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|  | <p>Ministry of Higher Education and<br/>Scientific Research - Iraq</p> <p>University of Warith Al_Anbiyaa<br/>Engineering Department</p> <p>Refrigeration and Air Conditioning<br/>Techniques Engineering</p> |  |
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## MODULE DESCRIPTION FORM

### نموذج وصف المادة الدراسية

| Module Information                 |                  |                               |  |
|------------------------------------|------------------|-------------------------------|--|
| معلومات المادة الدراسية            |                  |                               |  |
| Module Title                       | Thermodynamics 2 |                               | Module Delivery  |
| Module Type                        | C                |                               | <input type="checkbox"/> Theory<br><input checked="" type="checkbox"/> Lecture<br><input checked="" type="checkbox"/> Lab<br><input type="checkbox"/> Tutorial<br><input type="checkbox"/> Practical<br><input type="checkbox"/> Seminar |
| Module Code                        | MPAC203          |                               |  |
| ECTS Credits                       | 10               |                               |  |
| SWL (hr/sem)                       | 250              |                               |  |
| Module Level                       | 2                | Semester of Delivery          |  |
| Administering Department           | BSc-MPAC         | College                       | Engineering  |
| Module Leader                      | Amin Sami Amin   | e-mail                        | <a href="mailto:aminsami2000@yahoo.com">aminsami2000@yahoo.com</a>   |
| Module Leader's Acad. Title        | Lecturer         | Module Leader's Qualification | M.Sc   |
| Module Tutor                       |                  | e-mail                        |  |
| Peer Reviewer Name                 |                  | e-mail                        |  |
| Scientific Committee Approval Date | 23 / 9/2024      | Version Number                | 1.0  |
| Relation with other Modules        |                  |                               |  |
| العلاقة مع المواد الدراسية الأخرى  |                  |                               |  |

|  |  |                 |       |
|--|--|-----------------|-------|
| <b>Prerequisite module</b>                                       | MPAC108  | <b>Semester</b> | L1,S1 |
| <b>Co-requisites module</b>                                      | None   | <b>Semester</b> |       |
| <b>Module Aims, Learning Outcomes and Indicative Contents</b>    |  |                 |       |
| أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية         |  |                 |       |
| <b>Module Aims</b><br>أهداف المادة الدراسية                      | To study the principles of applied thermodynamics, as the basis of refrigeration & air conditioning engineering and power plant subjects   |                 |       |
| <b>Module Learning Outcomes</b><br>مخرجات التعلم للمادة الدراسية | <ol style="list-style-type: none"> <li>1. To know the type of steam power plants</li> <li>2. To know the regenerative cycle – dual cycle, High speed gas flow</li> <li>3. To know the properties of isentropic flows, Shock waves</li> <li>4. To know the supersonic nozzles, single and multi-stage reciprocating compressors</li> <li>5. To know the multistage gas turbines and velocity triangles</li> <li>6. To know the steam turbines. Internal combustion engines, Thermodynamics relations</li> <li>7. To know the Maxwell relations, Clausius Clapyron relations</li> <li>8. To know the gas mixtures, Gibbs- equations</li> <li>9. To know the gravimetric analysis, Combustion, heat of reaction.</li> </ol> |                 |       |
| <b>Indicative Contents</b><br>المحتويات الإرشادية                | <p>Indicative content includes the following.</p> <p><u>Part A – Steam Power Plans</u><br/>Regenerative cycle – dual cycle, High speed gas flow. [24 hrs.]</p> <p><u>Part B – Gas Flow</u><br/>Isentropic flows, shock waves, supersonic nozzles. [16 hrs.]</p> <p><u>Part C – Compressors and Turbines</u><br/>Single and multi-stage reciprocating compressors, multistage gas turbines, velocity triangles, steam turbines, internal combustion engines. [32 hrs.]</p> <p><u>Part D – Thermodynamics Relations</u><br/>Maxwell relations, Clausius Clapeyron relations, gas mixtures, Gibbs- equations. [48 hrs.]</p>   |                 |       |
| <b>Learning and Teaching Strategies</b>                          |  |                 |       |
| استراتيجيات التعلم والتعليم                                      |  |                 |       |

|                   |  |
|-------------------|--|
| <b>Strategies</b> | Assessment is based on hand-in assignment, written exams, case study, quizzes, seminars and practical testing. |
|-------------------|--|

**Student Workload (SWL)**

الحمل الدراسي للطالب

|  |     |   |    |
|--|-----|---|----|
| <b>Structured SWL (h/sem)</b><br>الحمل الدراسي المنتظم للطالب خلال الفصل       | 158 | <b>Structured SWL (h/w)</b><br>الحمل الدراسي المنتظم للطالب أسبوعيا       | 11 |
| <b>Unstructured SWL (h/sem)</b><br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 92  | <b>Unstructured SWL (h/w)</b><br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 10 |
| <b>Total SWL (h/sem)</b><br>الحمل الدراسي الكلي للطالب خلال الفصل              | 250 |   |    |

**Module Evaluation**

تقييم المادة الدراسية

|                             |                     | Time/Number | Weight (Marks)   | Week Due    | Relevant Learning Outcome |
|-----------------------------|---------------------|-------------|------------------|-------------|---------------------------|
| <b>Formative assessment</b> | <b>Quizzes</b>      | 5           | 5 % (5)          | 2,5,8,10,13 | LO # 1, 4, 5, 7,8         |
|                             | <b>Assignments</b>  | 5           | 5 % (5)          | 1,4,7,11,15 | LO # 1-15                 |
|                             | <b>Lab.</b>         | 10          | 10 % (10)        | 1-9         | LO # 1-15                 |
|                             | <b>Report</b>       | 10          | 10 % (10)        | 1-8         | LO # 1-15                 |
| <b>Summative assessment</b> | <b>Midterm Exam</b> | 3 hr.       | 20 % (20)        | 9           | LO # 1-15                 |
|                             | <b>Final Exam</b>   | 3 hr.       | 50% (50)         | 15          | All                       |
| <b>Total assessment</b>     |                     |             | 100% (100 Marks) |             |                           |

**Delivery Plan (Weekly Syllabus)**

المنهاج الاسبوعي النظري

|               | Material Covered                                     |
|---------------|--|
| <b>Week 1</b> | An overview of steam, dryness fraction measurements  |
| <b>Week 2</b> | Steam power plants, Rankine - reheat cycle           |
| <b>Week 3</b> | Regenerative cycle – dual cycle, High speed gas flow |
| <b>Week 4</b> | Properties of isentropic flows, Shock waves          |
| <b>Week 5</b> | Supersonic nozzles, Reciprocating compressors        |
| <b>Week 6</b> | Dynamic analysis, Clearance volume                   |
| <b>Week 7</b> | Multistage compressors, Gas turbines                 |

|                |   |
|----------------|---|
| <b>Week 8</b>  | Velocity triangles, frictional effects, Gas turbines comparison               |
| <b>Week 9</b>  | Steam turbines. Internal combustion engines, Thermodynamics relations         |
| <b>Week 10</b> | Maxwell relations, Clausius Clapeyron relations                               |
| <b>Week 11</b> | Thermodynamic relations for $du$ , $dh$ , $ds$ , $C_p$ and $C_v$ , Real gases |
| <b>Week 12</b> | Compressibility factors, Real gas equations of states                         |
| <b>Week 13</b> | Gas mixtures, Gibbs- equations  |
| <b>Week 14</b> | Dalton's law and molar ratio, Volumetric analysis                             |
| <b>Week 15</b> | Gravimetric analysis, Combustion, heat of reaction                            |

### Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

|               | Material Covered   |
|---------------|--|
| <b>Week 1</b> | Measurement of specific heat ratio of air                            |
| <b>Week 2</b> | Operating parameters of VCR  |
| <b>Week 3</b> | Saturated vapor pressure and temperature relation                    |
| <b>Week 4</b> | Steam boiler efficiency  |
| <b>Week 5</b> | Determination the phase of the refrigerant for VCR system components |
| <b>Week 6</b> | Vapor dryness fraction measurement                                   |
| <b>Week 7</b> | Determination the latent heat of evaporation                         |
| <b>Week 8</b> | Determination of thermal efficiency for VCR cycle                    |
| <b>Week 9</b> | EES software training  |

### Learning and Teaching Resources

مصادر التعلم والتدريس

|                       | Text   | Available in the Library? |
|-----------------------|--|---------------------------|
| <b>Required Texts</b> | <ol style="list-style-type: none"> <li>Borgnakke, C. and Sonntag, R.E., 2022. <i>Fundamentals of thermodynamics</i>. John Wiley &amp; Sons.</li> <li>Cengel, Y.A., Boles, M.A. and Kanoğlu, M., 2011. <i>Thermodynamics: an engineering approach</i> (Vol. 5, p. 445). New York: McGraw-hill.</li> <li>Rajput, R.K., 2005. <i>A textbook of engineering thermodynamics</i>. Laxmi Publications.</li> </ol> | No                        |

## Grading Scheme

## مخطط الدرجات

| Group                       | Grade            | التقدير             | Marks (%) | Definition                            |
|-----------------------------|------------------|---------------------|-----------|---------------------------------------|
| Success Group<br>(50 - 100) | A - Excellent    | امتياز              | 90 - 100  | Outstanding Performance               |
|                             | B - Very Good    | جيد جدا             | 80 - 89   | Above average with some errors        |
|                             | C - Good         | جيد                 | 70 - 79   | Sound work with notable errors        |
|                             | D - Satisfactory | متوسط               | 60 - 69   | Fair but with major shortcomings      |
|                             | E - Sufficient   | مقبول               | 50 - 59   | Work meets minimum criteria           |
| Fail Group<br>(0 - 49)      | FX – Fail        | راسب (قيد المعالجة) | (45-49)   | More work required but credit awarded |
|                             | F – Fail         | راسب                | (0-44)    | Considerable amount of work required  |

**Note:** Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

