University

Department: Mechanical Power Engineering

Faculty of Engineering

Total Marks: 85

Problem number (3) (15 Marks)

A. Briefly classify the draft system and show mathematically how to find the chimney height and diameter?.....assuming no loss through chimney pass **10Marks**

B. The height of the chimney used in a plant is 30 m. the temperature of flue gases and air is 297°C and 27°C respectively. The draught produced by the chimney is 15 mm of water. The coal burned in combustion contains 80% carbon, 6% moisture and the rest is ash. Neglect loses assuming the volume of burned products is equivalent to the volume of air supplied and complete combustion of fuel. Find the percentage of excess air supplied **5Marks**

Problem number (4) (25 Marks)

A. With suitable drawing explain the advantage of calculating the Peak diversity factor? **5Marks**

B. A generation station has a maximum demand of 5000Kw, and the daily load on the station is as follows:

Load (kW)	1000	1750	4000	1500
Time	11 PM to 6 AM	6 AM to 8 AM	8 AM to 12 PM	12 PM to 1 PM
Load (kW)	3750	4250	5000	2250
Time	1 PM to 5 PM	5 PM to 7 PM	7 PM to 9 PM	9 PM to 11 PM

a) Draw the load curve.
b) Draw the load duration curve.
c) Find the load factor and capacity factor for the plant. **10 Marks**

C. What are the most important items must be covered by energy bills? List down three different forms that can be used for the energy rating. **5Marks**

D. A step meter rate is quoted to calculate the electric energy rate as follows:

First 10 kwhr at 10 cent per kilowatt hour
Next 40 kwhr at 6 cent per kilowatt hour
Next 50 kwhr at 4 cent per kilowatt hour
Next 100 kwhr at 3 cent per kilowatt hour
Excess over 200 kwhr at 2 cent per kilowatt hour

Calculate the total bills and average unit cost for consumption of 50, 150, 250, and 450kwhr
Compare your result if the modified step meter rate is used for the bills calculation..... **5Marks**

With my best wishes:

Prof. Dr. Eng. Medhat Elkelawy

And committee

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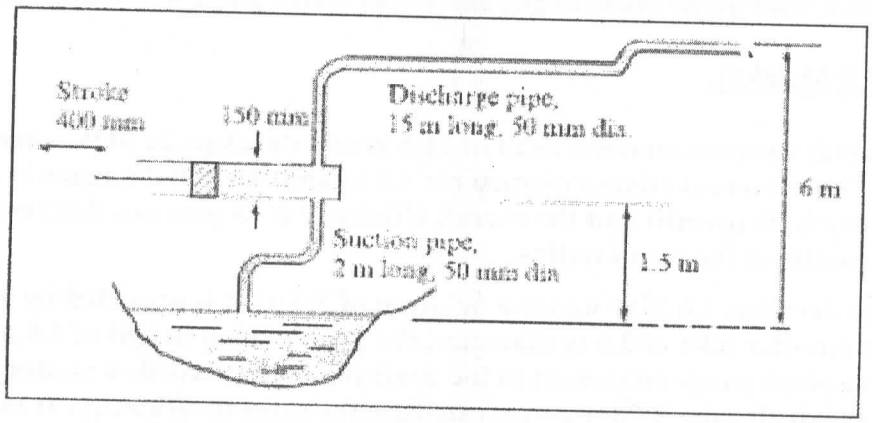
	TANTA UNIVERSITY FACULTY OF ENGINEERING DEPARTMENT OF MECHANICAL POWER ENGINEERING			
	EXAMINATION FOR FRESHMEN (2014 YEAR), STUDENTS OF 4th GRADE MECHANICAL POWER			
	COURSE TITLE:	HYDRAULIC MACHINES B		COURSE CODE: MEP 4220
DATE:	June 12, 2019	TERM: 2nd	TOTAL ASSESSMENT MARKS: 75	TIME ALLOWED (HOURS): 3

Please, answer the following questions (assume any missing data):-

Question One: (20 Marks)

a- Discuss briefly (using neat sketches as possible) the differences between the centrifugal pumps and the reciprocating piston pumps from the theory of operation, the performance characteristics, the flow rate and the pressure regularities with time, and the cavitation formation points of view.

b- A single-acting, single-cylinder, positive displacement pump, as shown in Figure, is used to drain an excavation. The pump has a bore of 150 mm and a stroke of 400 mm. The suction and discharge pipes are both of 50 mm diameter, the suction pipe being 2m long and the discharge pipe 15 m along. The suction lift to the pump is 1.5 m while the discharge is 6 m above the level of the water surface in the excavation. In the absence of any air chambers on either (a) pump suction or (b) discharge, calculate for (a, b) the absolute pressure head in the cylinder at the (i) start, (ii) end and (iii) middle of each stroke if the pump drive is at 0.2 rev/s and may be assumed to be simple harmonic.
Also, determine (c) the maximum pump speed if separation is to be avoided on the piston face. Assume a friction factor of 0.04 for both pipes, a pump slip of 4 percent, an atmospheric pressure of 10.3 m of water, and a fluid vapor pressure of 2.4 m.



For this reciprocating pump system, calculate the increase in pump speed in rev/min if only one large air chamber were fitted very close to the pump suction valve. Also, find the percentage increase in the maximum discharge of the system.

Question Two, (20 Marks):

a- Sketch a Pelton wheel power station. Then, sketch a detailed spear needle valve characteristics and performance and a bucket shape aspects and show the velocity triangles of the water at the bucket inlet an exit sections.

b- Three identical, double-jet Pelton wheels operate under a gross head of 400 m. The nozzles are of 75 mm diameter with a coefficient of velocity 0.97. The pitch circle of the buckets is 1.2 m diameter and the bucket speed is 0.46 × (jet velocity). The buckets deflect the jet by 165° and owing to friction the relative velocity is reduced by 18 percent. The mechanical efficiency is 96 percent. The water from the reservoir is supplied to the turbines by means of two parallel pipes, each of 0.5 m diameter and 450 m long, having a friction factor is 0.03.

If the quantity of water supplied to each turbine is 0.65 m^3/s, calculate the shaft power developed by it and its rotational speed.

Question Three, (20 Marks):

a- In an inward-flow reaction turbine (Francis turbine), the supply head is 12 m and the maximum discharge is 0.28 m^3/s. The runner external diameter is twice the internal diameter and the velocity of flow is constant and equal to [0.15 $\sqrt{(2gH)}$]. The runner vanes are radial at inlet ($\beta_1=90^o$) and the runner rotates at 300 rpm. Determine (a) the guide vane angles, (b) the vane angle at exit for radial discharge, (c) widths of the runner at inlet and exit. The vanes occupy 10 percent of the circumference and the hydraulic efficiency is 80 percent.

b- A Francis turbine works under a head of 120 m and is used to be connected to an electric generator. The inner diameter and width are 2 m and 0.16 m. The outer diameter and width are 1.2 m and 0.27 m. The flow velocity at inlet is 8.1 m/s. The whirl velocity at outlet is zero. The outlet blade angle is 16°. Assume the hydraulic efficiency as 90%. Determine, power, speed, specific speed, and blade angle at inlet and guide blade angle. If the discharge is reduced to its half value by varying the guide blades angle under the same head. Find the new power, hydraulic efficiency, inlet guide blade angle, and outlet water angle to the draft tube.

Question Four, (15 Marks):

a- An axial flow turbine operates under a head of 21.8 m and develops 21 MW when running at 140 rev min/min. The external runner diameter is 4.5 m and the hub diameter is 2.0 m. If the hydraulic efficiency is 94 percent and the overall efficiency is 88 percent, determine the inlet and outlet blade angles at the mean radius.

b- A Kaplan turbine develops 2.6 MW under a net head of 7.5 m, it is provided by an elbow type draft tube with a circular inlet of 2.5 m diameter, the inlet is set at height of 1.5 m above the tailrace level. A vacuum gauge connected to the draft tube inlet records a reading of 3.7 m. If the efficiency of the draft tube is 78 percent, calculate the turbine efficiency. If the ratio of area of a circular inlet to the rectangular exit of the draft tube is 1:5, determine the power lost due to friction in the tube.

If the turbine output power was reduced to 1.3 MW under the same rotational speed, estimate the vacuum gage reading.

EXAMINERS	Prof. Ayman Bakry	

Best wishes