MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF AERONAUTICAL ENGINEERING

IV B.TECH II SEMESTER

R15 SUPPLEMENTARY

PREVIOUS QUESTION PAPERS

LIST OF SUBJECTS

CODE	*NAME OF THE SUBJECT*
R15A2127	Helicopter Engineering

Code No: **R15A2127**

R15

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

IV B.Tech- II Semester Supplementary Examinations, May 2022

Helicopter Engineering
(AE)

Roll No										

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B

Part A is compulsory which carriers 25 marks and Answer all questions.

Part B Consists of 5 SECTIONS (One SECTION for each UNIT). Answer FIVE Questions, Choosing ONE Question From each SECTION and each Question carries 10 marks.

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PART-A (25 Marks)

1). a	Differentiate an autogyro and a helicopter.	**[2M]**
b	Write the principle of operation of NOTAR.	**[3M]**
c	Define ideal twist for rotor blades.	**[2M]**
d	Define 'figure of merit' for a rotor in hover?	**[3M]**
e	What are HIGE and HOGE?	**[2M]**
f	Define normal working state for a rotor in axial flight.	**[3M]**
g	State the recovery techniques for the vortex ring state.	**[2M]**
h	Plot the variation of various power requirements against true air speed.	**[3M]**
i	When is the helicopter said to be in the trimmed condition?	**[2M]**

j Explain the term speed stability. **[3M]**

PART-B (50 MARKS)

SECTION-I

2 How full articulation is provided to a helicopter rotor? Explain with sketches. **[10M]**

OR

3 Explain briefly the following helicopter configurations with suitable sketches:

(i) Conventional type **[3M]**
(ii) Tandem rotors **[3M]**
(iii) Coaxial rotors **[4M]**

SECTION-II

4 Derive the characteristics of rotor using momentum theory. Thus, obtain expression for Figure of merit. **[10M]**

OR

5 **[10M]**

Consider a helicopter with the following features:

Weight =l.333X10^4 N; Rotor radius = 4.88 m; Rotor Disk Area= 74.7 m^2; Rotor Tip Speed= 213 m/sec; Rotor Blade Chord= 0.3048 m (constant); Number of Blades = 2; Blade profile drag coefficient= 0.01; Lift-curve slope= 6. Assume that the inflow is uniform over the entire rotor disk. Take atmospheric density and pressure at sea level, respectively as ρ= 1.226 kg/m^3;P_∞ =1.013 x 10^5 N/m^2

(i) Find the non-dimensional pressure change $\Delta P / P_\infty$ across the rotor disk.

(ii) Find the value of the induced velocity far below the rotor, according to the momentum theory.

(iii) Find the thrust co-efficient.

(iv) Find the local lift coefficient (C_l) at r = 0.5R.

(v) Find the local blade pitch angle (θ) at r = 0.5R, in degrees.

SECTION-III

6 A preliminary design of a tandem rotor helicopter with a gross weight of 9,000 kg suggests a rotor diameter of 14 m, a blade chord of 0.6 m, three blades, and a rotor tip speed of 220 m/s. Estimate the total shaft power required to hover if the induced power factor for the front rotor is 1.20 and that for the rear rotor is 1.15. The rotor **[10M]**

airfoil to be used has a zero lift drag co-efficient of 0.01. Estimate the installed power if transmission losses amount to 5% and the helicopter must demonstrate a vertical rate of climb of 310 m/min at 5 km altitude.

OR

7 Explain the construction of universal power curve for a helicopter rotor in axial (vertical) flight. **[10M]**

SECTION-IV

8 (a) Define retreating blade stall by stating its cause and the effects on helicopter flight. State the solution to retreating blade stall. **[5M]**

(b) Define compressibility effect by stating its cause and the effects on helicopter flight. State the solution to compressibility effect. **[5M]**

OR

9 Discuss forward flight performance for a helicopter and estimate rate of climb (R/C) using equivalent flat plate area approximations. **[10M]**

SECTION-V

10 Discuss the parameters governing the static directional stability of the helicopter. **[10M]**

Explain the stability of a single rotor helicopter with sketches.

11 Explain how helicopter is Dynamically Stable in forward flight?Explain the concept of Control Sensitivity. **[10M]**