Question 3 **(marks 19)**

3- a) Draw sectional view of Pelton, Francis and Kaplan turbines. And explain the working mechanism of each turbine?

3- b) Drive an equation for maximum hydraulic efficiency of a Pelton wheel .

3- c) A pelton wheel has a tangential velocity of the buckets 15 m/s . The water is being supplid under head 36 m at a rate 20 lit/s . The buckets deflect the jet through 160 degree , If the coefficient of the velocity 0.98 , find the HP produced by the wheel , hydraulic and overall efficiencies.

3-d) Design a Pelton wheel using the following data:
Head = 200 m, H. Power developed = 1000, Speed = 300 r.p.m.
Assuming the other required data whenever necessary.
(Required, wheel diameter, jet diameter, bucket dimensions and number of bucket)

Question 4 **(marks 18)**

4- a) Write short notes on the flowing item :
- Load regulation of Francis and Kaplan turbines.
- Cavitations in hydraulic turbines.
- Draft tube.

4-b) A propeller turbine runner has an outer diameter of4.5 m and an inner diameter of 2.5 m and develops 28000 hp when running at 140 r.p.m. under a head of 20 m. The hydraulic efficiency 94% and overall efficiency 80%. Find discharge through the turbine, and the guide blade angle at inlet.

4-c) Francis turbine working under a head of 14 m, has guide blade angle of 20° and radial vanes at inlet. The ratio of inlet and outlet diameters is 3 to 2. The velocity of flow of water, at exit, is 4 m/sec. Assuming the velocity of flow to be constant, determine the peripheral velocity of water at inlet and the vane angle at outlet

Question 3 **(marks 25)**

3- a) Draw sectional view of Pelton, Francis and Kaplan turbines. And explain the working mechanism of each turbine?

3- b) Drive an equation for maximum hydraulic efficiency of a Pelton wheel .

3- c) The buckets of a Pelton wheel deflect the jet through an angle of 170°, while the relative velocity of water is reduced by 12 % due to bucket friction. Calculate the theoretical hydraulic efficiency from the velocity triangles for a bucket jet speed ration of 0.47 under a gross head of 600 m the wheel develops 1250 kW when the loss of head due to pipe friction between the reservoir and nozzle is 48 m. The bucket circle diameter of the wheel is 900 mm and there are two jets. The nozzle velocity coefficient is 0.98 find the speed of rotation of the wheel and the diameter of the nozzle if the actual hydraulic efficiency is 0.9 times that calculated above.

3-d) Design a Pelton wheel using the following data:
Head = 200 m, H. Power developed = 1000, Speed = 300 r.p.m.
Assuming the other required data whenever necessary.
(Required, wheel diameter, jet diameter, bucket dimensions and number of bucket)

Question 4 **(marks 25)**

4- a) Write short notes on the flowing item :
- Load regulation of Francis and Kaplan turbines.
- Cavitations in hydraulic turbines.
- Draft tube.

4-b) A vertical reaction turbine operates under 60m head at 400 rpm . The area and diameter of the runner at inlet are o.7m2 and 1m respectively . The absolute and relative velocities of the fluid entering the runner are at 15 and 60 to the tangential direction .The swirl-free entry to the draft tube is at 2m above the tailrace .If inlet and exit diameters are o.6 and o.8m respectively. Calculate the head saved by the draft tube.

4-c) Francis turbine working under a head of 14 m, has guide blade angle of 20° and radial vanes at inlet. The ratio of inlet and outlet diameters is 3 to 2. The velocity of flow of water, at exit, is 4 m/sec. Assuming the velocity of flow to be constant, determine the peripheral velocity of water at inlet and the vane angle at outlet

Tanta University
Faculty of Engineering
Department of Mechanical Power Engineering
Year: Fourth Subject: Hydraulic Machines B
Name: Z.M. Omara

(1997)

Date: -6-2011
Time allowed: 3 Hours
Full Marks : 100
Final Exam: pages 2
Academic Number: ME4203

Question 1 **(marks 25)**

1- a) Draw an accurate section of an submersible pump? And explain the working mechanism, explain some of the important applications, advantages and disadvantages

1- b) Compare between piston pump and centrifugal pump.

1-c) Explain, the delivery side of reciprocating pump and centrifugal pump.

1-d) The piston in reciprocating pump moves with simple harmonic motion. The diameter of piston is 25 cm and stroke 45cm. the suction pipe is 12.5 cm in diameter and 12 m long. The suction lift is 3 m. calculate the speed at which the pump can operate with out cavitation occurring at the beginning of the stroke. The barometer reads 9.15 m of water.

Question 2 **(marks 25)**

2-a) How is the discharge regulate in reciprocating pump ? and suggest some methods to smoothen the pulsating discharge from the reciprocating pump.

2-b) How does the basic operation of a lift pump differ from that of a force pump. Explain with net sketches. Explain some of the important applications of each pump.

2-c) Define a cavitation in a reciprocating pumps and explain how it can be avoided.

2-d) Find the power saved in fitting an air vessel on the delivery side to a single acting reciprocating pump of the following description: piston diameter = 30 Cm stroke = 50 cm, delivery pipe=10cm diameter, length = 70 m, speed = 60 r.p.m. and f = 0.04, what should be the capacity of the air vessel? Take h_{atm} = 10 m.

Tanta University
Faculty of Engineering
Department of Mechanical Power Engineering
Year: Fourth Subject: Hydraulic Machines B
Name: Z.M. Omara

(2004)

Date: -6-2011
Time allowed: 3 Hours
Full Marks : 75
Final Exam: pages 2
Academic Number: MEP4220

Question 1 (marks 19)

1-a) Draw an accurate section of an submersible pump? And explain the working mechanism, explain some of the important applications, advantages and disadvantages

1-b) Compare between piston pump and centrifugal pump.

1-c) Explain the function of the air vessel in a reciprocating pump.

1-d) A single acting reciprocating pump has the plunger diameter of 20 cm and stroke of 30 cm. The pump discharges 0.53 m^3 of water per minute at 60 rpm. Find the theoretical discharge, coefficient of discharge, and percentage of slip of pump, Further, if suction and delivery heads are 4 m and 17 m respectively, work out power required to run the pump.

.

Question 2 (marks 19)

2-a) How is the discharge regulate in reciprocating pump ? and suggest some methods to smoothen the pulsating discharge from the reciprocating pump.

2-b) How does the basic operation of a lift pump differ from that of a force pump. Explain with net sketches. Explain some of the important applications of each pump.

2-c) Define a cavitations in a reciprocating pumps and explain how it can be avoided.

2-d) The piston of double acting reciprocating pump has a diameter of 100 mm and a stroke of 250 mm. The pump has a vertical suction pipe 5 m long and its diameter is 100 mm. The pump runs at 90 double strokes per minute and the motion is considered to be simple harmonic. Calculate the maximum permissible suction lift assuming that separation occurs at 2 m of water absolute .Take atmospheric head as 10.2 m water.

c- The maximum pressure in the delivery line if it is completely closed, in the absence of any relief valves.

Question number (3) **(25 Marks)**

1- Discus briefly the main properties of hydraulic oils (vapour pressure, viscosity, and bulk modulus).

2- Discus in detail the modeling of the hydraulic transmission lines assuming lumped parameters. Derive the transfer function matrix relating the input and output pressures and flow rates.
Find the transfer function relating the pressures at both ends of a closed end line, given: Line length L = 3m, $\rho = 867\ kg/m^3$, $\mu = 0.13$ Pas, and B = 1GPa

Good Luck

Tanta University

Department: Mech. Power Engineering
Total Marks: 90 Marks

Faculty of Engineering

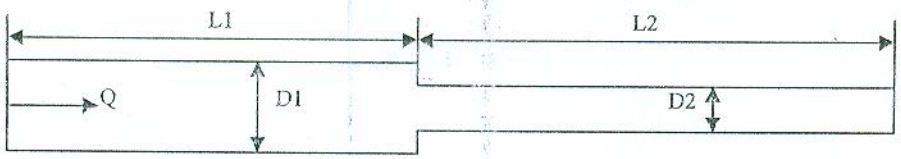
Course Title: Hydraulic circuit	Course Code: ME 4108	Year: 4th
Date: June 2011 (Final second term)	Allowed time: 3 hrs	No. of Pages:2

Remarks: (answer the following questions and assume any missing data

Question number (1) (25 Marks)

1- Discus briefly the advantages and disadvantages of hydraulic power systems.

2- Calculate the pressure losses in the given pipe line, given as shown in figure:
-Flow rate Q = 0.125 L/min -fluid density ρ = 850 kg/m3 - L1 = L2 = 4m
- D1= 13 mm - D2 = 8 mm - Fluid kinematics viscosity $\nu = 1.95 \times 10^{-5}$ m²/s



Question number (2) (25 Marks)

1- Calculate the displacement volume, delivery pulsation coefficient, input power and driving torque of a gear pump of the following parameters: n= 2500 rpm, number of teeth =12, module = 3.5 mm, tooth width = 20 mm, pressure angle = 20 deg., inlet pressure = 0.2 MPa, exit pressure = 15 MPa, mechanical efficiency = 0.85, volumetric efficiency = 0.9

2- Explain the different methods of:
   a- Hydraulic cylinders mechanical locking.
   b- Hydraulic cylinders mounting.

Question number (3) (25 Marks)

1- Draw a scheme of a rotating cylinders semi axial piston pump (fixed swash plate), explain briefly its function and give an expression for its displacement volume.

2- A piston pump with inclined cylinder block (bent axis) has the following parameters: No. of cylinders z =7, cylinder diameter d=10mm, γ = 22° deg, pitch circle diameter D= 70 mm, speed of rotation n=3000 rpm, mechanical efficiency = 0.9, hydraulic efficiency = 1, input pressure = - 0.03 MPa, resistance to internal leakage $R_L = 258 GNs/m^5$, calculate:
   a- The geometric volume of the pump.
   b- The total efficiency of the pump at exit pressure of 10 MPa.

Course Title: Electric Power | Course Code: EPM4201 | Year: 4th
Date: June 12th 2011 (Second term) | Allowed time: 3 hrs | No. of Pages: (2)

Answer all the following questions:

Question (1) **(14 Marks)**

a) Draw the schematic flow and the corresponding T-s diagram of a steam power plant with open-type feedwater heater. (4 Marks)

b) Reorder the following power plants according to the capital cost from the lower capital cost to the higher capital cost: Steam power plant – Diesel power plant – Gas power plant. (3 Marks)

c) Loads on a feeder during 24 hours of a day are given below:

Time	Load (kW)	Time	Load (kW)	Time	Load (kW)
12 am	450	8 am	900	4 pm	1400
1 am	380	9 am	1200	5 pm	1300
2 am	300	10 am	1350	6 pm	1600
3 am	300	11 am	1200	7 pm	1800
4 am	350	12 pm	1000	8 pm	2000
5 am	500	1 pm	950	9 pm	1850
6 am	700	2 pm	1250	10 pm	1000
7 am	750	3 pm	1300	11 pm	800

The connected demand is 2500 kW. Calculate the load factor and demand factor. (7 Marks)

Question (2) **(14 Marks)**

a) Derive an expression for A, B, C, D constants for two networks in series having constants A_1, B_1, C_1, D_1 and A_2, B_2, C_2, D_2. (4 Marks)

b) A short single-phase transmission line delivers 1100 kW at 33 kV at 0.8 lagging power factor. The total resistance of the line is 10 Ω and the total inductive reactance is 15 Ω. Determine: percentage voltage regulation, sending end power factor and transmission efficiency. (10 Marks)

Question (3) **(14 Marks)**

a) Derive an expression for the capacitance needed by the guard ring to make equal voltage distribution on a string insulator composed of 4 units. (4 Marks)

b) A string insulator has 4 units and each unit is rated for 12 kV. Find the maximum line voltage on which it can be operated safely. The mutual capacitance of unit is 10 times the capacitance between the pin to earth. Find the string efficiency. (10 Marks)

Tanta University	Department: Mechanical Power Engineering Total Marks: 75 Marks	Faculty of Engineering

Course Title: Gas Turbine Engines	Course Code: MEP4232	Year: 4th
Date: 15 /6/2011 (Second term)	Allowed time: 3 hours min	No. of Pages: (2)

Remarks: (Answer as much as you can .....Assume any missing data.....All questions carry equal marks)

Question 1[15 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.

B. Air at 101.3 kPa and 288 K enters an axial flow compressor stage with a velocity of 150 m/s. There are no inlet guide vanes. The rotor has a tip diameter of 61 cm, a hub diameter of 50.8 cm and rotates at 6000 rpm. The air enters the rotor and leaves the stator in the axial direction with no change in velocity and radius. The air is turned through 30° as it passes through the rotor.

a) Construct the velocity diagrams at the mean diameter for this stage.

b) Draw the shape of the rotor and stator.

c) Calculate the mass flow rate.

d) Calculate the required power.

e) Calculate the pressure ratio of this stage.

Question 2: (15 Marks)

A. For fixed maximum and minimum temperatures, what is the effect of the pressure ratio on (a) the thermal efficiency and (b) the net work output of a simple ideal Brayton cycle?

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 percent. The combustion gases leave the combustion chamber at 871°C and enter the turbine whose isentropic efficiency is 85 percent. Treating combustion gases as air with c_p=1093 J/kgK and γ=1.357, 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.

Please Turn Over

Question 3[15 Marks]

A. Draw a neat sketch of: (i)turbojet engine, (ii)turbofan engine, and (iii) turboprop engine. Compare the thrust force for each engine.

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:

i. the velocity of the exhaust gases,
ii. the propulsive power developed and,
iii. the rate of fuel consumption.

C. Repeat Problem **B** using a compressor efficiency of 80 percent and a turbine efficiency of 85 percent.

Question 4[15 Marks]:

A. Draw h-s diagram for impulse turbine and for reaction turbine with R=0%, 50%, 100%.

B. The following data refer to an impulse gas turbine:

Blade speed = 200 m/s, absolute velocity = 500 m/s, exit angle of moving blade = 25° measured from tangential direction, nozzle angle = 20° measured from tangential direction. Neglecting the effect of friction, when passing through blade passage, calculate:

i) Inlet angle of moving blade.
ii) Exit velocity and direction.
iii) Specific work done.
iv) Axial thrust.
v) Power developed for a mass flow rate of 5 kg/s.
vi) Diagram or blade efficiency.

Question 5[15 Marks]:

Sketch the velocity diagrams, to scale for blade speed U= 100 m/s and calculate the missing data, for the four turbine stages with the parameters listed in the following table:

Turbine	φ	ψ	R	α_2	β_2	α_3	β_3	v_3/v_2
1			0	70°		0°		
2				60°	0°	0°		
3		2	50%	70°				
4	0.5		1	45°				

Best Wishes **Dr Gamal Bedair**

Tanta University
Faculty of Engineering
Department of Mechanical Engineering
Year: Four Subject: Sea water Desalination
pages
Name: Talal Abouelmaaty

Date: June 2011
Time allowed: 3 Hr
Full mark: 85
Final Exam: 2

- Production capacity = 1 kg/s
- Brine blow down temperature = 35 °C
- Top brine temperature = 80 °C
- Terminal temperature difference in the condenser = 3 °C
- Thermodynamic losses = 2 °C
- The overall heat transfer coefficient for both the evaporator and condenser , U= 2 kw/m^2.°C

Where;

$M_s \lambda_s = M_f Cp (\Delta T_{st}+\Delta T_{ioss}+TTD_c)$
$M_d \lambda_v = M_f Cp \Delta T_{st} = (Mf+Mcw) Cp (T_o - \Delta T_{st} - \Delta T_{loss} - TTD_c - T_{cw})$
$(LMTD)_h = (\Delta T_{st}+\Delta T_{loss}+TTD_c)/\ln((TTD_h+\Delta T_{st}+\Delta T_{loss}+TTD_c)/(TTD_h))$
$(LMTD)c = (\Delta T_{st})/\ln((\Delta T_{st}+TTD_c)/(TTD_c))$
$PR = (\lambda_s)(\Delta T_{st})/((\Delta T_{st}+\Delta T_{loss}+TTD_c)(\lambda_v))$

Appendix A Thermodynamic Properties 539

Table A.7: Variation in latent heat of water evaporation in (kJ/kg) as a function of temperature (°C)

T (°C)	Calculated Latent Heat (kJ/kg)	Latent Heat from Steam Tables (kJ/kg)	Percentage Error
5	2489.89	2489.56	0.013241
10	2477.93	2477.75	0.007259
15	2466.006	2465.93	0.003078
20	2454.106	2454.12	0.000577
25	2442.218	2442.3	0.003365
30	2430.33	2430.48	0.006175
35	2418.43	2418.62	0.007845
40	2406.507	2406.72	0.008854
45	2394.548	2394.77	0.009271
50	2382.542	2382.75	0.008746
55	2370.476	2370.66	0.007767
60	2358.339	2358.48	0.005984
65	2346.119	2346.21	0.00389
70	2333.804	2333.84	0.001563
75	2321.381	2321.37	0.000489
80	2308.84	2308.78	0.002614
85	2296.169	2296.05	0.005166
90	2283.354	2283.19	0.007192
95	2270.385	2270.19	0.008602
100	2257.25	2257.03	0.009743
105	2243.936	2243.7	0.010528
110	2230.432	2230.2	0.010415
115	2216.726	2216.5	0.010206
120	2202.806	2202.61	0.008904
125	2188.66	2188.5	0.007316
130	2174.276	2174.17	0.004888
135	2159.643	2159.59	0.002441
140	2144.748	2144.76	0.00058
145	2129.579	2129.65	0.00334
150	2114.125	2114.26	0.006395
155	2098.373	2098.57	0.009369
160	2082.313	2082.56	0.01187
165	2065.931	2066.21	0.013499
170	2049.216	2049.5	0.013838
175	2032.157	2032.42	0.01295
180	2014.74	2014.95	0.010402
185	1996.955	1997.07	0.005742
190	1978.79	1978.76	0.001499
195	1960.232	1960	0.011812
200	1941.269	1940.75	0.026741

Table B.1: Variation in seawater boiling point elevation (°C) as a function of temperature (°C) and salinity (wt%)

temperature °C	Salinity (wt%)						
	1	2	3	4	5	6	7
10	0.085	0.171	0.258	0.348	0.441	0.538	0.639
15	0.087	0.175	0.266	0.359	0.456	0.556	0.662
20	0.089	0.180	0.273	0.370	0.470	0.575	0.684
25	0.091	0.185	0.281	0.381	0.485	0.593	0.706
30	0.093	0.190	0.290	0.393	0.500	0.612	0.727
35	0.096	0.195	0.298	0.405	0.516	0.630	0.748
40	0.099	0.201	0.307	0.417	0.531	0.648	0.769
45	0.101	0.207	0.316	0.430	0.546	0.666	0.789
50	0.104	0.213	0.326	0.443	0.562	0.684	0.809
55	0.108	0.220	0.336	0.456	0.578	0.703	0.829
60	0.111	0.227	0.346	0.469	0.594	0.721	0.848
65	0.115	0.234	0.357	0.483	0.610	0.739	0.866
70	0.118	0.241	0.368	0.497	0.627	0.756	0.885
75	0.122	0.249	0.379	0.511	0.643	0.774	0.903
80	0.126	0.257	0.391	0.525	0.660	0.792	0.921
85	0.130	0.265	0.402	0.540	0.677	0.810	0.938
90	0.135	0.274	0.415	0.555	0.694	0.828	0.955
95	0.139	0.283	0.427	0.571	0.711	0.845	0.971
100	0.144	0.292	0.440	0.587	0.728	0.863	0.987
105	0.149	0.301	0.453	0.603	0.746	0.880	1.003
110	0.154	0.311	0.467	0.619	0.764	0.898	1.018

Good luck
TALAL

Tanta University
Faculty of Engineering
Department of Mechanical Engineering
Year: Four Subject: Sea water Desalination
pages
Name: Talal Abouelmaaty

Date: June 2011
Time allowed: 3 Hr
Full mark: 85
Final Exam: 2

Assume any missing or necessary data; answer all questions- غير مسموح بالخرائط أو الجداول

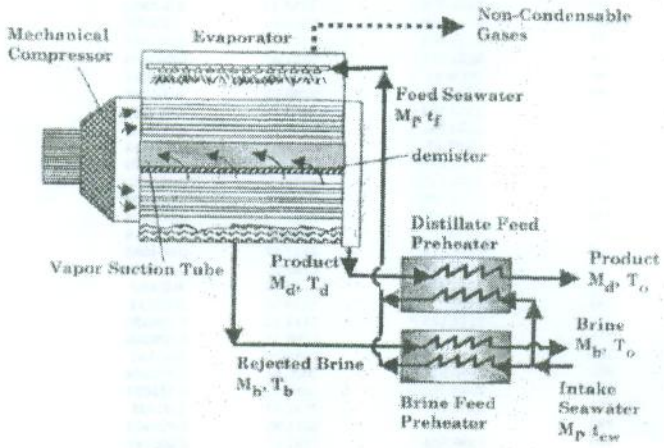
1- a) For desalination by reverse osmotic (RO) define the following terms; Osmotic pressure, Operating pressure, Salt rejection (SR) and permeate recovery.
b) Design a single stage RO desalination system by calculating the permeate salinity, the brine salinity, the brine flow rate and the membrane area;
Water permeability is 2.05×10^{-6} $m^3/m^2.s.Kpa$, salt permeability is 2.03×10^{-5} $m^3/m^2.s.Kpa.$, feed salinity is 34000 ppm, feed water rate = 2.5 kg/s, permeate flow rate = 1kg/s, feed pressure = 5000kpa, reject pressure = 4800 kpa and permeate pressure = 101kpa.

2- For a single effect evaporator, prove that

$$PR = \frac{\lambda_s}{\lambda_v + cp(T_v - T_f)\dfrac{X_f}{X_b - X_f} + \dfrac{X_f}{X_b - X_f}\, cp.\ BPE}$$

A single-effect evaporator generates a distillate product at a flow rate of 1kg/s. The system operating temperatures are as follows: The boiling temperature, T_b, is 90 °C, The feed temperature, T_f, is 85 °C and The steam temperature, T_s, is 102 °C . Determine the heat transfer areas in the evaporator and the condenser, the thermal performance ratio, the flow rates of feed seawater and reject brine, and the flow rate of cooling seawater. Assume that the specific heat of seawater is constant and equal to 4.2 kJ/kg °C. Assume that, the overall heat transfer coefficient for both the evaporator and condenser , 2.55 and 2 $kw/m^2.°C$ respectively.

3- For a single effect Mechanical vapour compression, describe the operation procedure, write the mass balance equations, evaporator thermal balance, heat exchangers energy balance, specific power consumption and draw the temperature profiles in evaporator and feed heaters



4- Calculate the performance ratio, specific heat transfer area, specific flow rate of cooling water, conversion ratio, and salinity of brine blow down for a single stage flash desalination unit operating at the following conditions:
- Feed salinity = 45000 ppm
- Feed temperature = 25 °C
- Heating steam temperature = 90 °C

4) *A fan described in a manufacturer's catalogue to deliver 9000 L/S at a static pressure of 250 Pa running at 256 RPM and requiring 3.4 kW. If the fan speed is changed to 300 RPM, what is the capacity, the static pressure and the power required. If in addition of changing the speed, the air handled were at 65°C instead of the standard 20°C, what capacity, static pressure and power would be required.*

(14 Marks)

5) *You have the problem of selecting a ventilating fan. The fan will be operated 4000 hours per year by an electric motor, which is 86% efficient. The cost of power is 5 PT/kW.h. A capacity of 10,000 L/S is needed in a duct system, which has a resistance of 400 Pa to air flow for this particular flow rate. The required velocity head is 95 Pa. The estimated life of the fan is 5 years. The following offers are available by three different companies:*

Company	Initial cost E.P.	Fan efficiency %
A	2000	61
B	1200	58
C	1102	55

Which one would you choose and why? (14 Marks)

TANTA UNIVERSITY
FACULTY OF ENGINEERING
MECHANICAL POWER DEPARTMENT
FOURTH YEAR (old system)

advanced air conditioning (ME4205)
summer semester exam 2011
time allowed: 3 hours
date: June 2011

Please, answer the following questions: (total 70 Marks)

1) *A regenerative type air cooling system, which is used in the supersonic military aircrafts, is designed to take a load of 15 T.R. when the aero-plane is moving at a Mach number 1.4. The temperature and pressure conditions of atmosphere are 5°C & 0.85 bar. The pressure of air is increased from 0.85 to 1.2 bar due to ramming action with a ram diffuser efficiency of 95%. The pressure of air leaving the main compressor is 4.2 bar. The ram air heat exchanger is 45%effective. The air from the heat exchanger passes on to the cooling turbine. Some portion of the air after expanding in the cooling turbine passes through the shell side of the regenerative heat exchanger reducing the temperature of the main compressed air to 109.4°C. The cooling air from the turbine gets heated in the regenerative heat exchanger to 105.5°C before discharged. The isentropic efficiencies of the compressor and the cooling turbine are 80% and 70% respectively. The cabin is pressurized to 1.013 bar and maintained at 25°C. Determine:*

a) *the ratio of the air extracted from cooling turbine for regenerative cooling of the ram air,*
b) *The mass flow rate of air supplied to the air conditioning system,*
c) *The horse power required for maintaining the cabin at the desired conditions,*
d) *Coefficient of performance of the system.* (14 Marks)

2.1) *Deduce a relation for calculating the optimum diameter of air ducts used in central air-conditioning systems.* (6 Marks)

2.2) *A duct system consists of a fan and a 25 m length of circular duct that delivers 800 L/S of air. The installed cost is estimated to be 200 E.P per square meter of galvanized sheet metal (ε = 0.15 mm). The power cost is 10 P.T per kilowatt-hour. The fan efficiency is 55% and the motor efficiency is 85%. The operating time during the amortization period is 10000 hours. Assuming that the friction factor for the galvanized sheet metal is 0.02, what is the optimum diameter of the duct?* (8 Marks)

3) *An air flow rate of 1500 L/S passes through a rectangular duct 30 by 50 cm. Calculate the pressure drop in 40 cm length straight duct, using:*

a) *Hydraulic diameter.*
b) *Frictional equivalent diameter.* (14 Marks)

f) The following data was collected during a boiler trial for one hour:

Steam Generated	= 5000 kg
Steam pressure	= 11 bar
Feed water temperature	= 60 °C
Temperature of steam	= 200 °C
Coal fired	= 460 kg.
H.C.V of coal used	= 35700 kJ/kg
Flue gas temperature	= 260 °C
Boiler house temperature	= 30 °C

Ultimate analysis of dry coal is given below:
$C = 82\%$, $H_2 = 14\%$, $Ash = 4\%$
The volumetric analysis of dry flue gases as observed using Orsat apparatus is given below:
$CO_2 = 12\ \%$, $CO = 1.5\ \%$, $O_2 = 7\ \%$, $N_2 = 79.5\ \%$
Cp (dry flue gases) = 1.05 kJ/kg °C
Partial pressure of steam going with flue gases = 0.07 bar
The fuel contained 4% moisture at the time of feeding into the boiler.

Draw up the heat balance sheet on the basis of one kg of coal fired (**wet coal**). **(10 Marks)**

Problem number (4) (15 Marks)

a) Illustrate using drawing the principle of natural circulation in the boilers. **(6 Marks)**
b) Describe in details the types of mechanical draft systems. **(6 Marks)**
c) Find the minimum height of chimney required to produce a draught of 1.5 cm of water if the temperature of the flue gases is 250°C and ambient air temperature is 20°C. **(3 Marks)**

With the best wishes

Course Examination Committee:

Dr. Mohamed Mahgoub Bassuni

(لائحة جديدة)

Tanta University

Department: Mechanical Power Engineering
Total Marks: 70 Marks
By-Law (لائحة قديمة)

Faculty of Engineering

Course Title: Energy Plants	**Course Code: MEP 4230**	**Year: 4th**
Date: June th 2011 (Second term)	**Allowed time: 3 hrs**	**No. of Pages: (2)**

Remarks: (Answer the following questions, assume any missing data, Steam tables are **ONLY** allowed)

Problem number (1) (20 Marks)

a) Define the capacity, demand, utility and load factors. Also, mention and define the meaning of hot, cold and spinning reserves and its rule in power plant operation. **(5 Marks)**

b) Define the energy rates (tariffs). What are the requirements of good one? **(3 Marks)**

c) Explain with details a diagram of a boiler feed water deaerator **(Tray Type)** **(3 Marks)**

d) A daily load curve of a power plant which has a capacity of 80 MW is given by the following table: **(9 Marks)**

Time (hours)	0-6	6-10	10-12	12-16	16-20	20-22	22-24
Load (MW)	20	50	60	40	80	70	40

- Draw the daily load curve and the load duration curve.
- Find the daily load, use and capacity factors.
- Calculate the daily load, use and capacity factors of standby unit of 25 MW that takes all loads over 60 MW.

Problem number (2) (11 Marks)

a) What are the types of tariffs? Which one is preferred? Why? **(3 Marks)**

b) High load factor is a desirable quality. Discuss comprehensively. **(2 Marks)**

c) Explain how could the cost of power generation can be reduced? **(2 Marks)**

d) A steam power plant consists of two units 500 kW capacity of each and one unit of 200 kW capacity. The fuel use has a calorific value of 42000 kJ/kg, consumption is 0.25 kg/kW. hr and fuel cost is 40 $/ton. The capacity factor on monthly bases is 0.5.

Find:

The mass of fuel in monthly, cost of fuel and efficiency of the plant **(4 Marks)**

Problem number (3) (32 Marks)

a) Describe in full details using a well-organized drawing the construction and operation of **Babcock Wilcox boiler.** What is the function of fusible plug and blow off cock? **(8 Marks)**

b) What are the requirements of a good boiler? Mention the function of attemperators in a water tube boilers. **(4 Marks)**

c) What are the advantages of high pressure boiler? **(3 Marks)**

d) What is the purpose of conducting a boiler trial? **(3 Marks)**

e) What are the advantages of water tube boiler over fire tube one? **(4 Marks)**

f) The following data was collected during a boiler trial for one hour:

Steam Generated	= 5000 kg
Steam pressure	= 11 bar
Feed water temperature	= 60 °C
Temperature of steam	= 200 °C
Coal fired	= 460 kg.
H.C.V of coal used	= 35700 kJ/kg
Flue gas temperature	= 260 °C
Boiler house temperature	= 30 °C

Ultimate analysis of dry coal is given below:
C = 82%, H_2 = 14%, Ash = 4%
The volumetric analysis of dry flue gases as observed using Orsat apparatus is given below:
CO_2 = 12 %, CO = 1.5 %, O_2 = 7 %, N_2 = 79.5 %
Cp (dry flue gases) = 1.05 kJ/kg °C
Partial pressure of steam going with flue gases = 0.07 bar
The fuel contained 4% moisture at the time of feeding into the boiler.

Draw up the heat balance sheet on the basis of one kg of coal fired (**wet coal**). **(10 Marks)**

Problem number (4) (12 Marks)

a) Illustrate using drawing the principle of natural circulation in the boilers. **(4 Marks)**
b) Describe in details the types of mechanical draft systems. **(5 Marks)**
c) Find the minimum height of chimney required to produce a draught of 1.5 cm of water if the temperature of the flue gases is 250°C and ambient air temperature is 20°C. **(3 Marks)**

With the best wishes

Course Examination Committee:

Dr. Mohamed Mahgoub Bassuni

Tanta University

Department: Mechanical Power Engineering
Total Marks: 85 Marks
New By-Law (لائحة جديدة)

Faculty of Engineering

Course Title: Energy Plants	**Course Code: MEP 4230**	**Year: 4th**
Date: June th 2011 (Second term)	**Allowed time: 3 hrs**	**No. of Pages: (2)**

Remarks: (Answer the following questions, assume any missing data, Steam tables are **ONLY** allowed)

Problem number (1) (22 Marks)

a) Define the capacity, demand, utility and load factors. Also, mention and define the meaning of hot, cold and spinning reserves and its rule in power plant operation. **(6 Marks)**

b) Define the energy rates (tariffs). What are the requirements of good one? **(3 Marks)**

c) Explain with details a diagram of a boiler feed water deaerator (**Tray Type**) **(3 Marks)**

d) A daily load curve of a power plant which has a capacity of 80 MW is given by the following table: **(10 Marks)**

Time (hours)	0-6	6-10	10-12	12-16	16-20	20-22	22-24
Load (MW)	20	50	60	40	80	70	40

- Draw the daily load curve and the load duration curve.
- Find the daily load, use and capacity factors.
- Calculate the daily load, use and capacity factors of standby unit of 25 MW that takes all loads over 60 MW.

Problem number (2) (13 Marks)

a) What are the types of tariffs? Which one is preferred? Why? **(4 Marks)**

b) High load factor is a desirable quality. Discuss comprehensively. **(2 Marks)**

c) Explain how could the cost of power generation can be reduced? **(2 Marks)**

d) A steam power plant consists of two units 500 kW capacity of each and one unit of 200 kW capacity. The fuel use has a calorific value of 42000 kJ/kg, consumption is 0.25 kg/kW. hr and fuel cost is 40 $/ton. The capacity factor on monthly bases is 0.5.

Find:

The mass of fuel in monthly, cost of fuel and efficiency of the plant **(5 Marks)**

Problem number (3) (35 Marks)

a) Describe in full details using a well-organized drawing the construction and operation of **Babcock Wilcox boiler.** What is the function of fusible plug and blow off cock? **(10 Marks)**

b) What are the requirements of a good boiler? Mention the function of attemperators in a water tube boilers. **(5 Marks)**

c) What are the advantages of high pressure boiler? **(3 Marks)**

d) What is the purpose of conducting a boiler trial? **(3 Marks)**

e) What are the advantages of water tube boiler over fire tube one? **(4 Marks)**