

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Special), Jan. 2016

B. Tech. in Mechanical Engineering, Semester V

Roll No.....

ME 509: APPLIED THERMODYNAMICS

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
4. Steam table and H-S chart are permitted.
5. Scientific Calculator without programming of any type is allowed.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	With increase of pressure, the latent heat of steam; (a) decreases (b) increases (c) remains the same (d) behaves unpredictably	
ii.	A convergent-divergent nozzle is used when the discharge pressure is; (a) less than the critical pressure (b) equal to the critical pressure (c) more than the critical pressure (d) none of the above.	
iii.	High pressure boilers have; (a) Small bore tube (b) lighter structure (c) lower number of drums (d) all of the above	
iv.	The reheat Rankine cycle operates when; (a) the boiler water is heated in the Boiler Feed water preheater after pumping (b) the exhaust steam is heated after expansion in steam turbine (c) the steam is extracted at the intermediate stage and reheated to the superheating steam (d) none of the above	
v.	Thermal efficiency of Rankine cycle increases with (a) Increase of inlet steam pressure only (b) Increase of inlet steam temperature only (c) Decrease of condenser pressure only (d) All of them	
vi.	The state of steam at the outlet of the condenser in the Rankine cycle has a dryness fraction of; (a) 1 (b) 0.5 (c) any value between 0 and 1 (d) zero	
vii.	Which one is true for pressure-compounded steam turbine? (a) pressure drop takes place in stages in various stages of nozzles (b) pressure remain constant throughout the stages (c) velocity goes on decreasing throughout the stages (d) velocity goes on increasing throughout the stages.	
viii.	The values of critical pressure and temperature of steam are (a) 374.15 bar, 221.297°C (b) 221.297 bar, 374.15°C (c) 274.15 bar, 321.297°C (d) 321.297 bar, 274.15°C.	
ix.	The flow is said to be subsonic when Mach number is (a) equal to unity (b) less than unity (c) greater than unity (d) none of the above.	
x.	The steam condenser in most thermal power plants operate at a pressure below the atmospheric one because; (a) the thermal efficiency of the Rankine cycle can be boosted by lowering the average temperature at which heat is extracted in the condenser (b) the average temperature during the heat rejection process can be	

	decreased by lowering the turbine exit pressure by the same amount as the condenser pressure (c) both are true	
Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	What do you understand by the term "boiler draught"?	
ii.	Define the term equivalent evaporation.	
iii.	What do you mean by the critical temperature and pressure of water?	
iv.	What do you mean by undercooling of the condensate?	
Q.3A	What is the function of a cooling tower?	05
Q.3B	What is the reason that the Carnot cycle is not a practical cycle for steam turbine plant even though its efficiency is higher?	05
Q.4A	What are the functions of a nozzle?	05
Q.4B	What are the advantages and disadvantages of mercury as working fluid?	05
Q.5A	What is a reheat cycle? When is it recommended in a steam power cycle?	05
Q.5B	What are the effects of moisture contents on the performance of steam turbines?	05
Q.6A	Sketch and describe the working of a superheater.	05
Q.6B	Explain the difference between fire tube and water tube boilers.	05
	OR	
Q.6B	Explain with the help of neat diagram either Locomotive boiler or Babcock and Wilcox boiler.	05
Q.7A	Explain with neat diagram the working of a surface condenser.	05
Q.7B	How does water loss occur in cooling tower?	05
	OR	
Q.7B	Explain the term induced draught and forced draught used in a boiler.	05
Q.8A	A surface condenser of a large steam power plant receives steam from turbine exhaust at the rate of 1500 ton/hour at 40°C having 88% dryness fraction. The circulating cooling water enters the condenser at 30°C and leaves at 38°C. The pressure inside the condenser is maintained at 0.078 bar. By showing the processes on T-s diagram, calculate the rate of flow of cooling water.	10
Q.9A	The mean diameter of the blades of an impulse turbine with a single row wheel is 105 cm. and the speed is 3,000 rpm. The nozzle angle is 18°, the ratio of blade velocity to steam velocity is 0.42 and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.84. The outlet angle of the blade is to be made 3° less than the inlet angle of the blade. The steam flow is 8kg/s. Draw the velocity diagram for the blades and calculate the tangential thrust on the blades.	10
Q.9B	In a stage of an impulse turbine provided with a single row wheel, the mean diameter of the blade ring is 80 cm and the speed of rotation is 3,000 r.p.m. The steam issues from the nozzles with a velocity of 300 m/s and the nozzle angle is 20°. The rotor blades are equiangular and due to friction in the blade channels the relative velocity of the steam at outlet from the blades is 0.86 times the	10

relative velocity of the steam entering the blades. What is the power developed in the blades when the axial thrust on the blades is 140 N?

OR

Q.9B Explain the working of a Simple (de-Laval) turbine with the help of a diagrammatic arrangement.

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-----ALL THE BEST-----