



دبلوم تطبيقات التحكم الأوتوماتيكي في نظم القوى الميكانيكية

MEP 572 Using Virtual Lab Applications for Industrial Diesel Engine Drive Plant

Dr. Mohsen Soliman, ACC Manager
Mechanical Power Engineering Department

What do we study? **ملاحظة:** هذا ليس مقررتدريس دورة محركات الديزل للمبتدئين ولكن **مقررمتقدم** للتدريب على نظم التحكم الأوتوماتيكي لهذه المحركات

مكق 572 تطبيقات المعامل الافتراضية في التحكم الأوتوماتيكي في محطات الديزل الصناعية (محتويات اللائحة):

- دراسة والتعرف على وتحليل عناصر العديد من مكونات وأجهزة ومعدات نظم التحكم الآلي المستخدمة في محطات الديزل الصناعية.

- دراسة حالة تطبيقية من خلال برنامج معامل افتراضية تفاعلي للتحكم الأوتوماتيكي وتشغيل وإدارة كافة أجزاء محطة صناعية لتوليد القوى باستخدام محرك ديزل تعمل على الدورة رباعية-المشوار 4-strook engine وتتضمن عدد ستة سلندرات على نفس عمود الإدارة وتستخدم نظام شحن الهواء التوربيني air turbo-charger للإستفادة من غازات العادم ونظام تبريد مائي للسلندرات وكذا لزيت المحرك.

- يتضمن المقرر تحليل كافة نظم القياس والتحكم الأوتوماتيكي في البرنامج لمعرفة وظائفها وتفاصيل عملها وماهية مخرجاتها.

- تحليل كافة عمليات الديناميكا الحرارية وميكانيكا الموائع وانتقال الحرارة المستخدمة في جميع أجزاء المحطة (الموضحة في البرنامج).

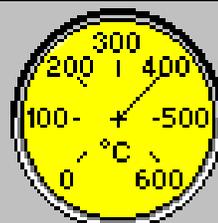
- التدريب على ممارسة ما يتم من تطبيق للقوانين المختلفة والحسابات المعقدة في عمليات التحكم الفعلية لمحطات محركات الديزل الصناعية للوصول للنتائج المنتظرة من عملية التحكم. كما يهدف المقرر كذلك إلى التأكد من مصداقية هذه البرامج وعمل معايرة علمية لمخرجاتها من خلال التحقق من القوانين والحسابات الداخلية التي تتم في هذه البرامج وإجراء عمليات مقارنة بينها وبين الحسابات التقليدية الموازية للوصول لنفس المخرجات والنتائج العملية مثل رسم وتوقيع كافة ظروف التشغيل on-line على خرائط h-s diagram عند كافة مراحل التكيف وكذلك عمل خرائط الإتزان الحرارى وتحديد القدرة وكفاءة المحطة عند ظروف التشغيل وكافة الاحمال المختلفة.

What do we have in the Industrial Diesel Engine Drive Plant ?

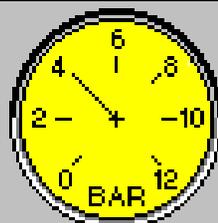
Course Contents: Interactive Automatic Control System for Industrial 6-cylinder, turbo-charger, 4 stroke Diesel engine drive with thermal balance calculations. This is an interactive computer-based training course that includes an investigation, a virtual computer simulation and flow visualization. The course is designed to give the participant a broad based understanding of the most important concepts of practical automatic control and real thermo-fluid processes existing in Industrial 6-cylinder, turbo-charger, 4-stroke Diesel engine drive. The engine follows the actual indicated compression ignition Diesel Cycle diagram. The thermal balance of this mechanical Power system is also performed and presented for each working engine condition. The engine utilizes the hot-exhaust gases to drive a compressor turbo-charger unit to pre-charge and increase the pressure of fresh air into the cycle. This unit has an air-cooler and two sea water pumps. The 6-cylinders are jacket-water cooled using a fresh water tank and two-fresh water pumps. Fuel is pumped to the injectors using two-fuel pumps. The lube oil unit is driven by two lube oil pumps & a lube oil cooler through one of the two sea-water heat exchangers. The second sea-water heat exchanger is used to cool the fresh water used in the engine cooling circuit. Automatic control system includes both of the engine conductions section and auxiliary management section. The simulation includes many critical control alarms, input/output signals, operation and instrumentation parameter-boards, diagnostic page tools, error-report filling, help/trouble-shooting menus , Thermal Balance Calculations and Plotting tools.

THW-8 Simulation of an Industrial Diesel Engine Plant with thermal balance calculating

EXHAUST GAS



LUBE OIL



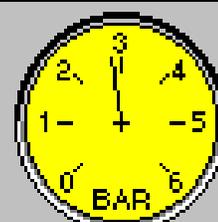
CYLINDERS-BLOWER

1	2	3	4
5	6	T	

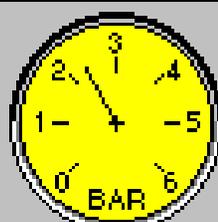
OIL PUMPS

1	OFF	ON
2	OFF	ON

FRESH WATER



SEA WATER



FRESH WATER PUMPS

1	OFF	ON
2	OFF	ON

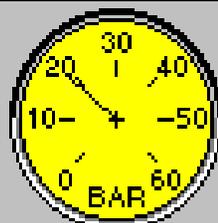
SEA WATER PUMPS

1	OFF	ON
2	OFF	ON

FUEL



STARTING AIR

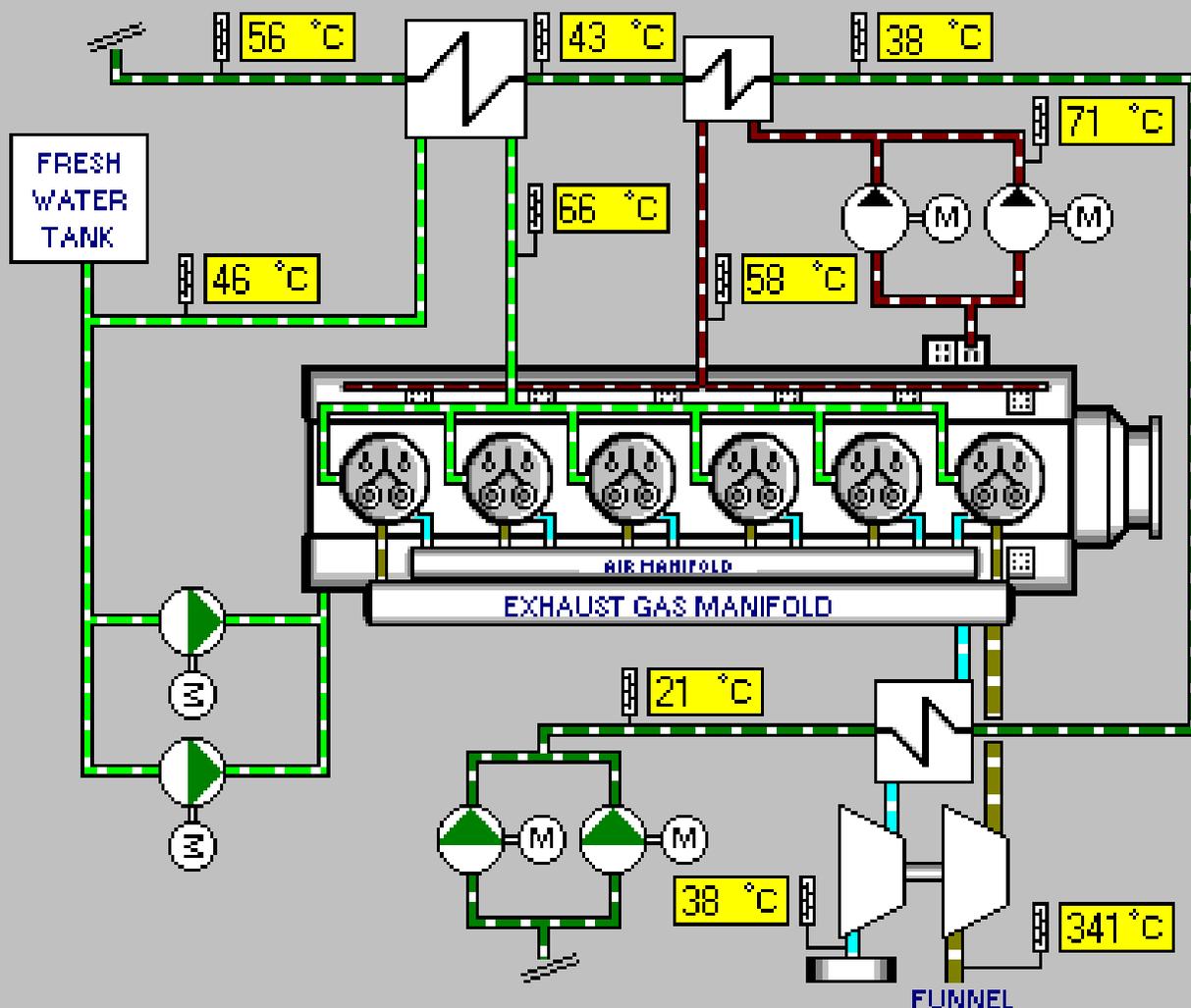


FUEL PUMPS

1	OFF	ON
2	OFF	ON

COMPRESSORS

1	OFF	ON
2	OFF	ON

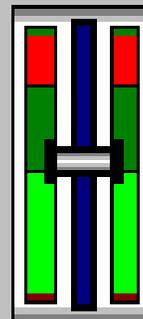
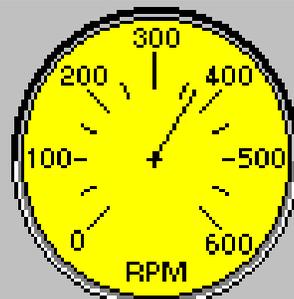


STARTED ENGINE

STOP FOR ALARM

START

STOP



FAILED STARTING

EXCLUDE SHUTDOWNS

MUTING ALARM

SHUTDOWN ON STAND BY	LOW PRESSURE SEA WATER
BARRING ENGINE ENGAGED	LOW PRESSURE STARTING AIR
LOW PRESSURE FRESH WATER	LOW PRESSURE FUEL
LOW PRESSURE LUBE OIL	HIGH TEMPERATURE TURBOBLOWER

Course Specifications & Basic Information

1. Title:	Using Virtual Lab Applications for Control of Industrial Diesel Engine Drive Plant			Code:MEP572
2. Credit hrs per week	Lectures= 3 hours per week	Tutorial= 0.0	Practical= 0.0	Total=3 Cr.Hrs

B- Professional Information

1. Course description: Overall Aims:

This is an interactive computer-based training course that includes an investigation, a virtual computer simulation and flow visualization. The course is designed to give the participant a broad based understanding of the most important concepts of practical automatic control and real thermo-fluid processes existing in Industrial 6-cylinder, turbo-charger, 4-stroke Diesel engine drive. The engine follows the actual indicated compression ignition Diesel Cycle diagram. The thermal balance of this mechanical Power system is also performed and presented for each working engine condition. The engine utilizes the hot-exhaust gases to drive a compressor turbo-charger unit to pre-charge and increase the pressure of fresh air into the cycle. This unit has an air-cooler and two sea water pumps. The 6-cylinders are jacket-water cooled using a fresh water tank and two-fresh water pumps. Fuel is pumped to the injectors using two-fuel pumps. The lube oil unit is driven by two lube oil pumps & a lube oil cooler through one of the two sea-water heat exchangers. The second sea-water heat exchanger is used to cool the fresh water used in the engine cooling circuit. Automatic control system includes both of the engine conduction section and auxiliary management section. The simulation includes many critical control alarms, input/output signals, operation and instrumentation parameter-boards, diagnostic page tools, error-report filling, help/trouble-shooting menus, Thermal Balance Calculations and Plotting tools.

2. Intended Learning Outcomes of Course (ILOs):

a) Knowledge and Understanding:

- Having successfully completed this course, the post-graduate student should have knowledge and understanding of:
- Theories, Information, sciences and specialized technologies in the fields of automatic control of mechanical power equipments and systems of Industrial Diesel Engine Drive Plant .
 - Moral, legal essentials and quality control principals related to the graduate's professional practices in the automatic control fields.
 - Various effects of engineering professional practices of Industrial Diesel Engine Drive Plant on different components of the environment.
 - Methods used for emission/pollution control and energy rationalization and maximization of the benefits of Industrial Diesel Engine Drive Plant .

b) Intellectual Skills:

Having successfully completed this course, the student should have the ability to do:

- Identify scientific & practical problems related to auto. control of Industrial Diesel Engine Drive Plant .
- Analyze & propose professional, technical solutions and algorithms for automatic control problems.
- Analytical reading of research & report topics related to control of Industrial Diesel Engine Drive Plant
- Evaluate and estimate various risks involved in professional practices related to of Industrial Diesel Engine Drive Plant .
- Take effective actions and professional decisions in accordance with and/or based on available data and technical information.

c) Professional and Practical Skills:

Having successfully completed this course, the student should have the ability to do:

Apply professional and practical skills in the fields of automatic control of Industrial Diesel Engine Drive Plant .

Execute short term project and write engineering technical report that involves graphs, charts, and diagrams.

Perform professional presentation and suggest possible alternative solutions for automatic control problems of Industrial Diesel Engine Drive Plant .

Write technical requirements & selecting engineering reference standards for Industrial Diesel Engine Drive Plant .

d) General and Transferable Skills:

Having successfully completed this course, the student should have the ability to do:

- Perform engineering calculations, draw feed-back control circuits, block diagrams, graphical presentation of experimental data, and perform data-regression analysis.
- Transfer knowledge, Work in group, & Communicate in written & oral forms, in English.
- Use IT& evolutionary technological tools& PC applications (Excel, Mat lab, Virtual labs, .etc).
- Prepare & write reports, Manipulate & sort data, Think logically, and continuous self-E-learning.
- Identify practical problems, compare between different technologies for measurement systems.
- Organise & manage time & resources effectively; for short-term and longer-term commitments.