Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – June 2023

Programme Name: B Tech (ME)

Semester: Second

Subject Code: UG11T4402

Subject Name: Marine Turbo Machinery

Date: 29.05.2023	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.

Section A

MCQ of 01 Mark each- Choose the correct answer as applicable.

Q1.What is the most important reason for compounding of the steam turbines?

a. For increasing the power output
b. For limiting the turbine RPM
c. To reduce the steam wastage
d. For increasing turbine efficiency

Q2. What is a Curtis stage?

a. Pressure compounded impulse turbine
b. Impulse - reaction turbine
c. Velocity compounded impulse turbine
d. Pressure and velocity compounded impulse turbine

Q3. Which type of turbine is usually equipped with 'end tighten' blades?

a. Impulse reaction turbine
b. Velocity compounded Impulse Turbine
c. Pressure compounded Impulse turbine
d. None of these

Q4. Holes are usually made in discs of Rateau stage is

a. To improve dynamic balancing
b. To reduce weight
c. To facilitate lifting out the disc for maintenance
d. To prevent build-up of pressure on one side

Q5. In a 'Free power turbine" arrangement the ....

a. Power produced by the turbine is free of any vibrations
b. Power turbine is mounted after the HP compressor
c. Power produced by the turbine is free – no energy is supplied
d. Power turbine is mounted on a separate shaft from the gas generator

Q6. Addition of a recuperator to the simple GT cycle has the effect of ...

a. Decreasing the total system pressure drop
b. Increasing the specific fuel consumption
c. Improving the cycle thermal efficiency for all pressure ratios
d. Improving the cycle thermal efficiency only for lower pressure ratios

Q7. Surging is the phenomenon of

a. Steady, periodic and reversed flow
b. Unsteady, periodic and reversed flow
c. Unsteady, periodic and uniform flow
d. Dimensional, steady and uniform flow

Q8. Maximum efficiency for an impulse reaction turbine can be written as

a. $Cos^2\alpha$
b. $2Cos^2\alpha /(1+ Cos^2\alpha)$
c. $(1+ Cos^2\alpha) / Cos^2\alpha$
d. $Cos^2\alpha /(2+ Cos^2\alpha)$

Q9. A radial turbine works on the principle of -----

a. Impulse principle
b. Impulse reaction principle
c. Pressure –velocity compounding
d. Centrifugal force principle

Q10. A centrifugal compressor is suitable for which of the following?

a. High pressure ratio low mass flow
b. High pressure ratio high mass flow
c. Low pressure ratio low mass flow
d. Low pressure ratio high mass flow

Section B

Five Questions of 02 Marks each

Q11. What is cavitation?

Q12. What are the different types of combustion chambers used in Gas turbines?

Q13. If steam is supplied to a C-D nozzle at 9 bar 300^{o}C and it discharges to a space with a pressure of 1 bar. Estimate the pressure of steam at the throat of the nozzle. (Note: saturation temperature of steam at 9 bar is 175.38 ^{o}C)

Q14. Draw a velocity triangle for first row of a two row velocity compounded impulse turbine stage. Consider the optimum blade velocity for maximum efficiency and a suitable nozzle outlet angle, blade velocity coefficient may be assumed. Label all the vectors and indicate the change in whirl velocity and change in flow velocity. Blade velocity coefficient may be assumed as unity.

Q15. What is the purpose of using shrouding in steam turbine blades?

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

Q16. (a) With the help of a neat sketch indicate the variation of temperature, total pressure, velocity along the length of a simple gas turbine. (5Marks)

(b) A ship is fitted with a modern high performance gas turbine unit consisting of three compressors and three turbines. The HP turbine drives the HP compressor and the LP turbine drives the IP and LP compressor. The arrangement is one of twin spool type. The generator is driven by a free turbine. A recuperator, two intercoolers and a re-heater is include in the system. Draw the gas turbine configuration. (5Marks)

Q17. (a) Write a short note on steam turbine diaphragms. Bring out the method of fixing and expansion arrangement for impulse turbine diaphragms. (5Marks)

(b) A 4 stage combination turbine has a two row Curtis wheel as the first stage followed by three stages of Rateau. The 3rd and 4th stage have slightly higher mean blade radius than the 2nd stage. Show how absolute steam pressure and velocity vary in the turbine. Considering the facts that have been mentioned. (5 Marks)

Q18. (a) Comment on dynamic similarity and its utility in design process. (5 Marks)

(b) Explain different losses in Centrifugal compressor. (5Marks)

Q19. (a) Explain constant pressure turbocharging system and list out the advantages. (5Marks)

(b) Write a short note on Gas turbine propulsion option for ship propulsion (5 Marks)

Q20. (a) With the help of a neat sketch explain the concept of blade cooling in gas turbines. (4 Marks)

(b) List out the various advantages and disadvantages of gas turbine over diesel and steam as propulsion plant options. (3marks)

(c) Draw a typical Performance characteristics curves for high speed axial Compressor. (3Marks)

Q21. (a) Bring out at least eight differences between an Impulse turbine and Reaction turbine. (4 Marks)

(b) Sketch and describe methods of fixing blades on impulse turbine rotor. (3 Marks)

(c) Write a short note on construction and manufacturing process for a HP turbine rotor. (3 Marks)

Q22. (a) With the help of a neat sketch explain gland sealing arrangement for a cross compounded marine propulsion turbine. (4 marks)

(b) Comment on incorporating a two row Curtis wheel as the first stage in a multi stage Rateau turbine or Parson's turbine (3 Marks)

(c) Write a short note on turbine thrust bearing. (3 Marks)