**TEMPLATE FOR COURSE SPECIFICATION**

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| HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW |

**COURSE SPECIFICATION**

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| This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programmed specification. |

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| College of Engineering  University of Baghdad | ***1. Teaching Institution*** |
| Mechanical Engineering Department (MED) | ***2. University Department/Centre*** |
| **Fluid Mechanics /II – ME302**  **Gas Dynamic:**  This course aims to teach the students the basic concepts of compressible fluid flow, concept of operation and performance of the nozzles and diffusers.  **Content:**   1. General concepts for fluid dynamics and and thermodynamics. 2. Concepts of compressible fluid and sound speed. 3. Isentropic flow. 4. Normal and oblique shocks. 5. Operation of nozzles under varying pressure ratio. 6. Flow with friction (Fanno lines). 7. Flow with heat (Raylish line). 8. Nozzle efficiency and jet propulsion.   The course is taught through 2 hrs. per week.  **Turbomachinery:**  in [mechanical engineering](http://en.wikipedia.org/wiki/Mechanical_engineering), describes [machines](http://en.wikipedia.org/wiki/Machine) that transfer [energy](http://en.wikipedia.org/wiki/Energy) between a [rotor](http://en.wikipedia.org/wiki/Rotor_(turbine)) and a [fluid](http://en.wikipedia.org/wiki/Fluid), including both [turbines](http://en.wikipedia.org/wiki/Turbines) and [compressors](http://en.wikipedia.org/wiki/Gas_compressor). While a turbine transfers energy from a fluid to a rotor, a compressor transfers energy from a rotor to a fluid. The two types of machines are governed by the same basic relationships including [Newton's second Law of Motion](http://en.wikipedia.org/wiki/Newton%27s_Laws_of_Motion) and [Euler's energy equation](http://en.wikipedia.org/wiki/Euler_equations) for [compressible fluids](http://en.wikipedia.org/wiki/Compressible_fluid). [Centrifugal pumps](http://en.wikipedia.org/wiki/Centrifugal_pump) are also turbo machines that transfer energy from a rotor to a fluid, usually a liquid, while turbines and compressors usually work with a gas.  **Content**  Topics covered in this subject include:   1. Introduction and General Principles. 2. Similarity Laws. 3. Centrifugal Pumps. 4. Impulse Turbines. 5. Reaction Turbines. 6. Axial Flow Compressors. 7. Centrifugal Compressors. 8. Gas Turbines.   The course is taught through 2 hrs. per week. | ***3. Course title/code& Description*** |
| Mechanical Engineering ( ME ) | ***4. Programme(s) to which itContributes*** |
| Annual System ; There is only one mode  of delivery, which is a “Day Program”.  The students are full time students, and on campus. They attend full day program in face-to-face mode. The academic year is composed of 30-week regular subjects.  Each graduating student has to successfully complete 120 credits. Each subject credit is one 100-minute lecture a week or 3 hours of lab a week. There is *no* on-line subject which may be used as supplementary material for the class room instruction. | ***5. Modes of Attendance offered*** |
| 1st & 2nd / Academic Year 2016 – 2017 | ***6. Semester/Year*** |
| 120 hrs. / 4 hrs. per week | ***7. Number of hours tuition (total)*** |
| April – 3 / 2017 | ***8. Date of production/revision of this specification*** |
| ***9. Aims of the Course*** | |
| **Gas Dynamic:**   1. Basic concepts from fluid dynamics and thermodynamics. 2. Introductory concepts to compressible fluid. 3. Velocity of sound in various media. 4. Isentropic flow. 5. Operation of nozzles under varying pressure ratio. 6. Norma and oblique shocks. 7. Flow with friction. 8. Flow with heat. 9. Nozzle efficiency and jet propulsion.   **Turbomachines:**   1. Introduce basic definitions and introductory concepts of Turbomachines. 2. Introduce the description of Turbomachines classified.  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 1. Derive the continuity, momentum, momentum of momentum and energy equations in a form suitable for the study of Turbomachines.  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 1. Determine the efficiency of compression and expansion flow processes.  |  |  |  |  |  | | --- | --- | --- | --- | --- | | 1. Perform a similarity analysis between a laboratory tested model and a full scale Turbomachine( Turbine, Pump) . 2. Introduce the description of centrifugal pumps.  |  |  |  | | --- | --- | --- | | 1. Understand the classification of centrifugal pumps. 2. Draw velocity diagram of a centrifugal pump. 3. Drive head of a centrifugal pump.  |  |  | | --- | --- | | 1. Understand the classification of different types of impulse turbine (pelton wheel) and reaction turbine  |  | | --- | | 1. Draw velocity diagram of a turbine (impulse and reaction). 2. Predict the performance of a turbine stage. 3. Determine stage losses and efficiency. 4. Predict the performance of a multistage turbine. 5. Understand and determine the head on impulse turbine and reaction turbine. | | |  1. Effect of cavitation on pump, impulse turbine and reaction turbine. 2. Centrifugal and axial flow compressors operation for operators.  |  | | --- | | 1. Understand the classification of different types of axial compressor and and centrifugal compressors. 2. Draw velocity diagram of a axial and centrifugal compressor. 3. Predict the performance of a compressor. 4. Understand about axial flow gas turbines. | | | | | |

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| ***10·Learning Outcomes***  **Gas dynamics:**   1. Basic concepts from fluid dynamics and thermodynamics. 2. Introductory concepts to compressible fluid. 3. Tutorial. 4. Monthly exam. 5. Velocity of sound in various media. 6. Isentropic flow. 7. Operation of nozzles under varying pressure ratio. 8. Norma and oblique shocks. 9. Flow with friction. 10. Flow with heat. 11. Nozzle efficiency and jet propulsion.   **Turbomachines**   1. Define turbo machines, open and enclosed machines, absorption and production of power and types of fluid handled. 2. Understand and apply governing equation (continuity, linear momentum, moment of momentum and energy equations. 3. Describe and use of performance velocity diagrams. 4. Understand and apply the principles of dimensional analysis and similitude. 5. Understand and calculate specific speed for pumps and turbines. 6. Analyze the operation of the centrifugal pumps. 7. Calculate head of a centrifugal pump. 8. Explain the system of a centrifugal pump. 9. Estimate power and efficiencies of a centrifugal pump. 10. Explain the constructional features and working principles of impulse turbine and reaction turbine. 11. Determined head of an impulse turbine and reaction turbine. 12. Estimate power and efficiencies of an impulse turbines and reaction turbine. 13. Describe Main components axial flow Compressors and centrifugal compressors. 14. Estimate power and efficiencies of axial flow and centrifugal compressors. 15. Construct Velocity diagrams of the axial flow and centrifugal compressors. 16. Comparison of centrifugal and axial compressors. 17. Explain the system of axial flow gas turbines. 18. Construct velocity diagrams of the axial flow gas turbines. |
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| ***11.Teaching and Learning Methods*** |
| 1. Lectures. 2. Tutorials. 3. Homework and Assignments. 4. Tests and Exams. 5. In-Class Questions and Discussions. 6. Connection between Theory and Application. |
| ***12. Assessment Methods***  . Examinations, Tests, and Quizzes  **2**. Student Engagement during Lectures. |
| ***13. Grading Policy***    **1**. Quizzes:  - There will be a (8– 10) closed books and notes quizzes during the academic year.  - The quizzes will count 20% of the total course grade.  **2**. Tests, 2-3 Nos. and will count 10% of the total course grade.  **3**. Final Exam:  - The final exam will be comprehensive, closed books and notes, and will take place on January 2014 from 9:00 AM - 12:00 PM in rooms ( M12 + M13 ).  - The final exam will count 70% of the total course grade and divide two parts (Gas dynamic 35% and turbo machine 35%) . |

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| ***14. Course Structure(turbomachines):*** | | | | | |
| **Assessment Method** | **Teaching Method** | **Unit/Module on Topic Title** | **Los Article (10 )** | **Hours** | **Week** |
| 1 – 2 of article (12) | 1-6 of  article (11) | Introductory Concepts, Basic concepts from fluid dynamics | a, b, c, A | 4  2 the  1 App. | 1 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Introductory Concepts, Basic concepts from fluid dynamics | a, b, c, A | 4  2 the  1 App | 2 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Introductory Concepts, Introductory concepts to compressible fluid | a, b, c, B | 4  2 the  1 App | 3 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Similarity Laws, Introductory concepts to compressible fluid | d, e, B | 4  2 the  1 App | 4 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Similarity Laws, Tutorial | d, e, C | 4  2 the  1 App | 5 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Similarity Laws, Monthly exam | d, e, D | 4  2 the  1 App | 6 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Centrifugal Pump, Velocity of sound in various media | f, g, h, c, i, E | 4  2 the  1 App | 7 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Centrifugal Pump, Tutorial | f, g, h, c, i, C | 4  2 the  1 App | 8 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Centrifugal Pump, Monthly exam | f, g, h, c, i, D | 4  2 the  1 App | 9 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Centrifugal Pump, Isentropic flow | f, g, h, c, i, F | 4  2 the  1 App | 10 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Impulse Turbine, Isentropic flow | j, k, l, c, F | 4  2 the  1 App | 11 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Impulse Turbine, Monthly exam. | j, k, l, c, D | 4  2 the  1 App | 12 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Impulse Turbine, Isentropic flow | j, k, l, c, F | 4  2 the  1 App | 13 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Impulse Turbine, Isentropic flow | j, k, l, c, F | 4  2 the  1 App | 14 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Reaction Turbine, Operation of nozzles under varying pressure ratio | j, k, l, c, G | 4  2 the  1 App | 15 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Reaction Turbine, Tutorial | j, k, l, c, C | 4  2 the  1 App | 16 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Reaction Turbine, Monthly | j, k, l, c, D | 4  2 the  1 App | 17 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Reaction Turbine, Norma and oblique shocks | j, k, l, c, H | 4  2 the  1 App | 18 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Axial flow Compressors, Norma and oblique shocks | m, n, o, p, H | 4  2 the  1 App | 19 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Axial flow Compressors, Tutorial | m, n, o, p, C | 4  2 the  1 App | 20 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Axial flow Compressors, Monthly exam | m, n, o, p, D | 4  2 the  1 App | 21 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Axial flow Compressors, Flow with friction | m, n, o, p, I | 4  2 the  1 App | 22 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Centrifugal Compressors, Flow with friction | m, n, o, p, I | 4  2 the  1 App | 23 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Centrifugal Compressors, Tutorial | m, n, o, p, C | 4  2 the  1 App | 24 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Centrifugal, Compressors, Monthly exam | m, n, o, p, I | 4  2 the  1 App | 25 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Centrifugal Compressors, flow with heat | m, n, o, p, J | 4  2 the  1 App | 26 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Axial Flow Gas Turbines, flow with heat | q, r, J | 4  2 the  1 App | 27 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Axial Flow Gas Turbines, Tutorial | q, r, C | 4  2 the  1 App | 28 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Axial Flow Gas Turbines, Monthly | q, r, D | 4  2 the  1 App | 29 |
| 1 – 2 of article (12) | 1-6 of  article (11) | Axial Flow Gas Turbines, Nozzle efficiency and jet propulsion | q, r | 4  2 the  1 App | 30 |

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| ***15. Infrastructure*** | | |
| ***References***  **Gas dynamics:**   1. Shapiro,L “The dynamics and thermodynamics of compressible fluid flow-1959. 2. Gas dynamics, Dr. Munthir Al-Duroby-1985.   **Turbomachine:**   1. Daugherty, R. L., Franzini, J. B., and Finnemore, E. J., ''Fluid Mechanice With Engineering Applications'', SI edition, Mc Graw- Hill Book Comp.,1989. 2. Khurmi, R.S., ''A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines'', 17th edition, S. Chand and Comp., 1988. 3. Streeter, V. L., and Wylie, E. B., ''Fluid Mechanics'', 6th edition, Mc Graw-Hill Book Comp., 1975. 4. Jagdish Lal, ''Hydraulic Machines'' 5th edition, Metropolitan Book Comp., 1995. 5. Vasandani, V. P., ''Theory of Hydraulic'', 6th edition, Khanna Publishers, 1977. 6. Dixon, S. L., ''Fluid Mechanics, Thermodynamics of turbo machinery'', 2th edition, Pergamon Press, 1975. 7. Cohen, H., Rogers, G. F. C., and Saravanamuttoo, ''Gas Turbine Theory'', 2th edition, Longman Group, 1972.   Hili, P. G., and Peterson, C. R., ''Mechanics and Thermodynamics of Propulsion'', Addison- Wesley, 1965.  ***Others***  Collection of sheets of solved and unsolved problems and Exams questions | Required reading:  · CORE TEXTS  · COURSE MATERIALS  · OTHER | |
| Laboratory experiments in the ( Fluids  Lab) of the department. | Special requirements (include forexample workshops, periodicals,IT software, websites) | |
| / | Community-based facilities  (include for example, guest  Lectures , internship,field studies) | |
| ***16. Admissions*** | | |
|  | | Pre-requisites |
| 29-32 | | Minimum number of students |
| 37 | | Maximum number of students |
| ***Instructor***  **Dr. Ayser Muneer**  Thermo-Fluids  Mech. Engr. Dept.  College of Engineering  University of Baghdad  Tel: /  Email: Aysermunner@yahoo.com***:*** | | ***17. Course Instructors*** |

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