[This question paper contains 4 printed pages.]

*Your Roll No.* .....

**3194** **J**

**MEM**

Paper—ME.602

TURBO MACHINERY—II

*Time* : 3 *Hours* *Maximum Marks* : 100

*(Write your Roll No. on the top immediately on receipt of this question paper.)*

*Attempt any five questions.*

*Use of steam & gas tables are allowed.*

*Assume suitable missing data, if any.*

1. (a) Discuss the factors that decide the choice of impulse or reaction turbine for a particular speed. Justify your response. 8

   (b) How is the degree of reaction of an axial turbine stage defined ? Prove that $\Psi = 2(1 - R)$ for axial exit, where $\Psi$ is blade loading coefficient and R is degree of reaction. Also state the assumptions used in driving the relation. 12

2. (a) Draw the velocity diagram of a three stage velocity compounded impulse turbine at the entry and exit stages for maximum utilisation factor. 8

[P. T. O.

(b) Explain the effect of high inlet temperature on specific power output, specific thrust, plant and turbine stage efficiencies. 12

3. (a) Describe briefly the various losses occuring in an inward flow radial turbine. 6

(b) A ninety degree IFR turbine stage has the following data :

| | | | |
|---|---|---|---|
| Total to static pressure ratio | $Po_1/P_3$ | = | 3·6 |
| exit pressure | | = | 1 bar |
| stagnation temperature at entry | | = | 700°C |
| blade to isentropic speed ratio | $\sigma$ | = | 0·66 |
| rotor diameter ratio | $d_3/d_2$ | = | 0·45 |
| rotor speed | N | = | 18,000 |
| rotor exit air angle | $\alpha_2$ | = | 20° |
| nozzle efficiency | $\eta_n$ | = | 0·95 |
| rotor width at entry | $b_2$ | = | 5 cm. |

Assuming constant meridional velocity, axial exit, determine (a) rotor diameter, (b) rotor blade exit air angle, (c) mass flow rate, (d) power developed, (e) hub and tip diameter at exit. 14

4. A steam turbine plant equipped with a single regenerative feed heater operates under the following condition :

| | | |
|---|---|---|
| Initial steam pressure | = | 16·5 bar |
| Initial superheat | = | 100°C |

Extraction pressure = 2 bar

Exhaust pressure = 0·07 bar

Compare the regenerative and non-regenerative cycle with respect to the following (a) thermal efficiency, (b) steam consumption in kg per kWh, (c) Condenser duty (steam condensed per kWh), (d) Power generated. 20

5. (a) Discuss the effect of blade friction on the performance of turbine. 7

(b) Compare and contrast subsonic and supersonic stages. 6

(c) Describe the various methods employed to recover the waste heat from the exhaust of a gas turbine. 7

6. (a) Discuss various methods of cooling of gas turbine blades. 6

(b) In a gas turbine plant, the air at 20°C and 1 bar is compressed to 6 bar with compression efficiency of 85%. The air is heated in a regenerator and combustion chamber till its temperature is raised to 750°C and during the process pressure falls by 0·2 bar. The air is then expanded in the turbine and passes to the regenerator which has 80% effectiveness and causes a pressure drop of 0·15 bar. Determine the thermal efficiency if the isentropic efficiency of the turbine is 85%. 14

7. Explain the method of achieving design operational matching performance characteristics of single shaft gas turbine. Also draw the equilibrium running lines. 20

8. (a) Discuss about the various casings generally used in gas turbines. List their advantages and disadvantages. 7

(b) List the various tripping devices and explain their specific usages with suitable example. 6

(c) How is the governing of steam turbines achieved ? Why is it necessary to govern them? 7