

**Benha University Subject: Turbo Machinery B**

**Faculty of Engineering- Shoubra Course Code: MPE423**

**Mechanical engineering Department Mid-Term Exam 28 / 3 / 2016**

**Year: fourth Mech. Power** **Time: 60 min**

**1-a) A centrifugal compressor impeller has 19 radial vanes of tip diameter 260 mm, It rotates at 44 000 rpm and the air mass flow rate is 0.7 kg/s with no whirl at inlet. Calculate the theoretical power transferred to the air. At inlet to the impeller, the tip diameter of the eye is 150 mm and the radius ratio of the eye is 2. The static pressure and temperature at the impeller inlet are 95 kPa and 295 K respectively,**

**Determine: (8 marks)**

* + 1. **The blade angle at the mean diameter at impeller inlet.**
    2. **Relative Mach No at impeller inlet based on mean radius.**
    3. **The stagnation temperature at impeller exit.**
    4. **The total pressure at impeller exit if the total-to-total efficiency of the compressor is 80 percent. With noting that the losses in impeller is twice that losses in diffuser.**

**1-b) describes the stalling phenomena and draws the performance curve of compressor**

**(2 marks)**

1. **Air standard gas turbine engine has a compressor inlet temperature of 290 K, a compressor inlet pressure 101.3 kPa and a turbine inlet temperature 1500 K. Assuming variable specific heats and that air enters the compressor at the rate of 1 kg/s, a compressor efficiency of 88%, a turbine efficiency of 89%, regenerator effectiveness of 0.8, there are a pressure drop across the air side of regenerator (5kPa) and in combustion chamber (8kPa) calculate network, thermal efficiency and power develop by this engine for pressure ratio of 8. (4 marks)**
2. **A- For standard air joule cycle determine the thermal efficiency ηth and dimensionless work W\* if the cycle has (temperature ratio) τ= 7 and (pressure ratio) п= 30**

**Comment on the result (3 marks)**

**B- At what velocity should tests be run in a wind tunnel on a model of an airplane wing of 160 mm chord in order that the Reynolds number should be the same as that of the prototype of 1000 mm chord moving at 40.5 m/s. Air is under atmospheric pressure in the wind tunnel. (3marks)**

**Best wishes**

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