Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – Nov/Dec– 2017**

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| **Code :** | **14EE3014** | **Duration :** | **3hrs** |
| **Sub. Name :** | **WIND ENERGY** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Discuss in detail with suitable examples the different wind turbine topologies. | CO1 | 12 |
| b. | Consider the application of a small 1 kW wind turbine with a capital cost of $2500. The installation and setup cost raises its total installed cost to $4500. Assume that the $2500 capital cost is to be paid for with a 15 year, 7% loan. Also assume that O&M costs will be $200 per year. Estimate the (simplified) cost of energy over the 15 year period if the capacity factor (CF) is 0.30. | CO1 | 8 |
| (OR) | | | | |
| 2. | a. | Summarize in detail about different wind turbine materials. | CO1 | 8 |
| b. | Enumerate how the value of wind energy can be determined and explain the economic assessment of wind energy systems. | CO3 | 12 |
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| 3. | a. | From an analysis of wind speed data (hourly interval average, taken over a one year period), the Weibull parameters are determined to be *c* = 6 m/s and *k* = 1.8.   1. What is the average velocity at this site? 2. Estimate the number of hours per year that the wind speed will be between 6.5 and 7.5 m/s during the year. 3. Estimate the number of hours per year that the wind speed is above 16 m/s. | CO1 | 6 |
|  | b. | Outline the general characteristics of wind resources and highlight the significance of wind resource assessment. | CO1 | 14 |
| (OR) | | | | |
| 4. | a. | Derive the wind turbine energy production estimates using statistical techniques. Obtain the idealized machine productivity using Rayleigh and Weibull distributions. | CO1 | 10 |
|  | b. | Examine the important parameters that should be measured in a wind monitoring station. Write in detail about wind measurement and instrumentation system. | CO1 | 10 |
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| 5. | a. | Two wind turbines emitting 105 dB(A) at the source are located 200m and 240m away from a location of interest. Calculate the sound pressure level (in dB(A)) at the point of interest from the combined acoustic effect of the two turbines. Assume a sound absorption coefficient of 0.005 dB(A)/m. | CO1 | 5 |
|  | b. | Evaluate the wind turbine siting issues that has to be considered while identifying potential sites for wind farms. | CO1 | 7 |
|  | c. | Point out the installation and operational issues faced while setting up a wind farm or wind monitoring station. | CO1 | 8 |
| (OR) | | | | |
| 6. | a. | Wind energy technologies have both positive and negative environmental impacts. Justify. | CO1 | 10 |
|  | b. | Review the technical developments in offshore wind energy technology. | CO1 | 10 |
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| 7. | a. | Detail the momentum theory and blade element theory. | CO2 | 10 |
|  | b. | Draw and label the different parts of an airfoil. Outline the important aerodynamic concepts underlying the operation of a wind turbine blade. | CO2 | 10 |
| (OR) | | | | |
| 8. | a. | Find *r, φ, θp, θT* and *c* at all 10 locations (*r/R* = 0.10, 0.20, ….,1.0) for the Betz optimum blade. Assume *λ=7, B=3, R=5, Cl=1.0, θp,0=1.56°* and the minimum *Cd/Cl* occurs at *α=7.* | CO2 | 10 |
|  | b. | Write down the procedure for generalized rotor design of a wind turbine using appropriate expressions. | CO2 | 10 |
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|  | | **Compulsory**: |  |  |
| 9. | a. | Explain the necessity and operation of the wind turbine control system. | CO3 | 10 |
|  | b. | Outline the hybrid system design rules and explain in detail the hybrid system components. | CO3 | 10 |

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