



Bharatiya Vidya Bhavan's SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058



END SEMESTER EXAMINATION JUNE 2023

Program: Final Year B. Tech.

Duration: 03 Hrs.

Course Code: OE-BTM712

Maximum Points: 100

Course Name: Introduction to Research Methodology

Semester: VIII

Notes: Final year B Tech (Mech) Sem - VIII

9/6/2023

1. Attempt any **FIVE** questions
2. Each question carries equal marks
3. Assume suitable data wherever necessary and justify the same

| Q.No. | Questions | Points | CO | BL | PI | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--------|----|-----|------|----|----|----|----|----|----|----|-----|----|----|----|----|----|----|----|----|-----|----|----|--|--|--|
| 1 | a) What is of more value to the corporate world – basic or applied research? Justify your reasoning. | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | b) A lot of business magazines conduct surveys, for example the best engineering colleges in the country; the top ten banks in the country. What do you think of these studies, would you call them research? Why/ why not? | 10 | 1 | 1,2 | 12.3 | | | | | | | | | | | | | | | | | | | | | | |
| 2 | a) The diet drink manufacturer in the study finds that young women are more health conscious and are looking at low calories option. Thus, any communication or advertisement for the product has to emphasize the health aspect. The purchase probability is also influenced by their education level and the nature of their profession. Other factors such as available brands, celebrity endorsement and dieticians' recommendations also have an impact on them. (1) Identify your research problem. (2) Is it possible to generate a theoretical framework for the study? | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | b) How would you define research design? What are the significant elements of research design? Illustrate with examples. | 10 | 1 | 1,2 | 12.1 | | | | | | | | | | | | | | | | | | | | | | |
| 3 | a) Explain any four popular search engines used for technical articles. | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | b) Describe steps in the Literature Review Process. | 10 | 1 | 1,2 | 12.1 | | | | | | | | | | | | | | | | | | | | | | |
| 4 | a) Explain secondary sources of data collection. | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | b) Explain quantitative data visualizations techniques in details (any two techniques). | 10 | 3 | 1,2 | 12.1 | | | | | | | | | | | | | | | | | | | | | | |
| 5 | a) Calculate the standard deviation for the following data: <table border="1"><tr><td>P</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr><tr><td>Age</td><td>78</td><td>22</td><td>38</td><td>44</td><td>46</td><td>28</td><td>17</td><td>54</td><td>62</td><td>31</td></tr></table> | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Age | 78 | 22 | 38 | 44 | 46 | 28 | 17 | 54 | 62 | 31 | 10 | | | |
| | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | | | | | | | | | | |
| Age | 78 | 22 | 38 | 44 | 46 | 28 | 17 | 54 | 62 | 31 | | | | | | | | | | | | | | | | | |
| b) Using the following data, the relation $Y = a+bX$, find the value of the constant a and b. Also calculate the correlation coefficient. <table border="1"><tr><td>X</td><td>4</td><td>6</td><td>9</td><td>13</td><td>18</td><td>24</td><td>32</td><td>40</td></tr><tr><td>Y</td><td>9</td><td>12</td><td>16</td><td>23</td><td>30</td><td>39</td><td>51</td><td>63</td></tr></table> | X | 4 | 6 | 9 | 13 | 18 | 24 | 32 | 40 | Y | 9 | 12 | 16 | 23 | 30 | 39 | 51 | 63 | 10 | 2 | 3 | 5.1 | | | | | |
| X | 4 | 6 | 9 | 13 | 18 | 24 | 32 | 40 | | | | | | | | | | | | | | | | | | | |
| Y | 9 | 12 | 16 | 23 | 30 | 39 | 51 | 63 | | | | | | | | | | | | | | | | | | | |



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END SEMESTER EXAMINATION JUNE 2023

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|--|------|------|------|------|------|------|------|------|------|------|---|------|------|------|------|------|------|------|--|--|------|------|------|------|------|------|------|------|------|------|----|------|------|------|--|--|--|--|--|--|----|---|---|-----|
| 6 | a) Based on field experiments, a new variety green gram is expected to give an yield of 12.0quintals per hectare. The variety was tested on 10 randomly selected farmers' fields. The yield (quintals/hectare) were recorded as 14.3,12.6,13.7,10.9,13.7,12.0,11.4,12.0,12.6,13 1. Do the results confirm the expectation? | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | b) The following data related the rubber percentage of two types of rubber plants, where the sample have been drawn independently. Test for their mean difference. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table><tr><td>Type</td><td>6.21</td><td>5.70</td><td>6.04</td><td>4.47</td><td>5.22</td><td>4.45</td><td>4.84</td><td>5.84</td><td>5.88</td></tr><tr><td>I</td><td>5.82</td><td>6.09</td><td>5.59</td><td>6.06</td><td>5.59</td><td>6.74</td><td>5.55</td><td></td><td></td></tr><tr><td>Type</td><td>4.28</td><td>7.71</td><td>6.48</td><td>7.71</td><td>7.37</td><td>7.20</td><td>7.06</td><td>6.40</td><td>8.93</td></tr><tr><td>II</td><td>5.91</td><td>5.51</td><td>6.36</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> | Type | 6.21 | 5.70 | 6.04 | 4.47 | 5.22 | 4.45 | 4.84 | 5.84 | 5.88 | I | 5.82 | 6.09 | 5.59 | 6.06 | 5.59 | 6.74 | 5.55 | | | Type | 4.28 | 7.71 | 6.48 | 7.71 | 7.37 | 7.20 | 7.06 | 6.40 | 8.93 | II | 5.91 | 5.51 | 6.36 | | | | | | | 10 | 2 | 3 | 5.1 |
| Type | 6.21 | 5.70 | 6.04 | 4.47 | 5.22 | 4.45 | 4.84 | 5.84 | 5.88 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| I | 5.82 | 6.09 | 5.59 | 6.06 | 5.59 | 6.74 | 5.55 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Type | 4.28 | 7.71 | 6.48 | 7.71 | 7.37 | 7.20 | 7.06 | 6.40 | 8.93 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| II | 5.91 | 5.51 | 6.36 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | a) What are the contents of report writing? | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | b) Explain different referencing formats used in report and write one example for each. | 10 | 4 | 2 | 12.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 1: Critical Values of F-Distribution (at 5 per cent)

| $v_1 \backslash v_2$ | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 12 | 24 | ∞ |
|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|
| 1 | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 | 238.9 | 243.9 | 249.1 | 243.3 |
| 2 | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 | 19.37 | 19.41 | 19.45 | 19.50 |
| 3 | 10.13 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.85 | 8.74 | 8.64 | 8.53 |
| 4 | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.04 | 5.91 | 5.77 | 5.63 |
| 5 | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.82 | 4.68 | 4.53 | 4.36 |
| 6 | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.15 | 4.00 | 3.84 | 3.67 |
| 7 | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.73 | 3.57 | 3.41 | 3.23 |
| 8 | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.44 | 3.28 | 3.12 | 2.93 |
| 9 | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.23 | 3.07 | 2.90 | 2.71 |
| 10 | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.07 | 2.91 | 2.74 | 2.54 |
| 11 | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 2.95 | 2.79 | 2.61 | 2.40 |
| 12 | 4.75 | 3.88 | 3.49 | 3.26 | 3.11 | 3.00 | 2.85 | 2.69 | 2.51 | 2.30 |
| 13 | 4.67 | 3.80 | 3.41 | 3.18 | 3.02 | 2.92 | 2.77 | 2.60 | 2.42 | 2.21 |
| 14 | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.70 | 2.53 | 2.35 | 2.13 |
| 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.64 | 2.48 | 2.29 | 2.07 |
| 16 | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.59 | 2.42 | 2.24 | 2.01 |
| 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.55 | 2.38 | 2.19 | 1.96 |
| 18 | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.51 | 2.34 | 2.15 | 1.92 |
| 19 | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.48 | 2.31 | 2.11 | 1.88 |
| 20 | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.45 | 2.28 | 2.08 | 1.84 |
| 21 | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.42 | 2.25 | 2.05 | 1.81 |
| 22 | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.40 | 2.23 | 2.03 | 1.78 |
| 23 | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.38 | 2.20 | 2.01 | 1.76 |
| 24 | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.36 | 2.18 | 1.98 | 1.73 |
| 25 | 4.24 | 3.38 | 2.99 | 2.76 | 2.60 | 2.49 | 2.34 | 2.16 | 1.96 | 1.71 |
| 26 | 4.22 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 | 2.32 | 2.15 | 1.95 | 1.69 |
| 27 | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 | 2.31 | 2.13 | 1.93 | 1.67 |
| 28 | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.45 | 2.29 | 2.12 | 1.91 | 1.65 |
| 29 | 4.18 | 3.33 | 2.93 | 2.70 | 2.54 | 2.43 | 2.28 | 2.10 | 1.90 | 1.64 |
| 30 | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.27 | 2.09 | 1.89 | 1.62 |
| 40 | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.18 | 2.00 | 1.79 | 1.51 |
| 60 | 4.00 | 3.15 | 2.76 | 2.52 | 2.37 | 2.25 | 2.10 | 1.92 | 1.70 | 1.39 |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.17 | 2.02 | 1.83 | 1.61 | 1.25 |
| ∞ | 3.84 | 2.99 | 2.60 | 2.37 | 2.21 | 2.10 | 1.94 | 1.75 | 1.52 | 1.00 |

v_1 = Degrees of freedom for greater variance.

v_2 = Degrees of freedom for smaller variance.

Table 1: Critical Values of Student's t-Distribution

| d.f. | Level of significance for two-tailed test | | | | | d.f. |
|----------|---|-------|--------|--------|--------|----------|
| | 0.20 | 0.10 | 0.05 | 0.02 | 0.01 | |
| | Level of significance for one-tailed test | | | | | |
| | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | |
| 1 | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 1 |
| 2 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 2 |
| 3 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 | 3 |
| 4 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 4 |
| 5 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 5 |
| 6 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 6 |
| 7 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 7 |
| 8 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 8 |
| 9 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 9 |
| 10 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 10 |
| 11 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 11 |
| 12 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 12 |
| 13 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 13 |
| 14 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 14 |
| 15 | 1.341 | 1.753 | 2.731 | 2.602 | 2.947 | 15 |
| 16 | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 | 16 |
| 17 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 17 |
| 18 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 18 |
| 19 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 19 |
| 20 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 20 |
| 21 | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 | 21 |
| 22 | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 | 22 |
| 23 | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 | 23 |
| 24 | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 | 24 |
| 25 | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 | 25 |
| 26 | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 | 26 |
| 27 | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 | 27 |
| 28 | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 | 28 |
| 29 | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 | 29 |
| Infinity | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 | Infinity |



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End Sem Examination June 2023

Program: Mechanical Engineering

Course Code: PE BTM 733

Course Name: Industrial Robotics

Duration: 3 Hrs

Maximum Points: 100

Semester: VIII

Notes:

Final year B.Tech (Mech.) Sem - VIII

1. Q.1 is compulsory and
2. Solve any Four out of Q.2 to Q.7

| Q.No. | Questions | Points | CO | BL | Module No. |
|-------|--|--------|-----|----|------------|
| 1a | Discuss types of Automation with suitable examples | 05 | I | 1 | I |
| 1b | Enlist the Laws of Robotics and AI with the definition of Robotics | 05 | IV | 2 | II |
| 1c | Explain the types of grippers with neat sketches | 05 | I | 3 | II |
| 1d | Comment on Social issues and economics of Robotics | 05 | IV | 2 | VII |
| 1e | Discuss the factors which determine the WSE | 05 | I | 3 | II |
| 2a | Discuss different types of drives with merits and demerits and various motors used. | 10 | III | 3 | II |
| 2b | Explain the specification of the robot and various sensors used such as for machine vision etc. | 10 | III | 2 | III |
| 3a | Discuss the degree of freedom and the factors on which it depends. | 10 | | 3 | II |
| 3b | What are different robot motions considered for the programming of the Robot e.g. Body motion and wrist motions. How to program a Robot. | 10 | II | 3 | III |
| 4a | Introduce Robot Intelligence and Task planning | 10 | | 2 | V |
| 4b | How to specify Robot. Explain each term in brief | 10 | | 2 | II |
| 5 | For the shown RPR Robotic manipulator, the DH parameters table is defined as shown in figure. Calculate the transformation matrices 0T_1 1T_2 2T_3 3T_4 and find 0T_4 | 20 | II | 4 | IV |

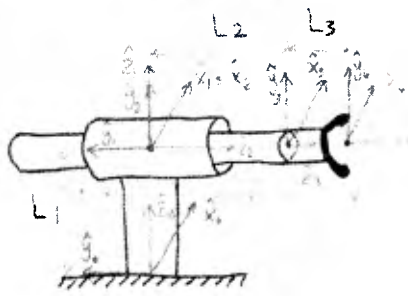
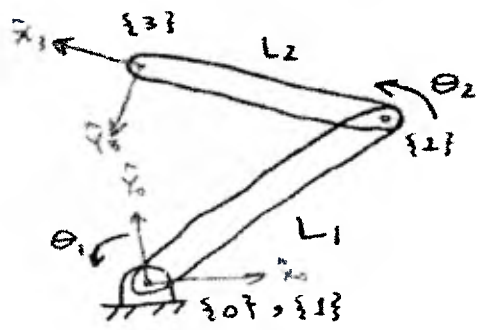


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End Sem Examination June 2023

| | | | | | |
|----|--|----|-----|---|----|
| |  | | | | |
| 6 | <p>For the 2R robot, find the Jacobian Matrix using Direct Differentiation Method relative to frame {0} to {3}</p>  | 20 | II | 4 | IV |
| 7a | <p>Find the X-Y-Z fixed angles of rotation (γ, β, α) for the following rotational matrix :</p> ${}^A_B R = \begin{bmatrix} 0.9077 & 0.3304 & -0.2588 \\ -0.2946 & 0.9408 & 0.1677 \\ 0.2989 & -0.0760 & 0.9513 \end{bmatrix}$ | 10 | III | 4 | IV |
| 7b | <p>Find the Z-Y-X Euler angles of rotation (α, β, γ) for the following rotational matrix :</p> ${}^A_B R = \begin{bmatrix} 0.9077 & 0.3304 & -0.2588 \\ -0.2946 & 0.9408 & 0.1677 \\ 0.2989 & -0.0760 & 0.9513 \end{bmatrix}$ | 10 | III | 4 | IV |



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END SEM EXAMINATION June-2023



12/6/23

Program: **B. Tech. in Mechanical Engineering**

Class: **Final Year B. Tech. (Mechanical)**

Course code: **BTM 754**

Course: **Power Plant Engineering**

Date: **12 June 2023**

Duration: **3 Hr.**

Max. Points: **100**

Semester: **VIII**

Instructions:

Final year B.Tech (Mech) Sem - VIII

- Attempt **ANY 05** of the following questions.
- Draw **neat Process diagrams /T-s Diagrams/ Figures** etc. wherever necessary.
- Use **Separate Graph papers** for graphical solution of Q 1A) and Q2 B).
- Answers to the questions should be **Brief and Specific** in **Legible hand writing**.
- Assume **suitable data** wherever necessary and mention the same.

| Q. N. | Question | Points | CO | BL | Module | PI | | | | | | | | | | | | | | | | | | | |
|-----------------|--|---------------|----------|--------|----------|--------------|------|--------------|------|-----------------|-------|--------------|------|-----------------|------|---------------|------|--------------|-------|---------------|------|--|--|--|--|
| 1 | A) Define : i) Load Factor ii) Plant Capacity Factor iii) Plant Use Factor iv) Reserve factor and Explain : Significance of each. | 10 | 1, 4 | I, II | 1 | 1.4.1 | | | | | | | | | | | | | | | | | | | |
| | B) Construct : Chronological daily Load Curve and Load Duration Curve from the following observations. | 10 | 1, 4 | III, V | 1 | 1.4.1 | | | | | | | | | | | | | | | | | | | |
| | <table><tr><th>Time</th><th>Load, kW</th><th>Time</th><th>Load, kW</th></tr><tr><td>6 am to 8 am</td><td>3000</td><td>5 pm to 6 pm</td><td>7000</td></tr><tr><td>8 am to 12 Noon</td><td>10000</td><td>6 pm to 9 pm</td><td>6000</td></tr><tr><td>12 Noon to 1 pm</td><td>5000</td><td>9 pm to 11 pm</td><td>6000</td></tr><tr><td>1 pm to 5 pm</td><td>10000</td><td>11 pm to 6 am</td><td>2000</td></tr></table> | Time | Load, kW | Time | Load, kW | 6 am to 8 am | 3000 | 5 pm to 6 pm | 7000 | 8 am to 12 Noon | 10000 | 6 pm to 9 pm | 6000 | 12 Noon to 1 pm | 5000 | 9 pm to 11 pm | 6000 | 1 pm to 5 pm | 10000 | 11 pm to 6 am | 2000 | | | | |
| Time | Load, kW | Time | Load, kW | | | | | | | | | | | | | | | | | | | | | | |
| 6 am to 8 am | 3000 | 5 pm to 6 pm | 7000 | | | | | | | | | | | | | | | | | | | | | | |
| 8 am to 12 Noon | 10000 | 6 pm to 9 pm | 6000 | | | | | | | | | | | | | | | | | | | | | | |
| 12 Noon to 1 pm | 5000 | 9 pm to 11 pm | 6000 | | | | | | | | | | | | | | | | | | | | | | |
| 1 pm to 5 pm | 10000 | 11 pm to 6 am | 2000 | | | | | | | | | | | | | | | | | | | | | | |
| | If the Reserve capacity in the station is 3000 kW, Evaluate : i) Load Factor ii) Plant Capacity Factor. | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | A) Explain : Concept of Fluidized Bed Combustion (FBC). State : Various arrangements of FBC. Describe : Working of any one arrangement of FBC. Draw : neat sketch. | 10 | 2 | I, II | 3 | 1.4.1 | | | | | | | | | | | | | | | | | | | |
| | B) Compare : Advantages and disadvantages of Diesel power plants over Steam power plants. A diesel engine with 75 % mechanical efficiency consumes 5 gm/s of diesel and produces 80 kW of power output. Calorific value of diesel is 43000 kJ/kg. Evaluate : i) bsfc ii) isfc and iii) brake thermal efficiency for the diesel engine | 10 | 2, 4 | V | 5 | 1.4.1 | | | | | | | | | | | | | | | | | | | |

| 3 | A) Explain with significance : i) Run-off and factors affecting it ii) Mass Curve iii) Factors for site selection of Hydro Power Plants. | 10 | 2 | II | 2 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------|---|-----------|------------------------------|------------|------------------------------|---------|-----|------|------|----------|-----|--------|------|-------|-----|-----------|------|-------|------|---------|------|-----|------|----------|-----|------|------|----------|-----|--|--|--|--|--|
| | B) Explain: Hydrograph and Flow Duration Curve. The mean monthly discharge at a particular hydro plant site is given in Table below. Construct: Hydrograph and Flow duration curve. | 10 | 2 | II, III | 2 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table><tr><th>Month</th><th>Discharge, m³/s</th><th>Month</th><th>Discharge, m³/s</th></tr><tr><td>January</td><td>200</td><td>July</td><td>2000</td></tr><tr><td>February</td><td>450</td><td>August</td><td>2400</td></tr><tr><td>March</td><td>600</td><td>September</td><td>1800</td></tr><tr><td>April</td><td>1200</td><td>October</td><td>1200</td></tr><tr><td>May</td><td>1500</td><td>November</td><td>800</td></tr><tr><td>June</td><td>1600</td><td>December</td><td>400</td></tr></table> | Month | Discharge, m ³ /s | Month | Discharge, m ³ /s | January | 200 | July | 2000 | February | 450 | August | 2400 | March | 600 | September | 1800 | April | 1200 | October | 1200 | May | 1500 | November | 800 | June | 1600 | December | 400 | | | | | |
| Month | Discharge, m ³ /s | Month | Discharge, m ³ /s | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| January | 200 | July | 2000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| February | 450 | August | 2400 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| March | 600 | September | 1800 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| April | 1200 | October | 1200 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| May | 1500 | November | 800 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| June | 1600 | December | 400 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | A) Explain: Essential elements of a nuclear reactor with their features and functions. Draw: Neat sketch. | 10 | 2 | I, II | 4 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | B) Explain: Working of i) Pressurised Water Reactor (PWR) and ii) Boiling Water Reactor (BWR). Draw: Neat sketches of both the types of reactors and Compare: their Advantages and disadvantages. | 10 | 2 | I, II, V | 4 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | A) Explain: Working, of Open Gas Turbine Cycle (OGTC) Plant with regeneration, intercooling and reheating and Derive: Expression for its thermal efficiency for ideal conditions. Draw: System diagram and T-s diagram. | 10 | 2 | I, II, III | 5 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | B) In an open cycle gas turbine plant, air at 10°C and 1 bar is compressed in the compressor having isentropic efficiency of 80 % and pressure ratio of 12. The compressed air is preheated in the regenerator of 75% effectiveness and further heated in the combustion chamber till its temperature 1400°C. There is no pressure drop during heat addition in the regenerator and combustion chamber. The air is finally expanded in the gas turbine having isentropic efficiency of 85 % and passes through the regenerator before venting to atmosphere. Evaluate: Thermal efficiency of the plant. Draw: System diagram and T-s diagram. | 10 | 2, 4 | I, V | 5 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | B) Differentiate: between Combined Cycle Power Generation and Combined Power Generation. Discuss: Simple Gas Turbine cycle combined with single Steam Turbine cycle (SG1ST). Draw: System diagram and T-s diagram. | 10 | 2 | I, II | 3 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | B) Explain: Base load and peak load plants. Describe: Favourable and adverse features of i) Steam power plants and ii) Gas turbine plants for its use as Base Load and Peak load plants | 10 | 2 | II | 1,6 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | A) Explain: Pollution due to nuclear power plants and methods of disposal of radioactive waste. | 10 | 3 | II | 4,7 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | B) State: Methods of controlling SO ₂ emission from thermal power plants. Explain: Working of a wet scrubber. Draw: Neat sketch. | 10 | 3 | I, II | 7 | 1.4.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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END SEM EXAM JUNE 2023

| | |
|---|-----------------------|
| DATE 14-06-2023 | SESSION: Afternoon |
| Class : Final Year B.Tech.in Mechanical Engineering | Semester : VIII |
| Course Name & Code- Supply Chain Management (PE-BTM734) | Code : PE-BTM734 |
| Total Points 100 | Time Allotted : 3hour |

- NB. *Final year B.Tech (mech) Sem - VIII*
1. Que 1 is compulsory
 2. Solve any 4 questions from remaining .
 3. Assume Suitable Data wherever required.

| QN | Question Statement | Points | Module | CO | | | | | | | | | | | | | | | | | | | | | | | | |
|----------|--|---------------------|------------------|---------------------|------------------|---------|-------|----|--------|----------|-------|-----------------|--------|--------|--------------------------------|----|--------|------------------|----|---------|-----------|----|--|---------------------------|---|----|----|---------------|
| Q1A | Consider a Supply Chain of Packaged Drinking Water. Identify the Supply Chain Players of the same. State the requirements of Each Supply Chain Player. State the issues / challenges faced by above supply chain players. | 10 | M1 | CO1, CO2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Q1B | Prepare the Causes of more vulnerability of Supply Chain . Draw the Cause and Effect diagram to show more vulnerability of Supply Chain. | 10 | M1 | CO1, CO3 | | | | | | | | | | | | | | | | | | | | | | | | |
| Q2A | The annual demand for a product is 64000 units. The buying cost per order is Rs10 and the estimated cost of carrying one unit in stock for a year is 20 percent. The normal price of the product is rs 10 per unit. However a supplier offers a quantity discount of 2 percent on an order of at least 1000 units at a time and a discount of 5 percent on an order of at least 5000 units. Suggest the most economic purchase quantity per order. | 10 | M3 | CO2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Q2B | Select the Best Location based on the following data . Selling Price per unit of the product \$120. Volume 2000 units. <table border="1"><thead><tr><th>City</th><th>Fixed cost in \$</th><th>Variable Cost in \$</th><th>Total Cost in \$</th></tr></thead><tbody><tr><td>Athens</td><td>30000</td><td>75</td><td>180000</td></tr><tr><td>Brisboin</td><td>60000</td><td>45</td><td>150000</td></tr><tr><td>Lisbon</td><td>110000</td><td>25</td><td>160000</td></tr></tbody></table> | City | Fixed cost in \$ | Variable Cost in \$ | Total Cost in \$ | Athens | 30000 | 75 | 180000 | Brisboin | 60000 | 45 | 150000 | Lisbon | 110000 | 25 | 160000 | 10 | M2 | CO1 CO2 | | | | | | | | |
| City | Fixed cost in \$ | Variable Cost in \$ | Total Cost in \$ | | | | | | | | | | | | | | | | | | | | | | | | | |
| Athens | 30000 | 75 | 180000 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brisboin | 60000 | 45 | 150000 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lisbon | 110000 | 25 | 160000 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Q3A | EV Tech company manufactures automobile components and supplies to 5 esteemed auto companies in South Asia. It evaluates its suppliers on variety of criteria as follows. <table border="1"><thead><tr><th>Sr.No.</th><th>Criterion</th><th>Weight</th></tr></thead><tbody><tr><td></td><td>Quality</td><td>20</td></tr><tr><td></td><td>Price</td><td>25</td></tr><tr><td></td><td>Credit facility</td><td>15</td></tr><tr><td></td><td>Adherence to delivery schedule</td><td>15</td></tr><tr><td></td><td>Service Facility</td><td>10</td></tr><tr><td></td><td>Lead time</td><td>10</td></tr><tr><td></td><td>Response to suggestions %</td><td>5</td></tr></tbody></table> <p>It has four suppliers for its one of the major supplies. Refer the following data and select the best supplier.</p> | Sr.No. | Criterion | Weight | | Quality | 20 | | Price | 25 | | Credit facility | 15 | | Adherence to delivery schedule | 15 | | Service Facility | 10 | | Lead time | 10 | | Response to suggestions % | 5 | 10 | M3 | CO1, CO2, CO3 |
| Sr.No. | Criterion | Weight | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Quality | 20 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Price | 25 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Credit facility | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Adherence to delivery schedule | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Service Facility | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Lead time | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Response to suggestions % | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Sr No. | Factor | Suppliers | | | |
|---|--|-----------|------------|--------------------|----|
| | | A | B | C | D |
| | Quantity supplied | 95 | 85 | 90 | 85 |
| | Quantity accepted | 85 | 75 | 80 | 72 |
| | Price per unit | 22 | 30 | 25 | 25 |
| | Credit facilities in days | 20 | 25 | 25 | 30 |
| | Delivery promised in weeks | 6 | 6 | 6 | 6 |
| | Delivery made in weeks | 7 | 7 | 6 | 8 |
| | Service facilities Evaluation % | 80 | 85 | 75 | 70 |
| | Lead time in week | 3 | 2.5 | 3 | 2 |
| | Response to suggestions % | 87 | 84 | 86 | 89 |
| State the guidelines for improving Supplier Relationship. | | | | | |
| Q3B | Consider the Supply Chain Electric vehicle industry. Prepare the list of activities to reduce to Inventory cost of i. Purchased Goods Inventory ii. WIP inventory iii. Finished goods inventory | 10 | M3 | CO1, CO2 | |
| Q4A | State the benefits and pitfalls of SWOT analysis. Prepare SWOT analysis of Metro Rail Service Supply Chain in Mumbai City | 10 | M1 | CO4 | |
| Q5A | Prepare the List of Parameters for selecting a Carrier. Rank them appropriately. | 10 | M5 | CO1, CO2, CO3 | |
| Q5B | Illustrate the Blockchain use case for automobile registration with suitable diagram. | 10 | M1, M6, M7 | CO1, CO2, CO3, CO4 | |
| Q6A | Select the Supply Chain of your choice. State the Challenges of Green Procurement Process and Describe how Blockchain IOT integrated architecture can be useful in addressing the challenges. | 10 | M1, M6, M7 | CO1, CO3, CO4 | |
| Q6B | Develop the strategies to improve the agility of procurement process in Electric vehicle manufacturing company by adopting industry 4.0 technologies. | 10 | M3 | CO1, CO3 | |
| Q7A | Select the Supply Chain of your choice. Draw and explain the chart showing Key areas of purchasing performance measurement. | 10 | M3,M7 | CO1, CO3, CO4 | |
| Q7B | Illustrate the integrated performance model for warehouse. | 10 | M4 | CO1, CO3 | |



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(Government Aided Autonomous Institute)



14/6/23

END SEMESTER EXAMINATION JUNE 2023

Program: Mechanical Engineering

Duration: 3 Hours

Course Code: PEBTM755

Maximum Points: 100

Course Name: Automobile Engineering

Semester: VIII

INSTRUCTIONS: Final year B.Tech (Mech) Sem - VIII

1. Question no 1 is compulsory and Attempt any four questions out of remaining six questions.
2. Draw neat schematic diagrams wherever is necessary, highlight important points of answer.
3. Assume suitable data if necessary and mention it.

| Q. No. | Questions | Point | CO | Module |
|---------|--|-------|----|--------|
| Q1 A | Derive final expression for thermal efficiency of Otto air standard cycle with the help of necessary P-V and T-S diagram? | 10 | 2 | 1 |
| Q1 B | What are the issues associated with controlled operation of wiper, explain its solution with the help of a neat sketch? | 10 | 4 | 6 |
| Q2 A | Why disk brake performance more reliable compared to drum brake performance? Explain it with the help of sketch? Write short note on traction limit, friction ellipse and draw graph between friction coefficient and wheel slip ratio, give its significance? | 10 | 2 | 5 |
| Q2 B | Give all functional requirements of any type of automobile body? | 10 | 3 | 7 |
| Q3 A | a) Draw neat sketch of multi-rail selector fork and explain how the gear interlock mechanism makes gear shift reliable? b) Estimate torque transmission capability by a three plate clutch, which has an average radius of 10 cm and it is coated using organic material (having coefficient of friction as 0.55)? After release of the clutch pedal, spring assembly applies 35 N of axial load on the clutch plate. Also estimate (all inertia loads are negligible and wheels rides without any slip) tractive effort available at road-tyre interface if $N_{t1} = 0.75$, $N_d = 0.75$, mean wheel radius = 0.25 meters? | 10 | 2 | 3 |
| Q3 B | Give the working principle of Magneto Ignition System with the help of a neat sketch? | 10 | 3 | 4 |



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END SEMESTER EXAMINATION JUNE 2023

| | | | | |
|---------|---|----|---|---|
| | Write a short note on battery capacity rating? | | | |
| Q4 A | With the help of neat sketch write short note on "Double wishbone suspension" system? Draw free body diagram of Quarter car model having 2 degree of freedom suspension system and obtain basic equations for both bodies? | 10 | 1 | 4 |
| Q4 B | When an automobile is steered using steering mechanism, then obtain expression for side slip angle (β) and radius of turn (R) using "kinetics of Bicycle model"? | 10 | 1 | 2 |
| Q5 A | Obtain expression for optimized gear ratio (including gear box and differential) of automobile at which automobile can be accelerated 'f' to 'f _{max} '? (consider resistance, inertia of slow and fast moving parts) | 10 | 2 | 1 |
| Q5 B | List down basic functions to be performed by brake system for satisfactory performance? What is Ideal brake force distribution and give its formula with all terminology? | 10 | 3 | 5 |
| Q6 A | Obtain expression for maximum tractive effort available in case of front wheel drive? Write short note on Independent suspension system with neat sketch? | 10 | 2 | 3 |
| Q6 B | List down three parameters of wheel alignment required to be maintained? Give significance of these parameters along with their sketch? | 10 | 4 | 2 |
| Q7 A | Give working principle of motor vehicle horn system with the help of neat sketch? | 10 | 1 | 4 |
| Q7 B | What are different types of chassis frames? Explain each type with 3 points? | 10 | 1 | 7 |



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End Semester Examination June 2023

14/6/23

Program: B. Tech Mechanical

Duration: 3 Hour

Course Code: PE BTM756

Maximum Points: 100

Course Name: Renewable Energy Sources and Utilization

Semester: VIII

Notes:

Final year B.Tech (Mech) Sem-VIII

- 1) Question number ONE is compulsory and solve any FOUR out of remaining SIX questions.
- 2) Use of steam table, refrigeration properties table and Gamma function table is permitted.
- 3) Draw neat sketches wherever required.
- 4) Assume suitable data and justify the same.

| Q.No. | Questions | Points | CO | BL | Module Number |
|-------|---|--------|-------|-----|---------------|
| 1 | Solve any four out of five questions. (a) Explain the method of manufacturing single crystal silicon solar cell (b) Explain the annual speed frequency distribution curve and annual speed-duration curve. (c) Discuss the use of selective surfaces for liquid flat plate collectors. (d) Discuss the electricity production of India and compare how much is the consumption of per person in India as compare to worlds per person consumption. (e) Explain the principle of working of the solar cell. | 20 | 1,2,3 | 1,2 | 1,2,3,4 |
| 2(a) | Compare the OTEC system working on Rankine cycle with steam power plant working on Rankine cycle. | 10 | 1 | 2 | 5 |
| 2(b) | A photovoltaic cell has an open circuit voltage of 0.6 V and a short circuit current of 250 A/m ² at a cell temperature of 40°C. Calculate the voltage and current density that maximizes the power of the cell. What would be the corresponding maximum power output per unit cell area? Given that charge of an electron, $e = 1.602 \times 10^{-19}$ J/V and Boltzmann constant, $k = 1.381 \times 10^{-23}$ J/K | 10 | 2 | 3 | 3 |
| 3(a) | Discuss the components of hydroelectric power plant and write the role of each component. | 08 | 4 | 2 | 6 |
| 3(b) | Calculate the overall loss coefficient for a flat-plate collector with two glass covers by calculation. (Without using empirical formula) Given the following data: Size of the absorber plate ($L_1 \times L_2$) : 1.90 m \times 0.9m Spacing between plate and the first glass cover (L) : 4 cm | 12 | 2 | 3 | 2 |



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End Semester Examination June 2023

| | Spacing between first and the second glass cover (L) : 4 cm Plate emissivity (ϵ_p) : 0.92 Glass cover emissivity (ϵ_c) : 0.88 Collector tilt (β) : 20° Mean Plate temperature (T_{pm}) : 70°C Ambient air temperature (T_a) : 24°C Wind speed (V_∞) : 2.5 m/s Back insulation thickness (δ_b) : 16 cm Side insulation thickness (δ_s) : 8 cm Thermal conductivity of insulation (k_i) : 0.04 W/m-K | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------|---|----------|------|----------|------|----------|------|----------|------|----|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|------|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|------|-------|-----|--|--|----|---|---|---|
| 4(a) | Draw neat schematic diagram of downdraft gasifier and explain the biomass gasification process in detail. | 10 | 4 | 2 | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4(b) | Calculate the actual energy available for wind machine for which the cut in speed is 14 kmph, the design speed is 36 kmph and the cut-out speed is 90 kmph for following location. Location : Indore Month : July Take ρ for air = 1.20 kg/m^3 . <table><tr><th>Interval</th><th>July</th><th>Interval</th><th>July</th><th>Interval</th><th>July</th><th>Interval</th><th>July</th></tr><tr><td>00</td><td>2.3</td><td>10-12</td><td>3.4</td><td>22-24</td><td>9.5</td><td>34-36</td><td>3.0</td></tr><tr><td>00-02</td><td>0.6</td><td>12-14</td><td>3.5</td><td>24-26</td><td>10.8</td><td>36-38</td><td>2.6</td></tr><tr><td>02-04</td><td>0.5</td><td>14-16</td><td>7.7</td><td>26-28</td><td>3.6</td><td>38-40</td><td>1.1</td></tr><tr><td>04-06</td><td>1.1</td><td>16-18</td><td>8.3</td><td>28-30</td><td>7.4</td><td>40-42</td><td>0.7</td></tr><tr><td>06-08</td><td>1.2</td><td>18-20</td><td>9.2</td><td>30-32</td><td>7.0</td><td>42-44</td><td>0.2</td></tr><tr><td>08-10</td><td>0.9</td><td>20-22</td><td>11.3</td><td>32-34</td><td>3.7</td><td></td><td></td></tr></table> | Interval | July | Interval | July | Interval | July | Interval | July | 00 | 2.3 | 10-12 | 3.4 | 22-24 | 9.5 | 34-36 | 3.0 | 00-02 | 0.6 | 12-14 | 3.5 | 24-26 | 10.8 | 36-38 | 2.6 | 02-04 | 0.5 | 14-16 | 7.7 | 26-28 | 3.6 | 38-40 | 1.1 | 04-06 | 1.1 | 16-18 | 8.3 | 28-30 | 7.4 | 40-42 | 0.7 | 06-08 | 1.2 | 18-20 | 9.2 | 30-32 | 7.0 | 42-44 | 0.2 | 08-10 | 0.9 | 20-22 | 11.3 | 32-34 | 3.7 | | | 10 | 2 | 3 | 4 |
| Interval | July | Interval | July | Interval | July | Interval | July | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 00 | 2.3 | 10-12 | 3.4 | 22-24 | 9.5 | 34-36 | 3.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 00-02 | 0.6 | 12-14 | 3.5 | 24-26 | 10.8 | 36-38 | 2.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 02-04 | 0.5 | 14-16 | 7.7 | 26-28 | 3.6 | 38-40 | 1.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 04-06 | 1.1 | 16-18 | 8.3 | 28-30 | 7.4 | 40-42 | 0.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 06-08 | 1.2 | 18-20 | 9.2 | 30-32 | 7.0 | 42-44 | 0.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 08-10 | 0.9 | 20-22 | 11.3 | 32-34 | 3.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5(a) | Explain how geothermal energy is renewable energy. Also explain the closed cycle and open cycle house heating system with available geothermal aquifer. | 10 | 4 | 2 | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5(b) | A propeller wind machine has a rotor diameter of 60 m. It is operating at a location having a wind speed of 35 kmph and rotating at 20 rmp. Calculate theoretically, the power which the machine can extract from the wind if (a) only wake rotation is considered (b) both wake rotation and the effect of drag are considered. For part (b) assume that value of | 10 | 3 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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End Semester Examination June 2023

| | | | | | |
|------|--|----|---|---|---|
| | $\varepsilon=0.012$. | | | | |
| 6(a) | Discuss the storage dam hydro-electric power scheme with neat sketch. | 10 | 4 | 2 | 5 |
| 6(b) | Calculate the efficiency of closed cycle OTEC system using ammonia as the working fluid and installed at a location where the warm and cold sea water streams are at temperature of 35°C and 5°C respectively. Make an allowance of about 5°C for the temperature difference required in the evaporator and condenser for transferring heat, and assume that the ammonia is evaporating at 30°C and condensing at 10°C . Take the isentropic efficiencies of the turbine and pump to be 90 and 80 per cent respectively. | 10 | 3 | 3 | 6 |
| 7(a) | Explain the method of Bio-ethanol and Bio-diesel production in detail. | 10 | 3 | 3 | 7 |
| 7(b) | It is proposed to set-up a wind machine on SPCE building for which long-term data on wind speed is not available. In order to assess the wind potential and select suitable wind machine, a large number of discrete measurements of hourly wind speed are made over some representative days for a couple of years. The measurements yield the following values of the average wind speed and the standard deviation: $\bar{V} = 5.8 \text{ m/s}$ $\sigma = 3.5 \text{ m/s}$ Plot the annual wind speed-frequency distribution under the assumption that it is Weibull distribution. | 10 | 1 | 3 | 4 |

Data Sheet

1. Relationship between Nusselt and Rayleigh numbers.

$$\begin{aligned} \text{Nu}_L &= 1 ; \text{Ra}_L \cos \beta < 1708 \\ \text{Nu}_L &= 1 + 1.446 \left(1 - \frac{1708}{\text{Ra}_L \cos \beta} \right) ; 1708 < \text{Ra}_L \cos \beta < 5900 \\ \text{Nu}_L &= 0.229 (\text{Ra}_L \cos \beta)^{0.252} ; 5900 < \text{Ra}_L \cos \beta < 9.23 \times 10^4 \\ \text{Nu}_L &= 0.157 (\text{Ra}_L \cos \beta)^{0.285} ; 9.23 \times 10^4 < \text{Ra}_L \cos \beta < 10^6 \end{aligned}$$

$$h_w = 8.55 + 2.56 V_{\infty}$$



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Properties of Air:

Table A 4.2 Properties of dry air at atmospheric pressure

| T °C | ρ kg/m ³ | C_p kJ/kg-K | $\mu \times 10^6$ N-s/m ² | k W/m-K | Pr | $\nu \times 10^6$ m ² /s |
|-----------|-----------------------------|------------------|---|--------------|-------|--|
| 0 | 1.293 | 1.005 | 17.2 | 0.0244 | 0.707 | 13.28 |
| 10 | 1.247 | 1.005 | 17.7 | 0.0251 | 0.705 | 14.16 |
| 20 | 1.205 | 1.005 | 18.1 | 0.0259 | 0.703 | 15.06 |
| 30 | 1.165 | 1.005 | 18.6 | 0.0267 | 0.701 | 16.00 |
| 40 | 1.128 | 1.005 | 19.1 | 0.0276 | 0.699 | 16.96 |
| 50 | 1.093 | 1.005 | 19.6 | 0.0283 | 0.698 | 17.95 |
| 60 | 1.060 | 1.005 | 20.1 | 0.0290 | 0.696 | 18.97 |
| 70 | 1.029 | 1.009 | 20.6 | 0.0297 | 0.694 | 20.02 |
| 80 | 1.000 | 1.009 | 21.1 | 0.0305 | 0.692 | 21.09 |
| 90 | 0.972 | 1.009 | 21.5 | 0.0313 | 0.690 | 22.10 |
| 100 | 0.946 | 1.009 | 21.9 | 0.0321 | 0.688 | 23.13 |
| 120 | 0.898 | 1.009 | 22.9 | 0.0334 | 0.686 | 25.45 |
| 140 | 0.854 | 1.013 | 23.7 | 0.0349 | 0.684 | 27.80 |
| 160 | 0.815 | 1.017 | 24.5 | 0.0364 | 0.682 | 30.09 |
| 180 | 0.779 | 1.022 | 25.3 | 0.0378 | 0.681 | 32.49 |
| 200 | 0.746 | 1.026 | 26.0 | 0.0393 | 0.680 | 34.85 |
| 250 | 0.674 | 1.038 | 27.4 | 0.0427 | 0.677 | 40.61 |
| 300 | 0.615 | 1.047 | 29.7 | 0.0461 | 0.674 | 48.33 |
| 350 | 0.566 | 1.059 | 31.4 | 0.0491 | 0.676 | 55.46 |
| 400 | 0.524 | 1.068 | 33.0 | 0.0521 | 0.678 | 63.09 |
| 500 | 0.456 | 1.093 | 36.2 | 0.0575 | 0.687 | 79.38 |
| 600 | 0.404 | 1.114 | 39.1 | 0.0622 | 0.699 | 96.89 |
| 700 | 0.362 | 1.135 | 41.8 | 0.0671 | 0.706 | 115.4 |
| 800 | 0.329 | 1.156 | 44.3 | 0.0718 | 0.713 | 134.8 |
| 900 | 0.301 | 1.172 | 46.7 | 0.0763 | 0.717 | 155.1 |
| 1000 | 0.277 | 1.185 | 49.0 | 0.0807 | 0.719 | 177.1 |



Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058



End Semester Examination June 2023

Gamma Function for $\Gamma(x)$

| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------|------|------|------|-------|--------|--------|---------|----------|-----------|------------|
| 0 | 1 | 1 | 2 | 6 | 24 | 120 | 720 | 5040 | 40320 | 362880 |
| 0.05 | 0.97 | 1.02 | 2.1 | 6.39 | 25.88 | 130.72 | 790.83 | 5575.35 | 44881.53 | 406177.83 |
| 0.1 | 0.95 | 1.05 | 2.2 | 6.81 | 27.93 | 142.45 | 868.96 | 6169.59 | 49973.71 | 454760.75 |
| 0.15 | 0.93 | 1.07 | 2.31 | 7.27 | 30.16 | 155.31 | 955.16 | 6829.42 | 55659.8 | 509287.17 |
| 0.2 | 0.92 | 1.1 | 2.42 | 7.76 | 32.58 | 169.41 | 1050.32 | 7562.29 | 62010.76 | 570499.03 |
| 0.25 | 0.91 | 1.13 | 2.55 | 8.29 | 35.21 | 184.86 | 1155.38 | 8376.51 | 69106.23 | 639232.6 |
| 0.3 | 0.9 | 1.17 | 2.68 | 8.86 | 38.08 | 201.81 | 1271.42 | 9281.39 | 77035.56 | 716430.69 |
| 0.35 | 0.89 | 1.2 | 2.83 | 9.47 | 41.2 | 220.41 | 1399.63 | 10287.32 | 85899.08 | 803156.43 |
| 0.4 | 0.89 | 1.24 | 2.98 | 10.14 | 44.6 | 240.83 | 1541.34 | 11405.89 | 95809.46 | 900608.9 |
| 0.45 | 0.89 | 1.28 | 3.15 | 10.85 | 48.3 | 263.26 | 1698 | 12650.08 | 106893.21 | 1010140.79 |
| 0.5 | 0.89 | 1.33 | 3.32 | 11.63 | 52.34 | 287.89 | 1871.25 | 14034.41 | 119292.46 | 1133278.39 |
| 0.55 | 0.89 | 1.38 | 3.51 | 12.47 | 56.75 | 314.95 | 2062.92 | 15575.08 | 133166.94 | 1271744.28 |
| 0.6 | 0.89 | 1.43 | 3.72 | 13.38 | 61.55 | 344.7 | 2275.03 | 17290.25 | 148696.14 | 1427482.93 |
| 0.65 | 0.9 | 1.49 | 3.94 | 14.37 | 66.8 | 377.42 | 2509.83 | 19200.21 | 166081.84 | 1602689.78 |
| 0.7 | 0.91 | 1.54 | 4.17 | 15.43 | 72.53 | 413.41 | 2769.83 | 21327.69 | 185550.94 | 1799844.13 |
| 0.75 | 0.92 | 1.61 | 4.42 | 16.59 | 78.78 | 453.01 | 3057.82 | 23698.13 | 207358.61 | 2021746.44 |
| 0.8 | 0.93 | 1.68 | 4.69 | 17.84 | 85.62 | 496.61 | 3376.92 | 26339.99 | 231791.89 | 2271560.56 |
| 0.85 | 0.95 | 1.75 | 4.99 | 19.2 | 93.1 | 544.61 | 3730.6 | 29285.17 | 259173.77 | 2552861.66 |
| 0.9 | 0.96 | 1.83 | 5.3 | 20.67 | 101.27 | 597.49 | 4122.71 | 32569.41 | 289867.73 | 2869690.49 |
| 0.95 | 0.98 | 1.91 | 5.64 | 22.27 | 110.21 | 655.77 | 4557.58 | 36232.73 | 324282.91 | 3226614.98 |