

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

شماره ویرایش: ۰۱

تاریخ صدور: ۸۶/۱۲/۲۰

صفحه: ۱ از ۱۱۲

وزارت راه و ترابری

سازمان بنادر و کشتیرانی

دستورالعمل اجرایی برگزاری دوره های آموزشی و آزمونهای شایستگی دریانوردی

(رشته موتور)

کنترل مدرک

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امضاء	سمت رئیس اداره استانداردهای دریانوردان	نام و نام خانوادگی نصرت اله علی پور	تهیه کننده مدرک
امضاء	سمت سرپرست اداره کل استانداردها، آموزش و گواهینامه های دریانوردی	نام و نام خانوادگی مرتضی آسیابان پور	تأیید کننده مدرک
امضاء	سمت سرپرست معاونت امور دریایی	نام و نام خانوادگی محمد نجفی	تصویب کننده مدرک

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ماده ۳- شرایط حاکم بر جلسات آزمون

۳-۱- رعایت نکات زیر در جلسات آزمونهای کتبی و شفاهی / عملی الزامی بوده و با متخلف یا متخلفین طبق مقررات مندرج عمل خواهد شد:

۳-۱-۱- داوطلب می‌بایست در تاریخ و ساعات مقرر که بوسیله سازمان از قبل تعیین می‌گردد در جلسه آزمون حاضر گردد. تأخیر به هر دلیل در حضور در صورتیکه آزمون شروع شده باشد باعث محرومیت داوطلب از آن آزمون خواهد بود.

۳-۱-۲- ورود اشخاص غیرمجاز به جلسات آزمون ممنوع می‌باشد.

۳-۱-۳- رعایت سکوت در جلسه آزمون الزامی است.

۳-۱-۴- آوردن کتب، جزوات، و یادداشتهای غیر مجاز به هر نحوی در جلسه آزمون ممنوع بوده و در صورت انجام این عمل بوسیله داوطلب، بمنزله مردودی در همان آزمون تلقی خواهد شد.

۳-۱-۵- هیچ داوطلبی بدون اجازه وبدون تسلیم کلیه اوراق امتحانی حق ترک آزمون را نخواهد داشت. انجام این عمل بمنزله مردودی در همان آزمون، تلقی خواهد شد.

۳-۱-۶- هر گونه تبادل اطلاعات در جلسه آزمون بمنزله مردودی در همان آزمون تلقی خواهد شد.

۳-۲- همراه داشتن دفترچه کار آموزشی "RECORD BOOK" و شناسنامه دریانوردی جهت شرکت در آزمون شفاهی/عملی الزامی می‌باشد.

۳-۳- در جلسه آزمون شفاهی/عملی اگر ممتحن قانع گردد که داوطلب دارای ضعف در موضوعاتی است که ایمنی کشتی، بار و مسافر یا محیط زیست را به مخاطره جدی می‌اندازد و رفع آن نیازمند خدمت دریایی بیشتری می‌باشد، می‌تواند داوطلب را ملزم به گذراندن حداکثر شش ماه خدمت دریایی قبل از شرکت در آزمون مجدد نماید.

۳-۴- هر گونه تخلف از قوانین و مقررات جاری سازمان از طرف داوطلبان می‌تواند به مدت حداکثر ۶ ماه با نظر کمیته تخصصی موتور و تأیید کمیته عالی باعث محرومیت در شرکت آزمون گردد.

۳-۵- آوردن هرگونه وسایل الکترونیکی مانند موبایل، ماشین حسابهای قابل برنامه ریزی، پیجر و دیگر وسایل مشابه به جلسه آزمون ممنوع می‌باشد.

ماده ۴- مدرسین و ممتحنین دوره‌های آموزشی

مدرسین و ممتحنین دوره‌های آموزشی مندرج در این دستورالعمل می‌بایست علاوه بر گذراندن دوره مدرسی مورد تأیید سازمان دارای حداقل مدارک و تجارب مشروحه ذیل باشند:

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به اصلاحیه موجود در سایت مراجعه شود

۲- کارگاه مکانیک

2- Mechanical workshop (materials and equipment)

- ❖ Work benches fitted with vices, tool storage lockers and cabinets.
- ❖ Portable power tools such as drilling machines, small bench or pedestal grinder etc.
- ❖ Measuring equipment : external and internal venires, inside and outside calipers, standard and adjustable micrometers, (mechanical or electronic) depth gauges, internal micrometers, depth and dial micrometers.
- ❖ Hand tools : chisels, center punches, hacksaws, scrapers, drills, reamers, hammers, taps and dies, die, nuts, spanners and wrenches, files.
- ❖ A marking-out table.
- ❖ Scribers, scribing blocks, try-square, trammels, protector, dividers, odd-leg calipers, straight-edge, bevel gauge.
- ❖ Vee blocks, leveling devices.
- ❖ Power tools: one pedestal or pillar drilling machine; one radial drilling machine.
- ❖ One pedestal or pillar drilling machine; one radial drilling machine.
- ❖ One forge for heat treatment.
- ❖ Bending rolls for sheet metal.
- ❖ Bending machine for small-diameter pipes.
- ❖ Oxyacetylene welding and cutting equipment.
- ❖ Electric arc-welding equipment.
- ❖ Steel-welding benches.
- ❖ Soldering equipment.
- ❖ Brazing equipment.
- ❖ Protective clothing, including aprons, gloves and masks.
- ❖ Welding boots.
- ❖ Fume extraction / ventilation.
- ❖ Gas storage.
- ❖ Welding electrodes for mild steel.
- ❖ Filler rods for mild steel.
- ❖ Mild steel plate up to 10 mm thick.
- ❖ Various steel bars, angles and sections.
- ❖ Shaping machine with machine vice.
- ❖ Metal-turning lathes: for every five trainees.
Three-and four-jaw chucks for the above machine

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Face-plates for the above machines

Drills, arboring tools, etc. For use in lathes

Tool holders for lathes and shaping machines

Protective equipment

Several of lathe tools : straight parting tool, round nose, finishing, cranked and boring tools,

- ❖ A horizontal, vertical or universal milling machines.
 - ❖ A range of cutting tools and arborts.
 - ❖ Work-securing vice and devices.
- A simple dividing head.

۳- کارگاه و آزمایشگاه برق و الکترونیک و ابزار آلات دقیق

3- Electrical Engineering laboratory / workshop (materials and equipment)

- ❖ Apparatus to demonstrate static electricity, examples of electrical diagrams (i.e,block system, circuit and wiring diagrams) ; ammeters, voltmeters, powermeteres , wiring connectors , resistors , electrical source , a selection of marine cables , equipment and cable runs for testing purpose , insulation testers , continuity testers, digital and analogue multi-meters, thermistors, diodes, a clampmeter , live-line tester , lead-acid and alkaline batteries , a charging circuit distilled water , hydrometer , magnets , iron filings solenoid iron-cored solenoid, induction coil, model A.C and D.C generators used A.C and D.C generators and motor, motor starters, switches, circuit breakers, fuses, a sectioned transformer, and earth lamp model system , equipment suitable for use in oil, gas and chemical takers.

Over currents, reverse-power and undervoltage-protection relays, high-rupturing-capacity fuses and housings, preferential trips, instrument and relay transformers, a main switch board, an emergency switch board, an operational three-phase terminal box, automatic voltage regulation, induction motors with direct on-line and star-delta starters, speed controllers, a selection of lighting equipment, a model navigation light system, water tight fittings. Examples of the : drip proof , totally enclosed water tight and flame-proof winch, crane and windlass motors and their controllers.

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۲- کارگاه و آزمایشگاه برق و الکترونیک

2) Electrical and electric workshop.

A .C and D.C electrical supplies, ammeters and voltmeters with appropriate shunts, etc. To extend their range; instruments incorporating the wheatstone bridge, potentiometers, multiunit indicators and recorders, thermocouples, ohmmeters, insulation and continuity testers, MultiMeter's , oscilloscopes , a selection of insulating materials , a D.C generator , a selection of open-front and dead-front switchboards, reverse-current trips, preferential trips, instruments or trips fitted with dashpots, a selection of resistors, of inductors and of capacitors, a synchronous A .C generator , induction motors , an A .C switchboard , an A .C. circuit breaker, ammeter and voltmeter transformers , a selection of semiconductors (to include diodes , transistors , thyristors , rectifiers , etc.), connector blocks , connecting wire , switches, circuit boards , commercially produced training kits , A .C. motor starters and a speed controller , a shore supply connection box , a selection of cables , examples of watertight, hoseproof , waterproof deck watertight and submersible motors, a selection of D.C . Motors, starters and a charging system , samples of equipment for witch the safety levels are flameproof , increased safety , intrinsically sage and pressurized ; a model on which to practice resuscitation.

۳- کارگاه و آزمایشگاه ابزار آلات دقیق

3) Instrumentation work shop

Thermometers / pyrometers :

Mercury in steel , vapor-pressure , gas-filled , bimetallic , resistance , thermistor-type, thermocouple.

Manometers :

Wide-cistern, inclined-tube , mercury.

Pressure gauges:

Bourbon, diaphragm , Schaffer , differential-twin bellows , strain gauge pressure-gauge testing equipment .

Level-measuring devices :

Float, probe element , displacement , chamber , pneumericator gauge.

Flow measurement :

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Rotormeter , rotormeter.

General: mechanical tachometer, viscometer , a detector using a photoelectric cell, i.e.

- ❖ For oil in water.
- ❖ For smoke density.
- ❖ For oil mist.
- ❖ For flame.

A selection of fire detectors, explosive-gas detector, oxygen analyzer, CO2 analyzer, relative humidity meter, sectioned pneumatic transducer with negative feedback, pneumatic receiver integrator.

Valves :

Diaphragm-operated control valve with motor, correcting element and positions, miter valve, vee-ported valve, piston actuator, butterfly valve, wax-element control valve.

Controllers:

Working models to demonstrate the production of :

- ❖ Proportional control.
- ❖ Integral action.
- ❖ Derivative action.

۶-۷- امکانات آزمایشگاهی و کارگاهی زیر در طول دوران آموزش افسران مهندس سوم $KW < 3000$

می‌بایستی در اختیار کار آموزان قرار بگیرد:

- کلاس درس مناسب جهت برگزاری آموزشهای نظری با امکانات دیداری و شنیداری.
- محل برگزاری آموزشهای عملی با امکانات مناسب جهت برگزاری تمرینات عملی.
- ابزار دستی مناسب و قابل حمل مانند قلمها ، اره های آهن بر ، چکشها ، حدیده ، سوهانها و اسکنه ها ، پتکها.
- وسایل اندازه گیری و کنترل کننده های فشار ، جریان دما (مانند بی متال ، منومتر ، مانومتر U شکل) ، عمق سنج الکتریکی ، مولتی متر دیجیتالی ، کلمپ متر ، اهم متر ، ولت متر ، ترک متر.
- انواع الکترودهای جوشکاری.
- انواع گازهای جوشکاری.
- انواع پیچ و مهره و سیستم دنده آنها (برای اتصال قطعات فلزی) ، وسایل قفل کننده پیچ و مهره و انواع واشرها) و اشراهای لاستیکی و ...
- انواع پرچها.

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- ماکت موتورهای چهارزمانه.
- قطعات اصلی موتورهای دیزل دریایی.
- نقشه های ماشین آلات (قسمتهای مختلف موتور دیزلی) و کتابچه راهنمای انگلیسی عیب یابی.
- انواع پمپهای مورد استفاده در شناور (پمپ دنده ای، پمپ روفنده (روتوری)، پمپهای جارویی، پمپهای محوری، پمپهای مانند سانتریفیوژ، پمپ آتش نشانی ترانسفر سوخت، غلیظ کش دستی.
- انواع شیرها (شیرهای دروازه ای، سماوری، بشقابی یکطرفه، کنترل فشار و...).
- کمپرسور هوا (تک مرحله ای و دو مرحله ای).
- انواع باتریها (اسیدی، قلیای و دستگاه شارژ باتریها).
- تابلو کنترل برق.
- انواع فیوزها.
- روغن و گریس و انواع فیلتر.
- وسایل حفاظتی (لباس کار، عینک ایمنی، دستکش، کفش ایمنی و...).
- فیلمهای آموزشی مرتبط با دوره.
- آزمایشگاه زبان برای برقراری تمرین زبان تخصصی.

۸-۶- امکانات آزمایشگاهی و کارگاهی زیر در طول دوران آموزش افسران مهندس دوم $KW < 3000$

می بایستی در اختیار کارآموزان قرار بگیرد:

- کلاس درس مناسب جهت برگزاری آموزشهای نظری با امکانات دیداری و شنیداری.
- محل برگزاری آموزشهای عملی با امکانات مناسب جهت برگزاری تمرینات عملی (کارگاهی).
- انواع پیچ و مهره با گام دنده های اینچی و میلیمتری در اندازه های مختلف، انواع واشرها برای اتصال فلزی و ...
- انواع آچار تخت، رینگ، بوکس، تورک متر قابل استفاده برای موتورهای دیزل دریایی.
- دستگاه برش و قیچی ورق بر نوع دستی و ثابت.
- انواع دماسنج، فشارسنج ها، مانومترها و سوخت نما، تاکتومتر.
- ابزار کار برقی شامل: دم باریک، انبردست، فازمتر، سیم لخت کن، اهم متر، تستر، مولتی متر دیجیتالی، یک نوع گلوآنومتر ساده برای استفاده آموزشی، چند نوع PN (دیود) و چند نوع ترانزیستور با پایه ها و اندازه گیری های مختلف و میگر.

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

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- انواع عایق‌های برودتی و حرارتی و انواع عایق‌های الکتریکی (شیشه ای و الیاف شیشه ای).
- چند نوع الکترو موتور تک فاز که دارای پلاک مشخصات باشند و چند نوع الکترو موتور سه فاز که دارای پلاک و مشخصات باشند .
- سیم روپوش دار در اندازه های گوناگون از نظر سطح مقطع.
- انواع کلیدهای دستی (اهرمی ، غلتکی زبانه ای - سلکتور سویچ، کلید فیوزهای مینیاتوری ، کلیدهای اتوماتیک ، کلید های محدود کننده ، (لمیت سویچ و انواع آن) کلیدهای تابع فشار کلیدها شناور (لول سویچها) کلیدهای استاپ و استارت فیوزها ، اورلودها تر موكوپلها ، تایمرها (دیجیتالی ، الکترومکانیکی و الکترونیکی ، هیدرولیکی ، بی متال و نیوماتیکی).
- انواع مختلف کابلها (یک رشته ای ، چند رشته ای ، فشار ضعیف و فشار قوی کواکسیال ، کابل نوری که دارای مشخصات مربوطه باشند) و کابل‌های جوشکاری.
- باتری از نوع Lead ، Acid و ...
- چند نوع ترانسفورماتور تک فاز و سه فاز ، یک سوسازها ، دیزل ژنراتور ، چند نوع کلید قطع کننده مدار (Circuit Braker).
- انواع روغن از نظر ویسکوزیته ، انواع گریس از نظر نوع و کاربرد.
- دو نوع موتور دیزل دریایی (دوزمانه ، چهار زمانه) - قطعات موتور دیزل (پیستون ، رینگ ، یاتاقان ، دسته شاتوق، سوپاپ ، میل سوپاپ ، انژکتور ، پمپ انژکتور ، پمپ سه گوش ، سرسیلندر ، تریوشارژر و ...).
- کندانسور ، اینترکولر ، کمپرسور هوای دو مرحله ای به بالا ، چند نوع فیلتر هوا ، چند نوع فیلتر روغن چند نوع فیلتر گازوئیل واسترینر.
- انواع اتصالات لوله کشی ، چند نوع اتصال قابل انعطاف .
- انواع پمپها (رفت و برگشتی ، گریز از مرکز ، پروانه محوری ، مارپیچ ، دنده ای) - انواع پروانه (چدن ، آلومینیم ، برنز ، لاستیک و ...).
- سیستم سکان و اجزاء آن (هیدرولیکی ، الکتریکی و مکانیکی).
- کمپرسور تبرید و سیستم های کنترلی آن کندانسور ، اپراتور و ...
- ماشین تراش موتور جوش ، دستگاه جوش استیلن ، انواع الکتروود جوش برقی و جوش استیلن وسایل ایمنی لازم برای افرادی که انواع جوش را انجام می دهند .

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

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۹-۶- امکانات آزمایشگاهی و کارگاهی زیر در طول دوران آموزش ملوان موتور $KW > 750$ می‌بایستی در

اختیار کار آموزان قرار بگیرد:

- ابزار دستی مناسب و قابل حمل مانند چکشها، پتکها، قلمها، اره های آهن بر، حدیده، سوهانها و اسکنه ها.
- وسایل اندازه گیری و ابزار دقیق مانند گونیاها، پرگارها، کولیسها، میکرومترها، سطح صاف و سوزن خط کش.
- انواع مته ها، سمبه نشانها (۶۰ و ۹۰)، گیره ها.
- انواع الکتروودها.
- انواع پیچ و مهره و سیستم دنده آنها (برای اتصال قطعات فلزی)، وسایل قفل کننده پیچ و مهره و انواع واشرها) واشرهای لاستیکی و ...
- انواع پرچها.
- قطعات اصلی موتورهای دیزل دریایی.
- نقشه های ماشین آلات.
- انواع پمپهای مورد استفاده در شناور (پمپ های حریق، ترانسفر سوخت، غلیظ کش دستی و ...).
- انواع شیرها (شیرهای دروازه ای، سماوری، بشقابی یکطرفه، کنترل فشار و ...).
- انواع باطریها (باطریهای سری، اسیدی، قلیای، اسکالاین) شارژ کننده باطری.
- انواع روغن و گریس، فیلتر.
- وسایل حفاظتی (دستکش، عینک ایمنی، کفش ایمنی، لباس و ...).
- فیلمهای آموزشی مرتبط با دوره.

۱۰-۶- امکانات آزمایشگاهی و کارگاهی زیر در طول دوران آموزش کاربر موتور $KW < 750$ می‌بایستی

در اختیار کار آموزان قرار بگیرد:

- ابزار دستی مناسب و قابل حمل مانند چکشها، پتکها، قلمها، اره های آهن بر، حدیده، سوهانها و اسکنه ها.
- وسایل اندازه گیری و ابزار دقیق مانند گونیاها، پرگارها، کولیسها، میکرومترها، سطح صاف و سوزن خط کش.
- انواع مته ها، سمبه نشانها (۶۰ و ۹۰)، گیره ها.
- مولتی متر دیجیتال، آنالوگ، کلمپ کتر، اهم متر، ولت متر، ترک متر.
- انواع الکتروودها.

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

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- انواع پیچ و مهره و سیستم دنده آنها (برای اتصال قطعات فلزی)، وسایل قفل کننده پیچ و مهره و انواع واشرها و واشرهای لاستیکی و ...
- انواع پرچها.
- ماکت موتورهای چهارزمانه.
- موتور دیزل دریایی.
- قطعات اصلی موتورهای دیزل دریایی.
- نقشه های ماشین آلات .
- انواع پمپهای مورد استفاده در شناور (پمپ های حریق ، ترانسفر سوخت ، غلیظ کش دستی و ...).
- انواع شیرها (شیرهای دروازه ای ، سماوری ، بشقابی یکطرفه ، کنترل فشار و...).
- کمپرسور هوا (تک مرحله ای و دو مرحله ای) .
- انواع باطریها (باطریهای سری ، اسیدی ، قلیای ، اسکالاین) شارژ کننده باطری.
- تابلو کنترل برق .
- انواع فیوزها .
- انواع روغن و گریس ، فیلتر .
- وسایل حفاظتی (دستکش ، عینک ایمنی ، کفش ایمنی، لباس و ...).
- فیلمهای آموزشی مرتبط با دوره .

ماده ۷- شرایط تأیید دوره به دستورالعمل نظارت بر مراکز آموزشی ارجاع می گردد

ماده ۸- آزمونهای شایستگی

- ۸-۱- تعداد و نوع آزمونهای هر درجه و همچنین نصاب قبولی هر آزمون به شرح جداول مندرج در این دستورالعمل می باشد.
- ۸-۲- شرایط قبولی در آزمونهای شایستگی:
 - ۱- اخذ حد نصاب قبولی هر آزمون به منزله قبولی در آن آزمون می باشد.
 - ۲- عدم کسب حد نصاب قبولی در آزمونهای کتبی به منزله تجدیدی در آزمون مربوطه می باشد.

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

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به اصلاحیه موجود در سایت مراجعه شود

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

شماره ویرایش: ۰۱

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صفحه: ۲۰ از ۱۱۲

صفحات ۲۰ الی ۲۶ به جداول موجود در سایت مراجعه شود

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

شماره ویرایش: ۰۱

تاریخ صدور: ۸۶/۱۲/۲۰

صفحه: ۲۱ از ۱۱۲

صفحات ۲۰ الی ۲۶ به جداول موجود در سایت مراجعه شود

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

شماره ویرایش: ۰۱

تاریخ صدور: ۸۶/۱۲/۲۰

صفحه: ۲۲ از ۱۱۲

صفحات ۲۰ الی ۲۶ به جداول موجود در سایت مراجعه شود

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

شماره ویرایش: ۰۱

تاریخ صدور: ۸۶/۱۲/۲۰

صفحه: ۲۳ از ۱۱۲

صفحات ۲۰ الی ۲۶ به جداول موجود در سایت مراجعه شود

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

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شماره ویرایش: ۰۱

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صفحه: ۲۴ از ۱۱۲

صفحات ۲۰ الی ۲۶ به جداول موجود در سایت مراجعه شود

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

کد بخش: EC-02

شماره ویرایش: ۰۱

تاریخ صدور: ۸۶/۱۲/۲۰

صفحه: ۲۵ از ۱۱۲

صفحات ۲۰ الی ۲۶ به جداول موجود در سایت مراجعه شود

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

عنوان مدرک: دستورالعمل مصوب

کد مدرک: EC

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صفحات ۲۰ الی ۲۶ به جداول موجود در سایت مراجعه شود

ماده ۹- موضوعات درسی

۹-۱ مواد درسی دوره افسر مهندسی سوم در کشتی های با قدرت موتور ۷۵۰ کیلووات یا بیشتر - سفرهای نامحدود

FUNCTION 1: MARINE ENGINEERING AT OPERATIONAL LEVEL

Competence 1.1: Use appropriate tools for fabrication and repair operation typically performed on ships

1.1.1. Materials for construction and repair

1.1.1.1. Properties and uses

Knowledge of: Choice of materials for marine engineering components, mechanical properties of a material and their definition, uses and principle mechanical properties of low, medium and high carbon steel, properties and uses of cast iron, meaning of alloys, uses and components metals of brass, bronze and with metal, normal range of carbon content in mild steel, cast steel, and cast iron; ferrous and non, ferrous basic difference, purpose of alloying elements and nickel chromium and molybdenum in steels used in marine engineering.

1.1.1.2. Process

Knowledge of: Various characteristics of metals such as ductility, tensile stress, brittleness, vibration, differentiation between ferrous and non-ferrous metals, and their etc (only a simple comparison of those metals commonly used in workshop fabrication and repairs.

1.1.2. Process for fabrication and repair

1.1.2.1. Basic metallurgy, metal and processes

Knowledge of: Basic heat treatment process, i.e. tempering, annealing, normalizing and hardening and their objective, heat treatment processes for common carbon steels and properties obtained in each case; basic principle of modern processes for production of steel from pig iron.

Proficiency in: Identify samples of various metals, carrying out four basic heat treatment, testing a hardened and tempered cutting edge safely.

1.1.2.2. Non-metallic materials

Familiarization With: Polymers and other non-metallic materials in commonly used and their applications in marine plants, Properties and reaction of various plastic bonds.

1.1.2.3. Materials under load

Knowledge of: Definition & types of stress, strain in a material, types of loading on a material, definition of tensile, compressive and shear forces, behavior of material under tensile, compressive and shear forces, definition of elastic limit, yield point, ultimate strength, breaking strength, as applied to an elastic material, definition and application of hook's law.

1.1.2.4. Vibration

Knowledge of: Vibration, causes of vibration with regard to unbalanced rotational and reciprocating forces, main sources of vibration on a ship and their effects, critical range of speed, methods of reducing and importance of eliminating vibration, transmission of vibration, anti-vibration materials.

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

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1.1.3.Fabrication and repair

1.1.3.1.Permanent joints

Knowledge of: Ways of making permanent joints, Riveting, Soldering, Welding, the principle of common forms of riveted joints and range of rivets commonly used, the basic principle of soldering, basic types of soldering and their applications, the main hazards of and precautions necessary when soldering, self secured joints.

Proficiency in: Making riveted joints; making soft and hard soldered joints, making self secured joints.

Knowledge of: Types of threaded fasteners, use of black and bright nuts and bolts and set screws, factors for identify nuts and bolts, use of studs, positive locking device and friction locking.

Proficiency in: Identifying the different bolt or screw, fitting studs and bolts using correct tightening procedure, removing intact and broken studs and split nuts, protecting finished surfaces.

1.1.3.2.Welding

Knowledge of: Principles of electric arc welding, suitability of low, medium and high carbon steels, A.C and D.C welding and voltages used, electrodes classifications and purpose of electrode covering, correct storage of electrode, tools commonly used when welding. Welded joints in Low-Carbon steel, Common Faults in Welded Joints. Principles of thermal cutting, application of flame and plasma- arc cutting, basic principle of metalarc gas-shielded and tungsten inert gas welding, (TIG and MIG) inert gas welding; familiarization with under water welding.

Knowledge of: Gas welding, low pressure and high pressure systems, proportions of oxygen and acetylene to produce various flame, dangers of handling acetylene gas and method of its storage, safety fittings for an acetylene gas cylinder, safety features of a gas pressure gauge, principle parts of light pressure blow pipe and care necessary for blow pipe nozzles and hoses, purpose of flash back arrestors, purpose of the cylinder manifold system, recognition of different gases using color codes, left hand and right hand gas welding techniques and their respective limitations and advantages, principle of cutting ferrous metals using oxy-acetylene equipment.

Proficiency in: Preparing plate edges for welding, using correct techniques to make welded butt and fillet joints using electric arc gas welding technique, carry out destructive tests on welded joints, Condition necessary in order to cut when using an oxygen fuel gas mixtures, list of gases commonly used as fuel, factors effecting the quality of cutting, basic principle of plasma-arc cutting. using correct techniques for testing welded joints.

Proficiency in: Thermal Cutting, using an oxygen-fuel gas cutting torch to cut straight and curves in mild steel plate up to 10 mm thick and to crop mild steel sections.

Proficiency in: Observing Safety and Health when Welding, protective clothing witch should be worn when welding at a bench or in difficult situation/ odd positions, measures necessary to protect other personnel when welding, dangers and effect of radiation from welding and fume on human and means of dealing with it, precautions necessary when handling and storing compressed gas cylinders of oxygen and acetylene, safety measures when using welding and cutting equipments in a enclosed spaces.

Proficiency in: Inspection and testing, as an important part of welding and fabrication process including pipe work.

اداره کل استانداردها، آموزش و گواهینامه‌های دریانوردی

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1.1.3.3.Mechanical Cutting

Knowledge of: Basic principles of mechanical cutting; basic sheet metal operations. Maximum thickness of mild steel plate that can be cut.

Proficiency in: Mechanical Cutting, using hand or foot operated machine and small hand-held power tools to cut steel sheet by mechanical means (shears).

1.1.3.4.Forming

Knowledge of: Basic principles of the method of plate forming; maximum thickness of mild steel which can be bent using hand operated machine; meaning of development of a sheet-metal component; lists of equipment required to bend thin sheet plate; dangers encountered in sheet-metal work and the precautions to be taken; principle of the method of pipe bending and factors governing the process and safety precautions needed.

Proficiency in: Estimating the length of plate including bending allowance when plate forming, design and construct simple containers from thin plate; bend pipes using cold and hot techniques; checking bend pipes for ovality, thinning and other defects; anneal, normalize and stress relieve pipes as necessary.

Proficiency in: Bending copper tube/ pipes of small diameter; bending of mild steel pipes and familiarity with associated equipments.

1.1.3.5.Bonding

Knowledge of: The care necessary to observe when using adhesives to make bonding; advantage and disadvantages of adhesive bonding, the principles of bending plastics, softening temperature for plastics, the care and safeguards necessary when heating plastics, the basic principle of testing for sheer and peel strength of adhesives, principle of bonding friction lining to steel shoes or discs and smooth surfaces, sources of adhesives, purpose of activator in epoxy resin, significance of pot life, friction of correct adhesive; principle of welding, solved welding, principle of welding Plastics.

Proficiency in: Selecting and using the correct adhesive for a variety of applications and strength testing.

1.1.4.Safe working practices

Safety Knowledge of: Assessment of risks and Hazards inherent to any workshop or machinery space, Responsibility of the employee under the health and safety at work, Dangers associated with unsuitable clothing, loose hair, shoes, jewelry, gloves, and machine guard, Need for use of safety gears such as: safety shoes, overalls, goggles, ear muffs, safety harness, etc... where and when applicable. Safety and health risks which may arise when using adhesives, dangerous substances, chemical, noxious liquid and gas.

Competence 1.2: Use of hand tools and measuring equipment for dismantling, maintenance, repair and re-assembly of shipboard plant and equipment

1.2.1.Use of hand and power tools

1.2.1.1 Marking out process

Knowledge of: Care of a vee blocks, a surface plate, scribes, dividers, odd-leg calipers.

Proficiency in: marking out exercises using a surface plate, vee blocks, scribes, dividers, odd-leg calipers.

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کد مدرک : EC

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1.2.1.2 Hand tools

Knowledge of: Selecting the correct hand Tools, Types of hacksaw, hammer, taps, die, scrapers, chisels and their applications.

Proficiency in: Use and selection of files, hacksaw, hammer, taps, die, scrapers, chisels, safety measure when using hacksaws, files, chisels, hammer taps, die and scrapers. Powered hand tools, advanced workshop practice.

1.2.1.3 Power tools

Knowledge of: Types and the function of Drilling Machine/ milling machine, Knowledge of: component parts and drive system of a drilling machine, operations which can be carried out by different types of drilling machine, features of twist drill, trepanning tools and reamers,. Function of a shaping machine, basic cutting action of a shaping machine, component parts of a shaping machine, selection of appropriate cutting tools for various cutting operations by hand and machine tools, profile of a cutting edge, essential requirements when setting-up a tool and dimensional tolerances, uses of straight knifeedge and oblique cutting tools, difference between grinding and sharpening tools, function and types of cutting fluid.

Proficiency in: Inserting and removing drills with parallel and tapered shanks, sharpening correctly and safety twist drills, clamping and work holding safety, using drilling machines to produce through and blind holes, use of drill selection charters for threads and holes, use of drill selection charts for threads and holes.

Knowledge of: Function of a center lathe, the component parts and drive system of a center lathe, essential movement of a center lathe for various tasks, the purpose and uses of 3 and 4 jaws chucks, carriers, centers and face plate, finding cutting speed for different tasks, using center lathe for thread cutting and taper turning, using center lathe to produce a mild steel bar with good surface finish, cutting threads, taper turning, use of drills, boring tools on a lathe machine to produce holes to a given specifications. Using a shaping machine correctly and safety to produce simple forms to a given specification. Identifying using and maintaining the appropriate cutting tools for various cutting operations by hands and machine tools, using published tables for obtaining the correct cutting speeds. Identifying the component parts of basic milling machine and their functions, care of milling machine arbor, types of milling cutter and their applications, purpose of simple diving head, dangers of excessive overhang of a cutting tool.

Proficiency in: Correct mounting and securing of cutting tools and arbor; estimating speeds for commonly used materials; use of milling machine to produce simple forms to a given specification, Measurement; Safety and care necessary when using a Drilling/ milling machine; Cares necessary when using a shaping machine/ center lathe; Cares necessary when using automatic feed, care necessary when drilling soft materials, care necessary when sharpening twist drills.

1.2.2 Marine engineering drawing and design

1.2.2.1.Types of drawing

Knowledge of: Standard sizes of drawing paper, Pictorial Projection, purpose of general arrangement, component and assembly drawings, user of collective and pictorial drawings, Dimensioning Need for limits and fits, meaning of tolerance, actual size, basic size and normal size, meaning of clearance fit, transition fits and interference fits, the meaning of geometrical

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tolerances learning and related symbols; Application of lines, meaning of 1st and 3rd angle projection and their symbols, use of auxiliary projection.

Proficiency in: Drawing tangents complete first and third angle projections using given examples, draw third angle projection with hidden detail. Development, drawing isometric projection of simple sides, drawing oblique projections of simple solids, drawing development of 90° intersection of circular trunking, a cone, a square pyramid.

1.2.2.2.Screw threads and fasteners

Knowledge of: Common terminology related to screw threads; name of threads which are common on nuts and bolts and pipes; threads used for power transmission and their application, meaning of multiple thread and its use, range of socket, head screw, range of machine screws. Types of threaded fasteners, uses of black and bright nuts and bolts and set screws, factors for identify nuts and bolts, uses of studs, positive locking device and friction locking.

Proficiency in: Identifying left and right hand screw threads, drawing a nut, stud and washer assembly in a tapped hole, identifying the different bolt or screw, fitting studs and bolts using correct tightening procedure, removing intact and broken studs and split nuts, protecting finished surfaces.

1.2.2.3.Locking and retaining devices

Knowledge of: Locking and Retaining Devices, uses of lock washer, spring washer and tab washers, locking by adhesive, pinning and wire, uses of taper pins, parallel pins, and split pins, uses of locking rings, Identifying common rivet heads and the application.

Proficiency in: sketching common riveted joints.

1.2.2.4.Limits and fits

Knowledge of: Limits and Fits especially with regard to interchangeability of spares; Geometrical Tolerancing, Cams and cam profiles, (negative, positive cam); Bearings, Seals, Lubrication of Ball and Roller Bearings,

1.2.2.5.Engineering drawing practice

Knowledge of: Parallel plane and their sections, revolved section, thin/ part/ half sections, hidden details, symbols, PCD, angular dimensions, threads, etc.

Proficiency in: applying all above terms in drawings.

1.2.2.6.Computer applications in shipping

Proficiency in: Running and use of computer applications on board ships; Principles of operation of a computer, hardware configuration; purpose of an operating system; Running and use of application packages.

Competence 1.3: Use of hand tools, electrical and electronic measuring and testing equipment for fault finding, maintenance and repair operations

1.3.1.Theory

Knowledge of: Electron Theory, Diagrams and Symbols, Simple Circuits and Ohm's Law, Series and Parallel Circuits. Work, energy and power, shipboard electrical power supply, conductors, battery (lead acid and alkaline), magnet (natural and artificial), presence of magnetic field around the conductor carrying a current, flux density, magnetic flux, Fleming's right hand rules.

1.3.2.Safety requirements for electrical systems

Knowledge of: Basic Safety, Assessment of risks and Hazards associated with electrical supply and consumers in any workshop or machinery space, methods of protection against electric

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shock, How to respond in an emergency of electrical nature; safeties to be considered in battery room..

Proficiency in: Essential safety precautions when working in electrical equipment, causes of electric shock, range of safe voltage. Dangers associated with electric power (High and low voltage circuits), safety on electricity, correct and safe practice when using a grinding machine, drilling and lathe machine; types of power used in hand tools, processes for which powered hand tools are used, care necessary for the supply cables of powered hand tools. Identify start, stop and emergency stop buttons.

1.3.3. Electrical tests and measuring equipments

1.3.3.1. Instruments

Familiarization with: Ampere meter, volt meter, frequency meter, clamp meter, watt meter, megger, multi tester, oscilloscope, synchronoscope.

Knowledge of: Range of voltages used for testing ships equipment; function and uses of insulation tester, continuity tester, digital and analogue multi meters, clamp meter and a live line tester; method of measurement and safeguards.

Proficiency in: Using correctly and safety an insulation tester and making entries of test readings into a record card, a continuity tester and making entire of test reading into record card, digital and analogue multi meters and checking the meter and a live line tester, ammeters and voltmeters

Competence 1.4: Maintain a safe engineering watch

1.4.1. Duties associated with taking over and accepting a watch

Understanding and Proficiency in: Ensuring the members of the relieving engineering watch are fully capable of performing their duties effectively standing orders and special instructions of the chief engineer officer relating to the operation of the ship's system and machinery; the nature of all work being performed on machinery and systems, the personnel involved and potential hazards; the level and the condition of water or residues in bilge's, ballast tanks, slop tanks, reserve tanks, fresh water tanks, sewage tanks and any special requirements for or disposal of the contents there of; the condition and level of fuel in the reserve tanks, settling tank, day tank and other fuel storage facilities; special requirements relating to sanitary system disposal; condition and mode of operation of the various main and auxiliary systems, including the electrical power distribution system; the condition of monitoring and control console equipment, and which equipment is being operated manually; the condition and mode of operation of automatic boiler controls such as flame safeguard control systems, limit control systems, combustion control systems, fuel supply control systems and other equipment related to the operation of steam boilers; any special modes of operation dictated by equipment failure or adverse ship conditions; the availability and use of fire fighting appliances; the state of completion of engine room log; dead man alarm and when should it be used.

1.4.2. Routine duties undertaken during a watch.

Knowledge of and Proficiency in: The assigned watch keeping duties. Use of appropriate internal communication system; escape routes from machinery spaces; engine room alarm systems and be able to distinguish between the various alarms, with special reference to the fire extinguishing media alarm; the number, location and types of fire fighting equipment and damage control gear in the machinery spaces to be observed; operating the propulsion equipment in response to needs for changes in direction or speed; keeping the main propulsion plant and

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auxiliary system under constant supervision until properly relieved and periodically inspect the machinery and steering gear spaces are made for the purpose of observing and reporting equipment malfunctions or break downs, performing or directing routine adjustment, required upkeep and any other necessary task; take the action necessary to contain the effects of damage resulting from equipment malfunction or failure and take immediate remedial actions to ensure the safety of the ship, cargo operation, the port and its environment when vessel in port.

1.4.3.Maintenance of the machinery space log book and significance of the readings

Taken Understanding and Proficiency in: Co-operating with any engineer in charge of maintenance work during all preventive maintenance, damage control or repairs; isolating and bypassing machinery to be worked on; adjusting the remaining plant to function adequately and safety during the maintenance period, recording in the engine room log book, the equipment worked on and the personnel involved, and safety steps have been taken, for the benefit of relieving officers and for record purposes; testing and putting into service when necessary the repaired machinery or equipment; ensuring any engine room rating who perform maintenance duties are available to assist in the manual operation of machinery in the event of automatic equipment failure; detailed repair maintenance involving repairs to electrical, mechanical, hydraulic, pneumatic or application electronic equipment throughout the ship shall be performed and recorded.

1.4.4.Duties associated with handing over a watch

Knowledge of: The officer in charge of the engineering watch should not hand over the watch to the relieving officer if there is reason to believe that the latter is not capable of carrying out the watch keeping duties effectively, in which case the chief engineer officer to be notified; the state of any special modes of operation dictated by equipment failure to be reported to take over officer; condition and mode of operation of the various main and auxiliary systems including the electrical power distribution system to be reported to take over officer; ensuring that all events related to the main and auxiliary machinery watch have occurred during the watch are suitably recorded.

1.4.5.Safety and emergency procedures

Knowledge of and Proficiency in: Taking action necessary to contain the effects of damage resulting from equipment breakdown, fire flooding rupture, collision, stranding, or other cause; when the engine room put in a stand by condition, the officer in charge of the engineering watch shall ensure that all machinery and equipment which may be used during maneuvering is in a state of immediate readiness and that an adequate reserve of power is available for steering gear and other requirements; direct any other member of the engineering watch to information them of potentially hazardous conditions which may adversely affect the machinery or jeopardize the safety of life or the ship; changing in speed resulting from machinery malfunction or any loss of steam which may imperil the safety of the ship and life at sea, bridge should be immediately notified, in the event of fire and of any impending action in machinery spaces that may cause reduction in the ship's speed, imminent steering failure, stoppage of the ship's propulsion system or any alteration in the generation of electric power or similar threat to safety chief engineer to be notified, when engine damage or a malfunction occurs; Ensuring all machinery involved with the maneuvering of the ship is facing troubles; emergency steering, generator and other auxiliary equipment should be ready for immediate operation; measures to be taken to protect the environment from pollution by the ship and that applicable pollution prevention regulations are

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به اصلاحیه موجود در سایت مراجعه شود

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1.6.1.5. Inertia

Knowledge of: Definition of mass in terms of inertia, relation of mass to weight, inertia force, active and reactive forces, tractive resistance and its components.

Proficiency in: Applying the principles of inertia force to connected bodies, solving simple problems which illustrate the effect of inertia forces.

1.6.1.6. Circular motion

Knowledge of: Forces due to circular motion, derivation of formula " $\omega^2 r = v^2/r$ ", definition of centripetal/ centrifugal forces and related formula, similarities between a conical pendulum and simple engine governor, principles of balancing two forces acting on either side of a pivoted beam, static and dynamic balancing of several masses in one plane, dynamic force on bearings and its variations,

Proficiency in: Sketching the arrangement of a conical pendulum, solving simple problems with regard to varying m , r and rotational speed, solving problems involving three or four masses in one plane, calculation of max. and min. forces on bearings, calculation of balancing three masses rotating in different planes.

1.6.1.7. Periodic Motion

Knowledge of: Simple harmonic motion, variation of velocity and acceleration of piston in a reciprocating engine, deriving the expression " $v = \omega r \sin \theta$ " and " $a = \omega^2 r \cos \theta$ " in simple harmonic motion, definition of periodic time, frequency and amplitude.

Proficiency in: Solving problems which illustrate the principles of above objectives, sketching graphs with regard to velocity and acceleration during one complete cycle, identifying mechanisms where simple harmonic motion is applicable.

1.6.1.8. Dynamics of rotation

Knowledge of: Linear and angular acceleration, accelerating torque and its value in relation to angular acceleration and second moment of mass, radius of gyration.

Proficiency in: Solving practical problems concerning the above objectives with given values to find accelerating/ driving and retarding torque, explaining the effect of bearing friction when accelerating/ retarding a shaft.

1.6.1.9. Work, power and energy

Knowledge of: Definition of work as force \times distance and its unit; Definition of energy (potential, kinetic); Energy and equation $mv^2/2$; solve simple problems involving force, distance and work; definition of inertia; drawing the graphs of force and distance; conversion of energy; deficiency of energy in terms of input and output; define power as energy transfer/time taken; unit of power; work done when accelerating a body against a resistance, conservation of energy, derivation of units of energy.

Proficiency in: Solving problems concerning above objectives, developing equation for kinetic energy of rotation, explaining the function of flywheel, comparison between flywheel and governor.

1.6.1.10. Impulse and momentum

Knowledge of: Impulse of a force, momentum of a body, angular impulse, angular momentum, derivation of formula and units of equation relating impulse and momentum,

Proficiency in: Solving problems to demonstrate variation of speed when the position and magnitude of rotating massed are changed, describing examples where the principle of

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conservation of momentum applies, application of equation of the above objective to determine the thrust of, and power developed by a jet.

1.6.1.11. Hydrostatics

Knowledge of: Definition of volume, density as mass/volume, relative density; formulae for pressure exerted by a liquid at any given vertical depth; deducing the equipment " $f = \rho \times g \times h \times A$ " to give force on the surfaces of a rectangular tank when filled with liquid; effect of liquid in "sounding pipe" air; centre of pressure, centroid of a wetted area, position of centre of pressure with regard to centroid, derivation of formula: Second moment of area of the wetted area about the water surface First moment of area of the wetted area about the water surface

Proficiency in: Calculating the forces at the bottom and top of rectangular bulkheads when compartments are flooded on: one side only/ two sides, but to different heights; solving simple numerical problems related to objective.

1.6.1.12. Hydrodynamics

Knowledge of: Energies stored in a liquid; potential, pressure and kinetic energy; definition of "head of a liquid"; energy component in a moving liquid in term of its head; volumetric flow of liquid as its velocity x cross-section area x density; solving simple problems concerning objective.

Knowledge of: Rate of flow, Bernoulli's equation for unit mass/ unit weight of liquid and its application, derivation of pressure energy, potential and kinetic energy per unit weight in terms of liquid head, laminar flow, viscosity, changes in flow pattern of a liquid as the liquid speed is increased until turbulence occurs, critical velocity, effect of liquid density/velocity and pipe diameter on critical velocity, factors affecting turbulent flow, factors affecting the head loss of a liquid, eddies, coefficient of discharge.

Proficiency in: Solving problems to find flow rate and pressures in sloping and horizontal pipes of varying diameter with negligible friction, sketching the principal features of a venturi meter, developing an equation for the flow rate through a venture meter in terms of head loss and cross-sectional area, sketching a graph to show the relationship between flow rate and head loss, solving simple problems to find flow rates through an orifice/ through a pipe when the coefficient of discharge is given.

1.6.2. Thermodynamics and heat transmission

1.6.2.1. Thermodynamic properties

Knowledge of and Understanding in: Properties of a substance and the units of their measurements; absolute and specific quantities, intensive and extensive values; states of a substance; enthalpy of fusion and enthalpy of evaporation; from of a fluids.

1.6.2.2. Heat transfer

Knowledge of and Understanding in: Methods of heat transfer (induction, radiation and conduction), factors influencing the rate of heat transfer by conduction/ convection and radiation; specific heat transfer; specific heat Capacity; Fourier law; solve simple numerical problems involving heat transfer between substances when placed in contact with each other; solve simple problems in the application of the Fourier law to solid materials; developing an equation for the temperature drop across the outer surfaces of a three-layer composite wall.

Proficiency in: Solving simple problems concerning above objectives to determine surface and interface temperatures and the heat transfer, application of above to a simple treatment of thin

cylinders with not more than one layer of insulation attached to the cylinder, sketching diagrams showing the nature of temperature gradients across a two layer composite wall and surface films.

1.6.2.3. Thermodynamic energy

Knowledge of: The term “the conservation of energy” and its application to the flow of fluid in a system, steady-flow energy equation (SFEE), potential /kinetic energy, internal energy, displacement energy, heat transfer, external work done; first law of thermodynamics; solve problems related to objective; identifying systems and its importance.

Proficiency in: Developing the (SFEE) to incorporate specific enthalpy, solving simple problems which prove sufficient understanding of the principles of (SFEE). Explaining the equation: heat transferred= change of internal energy + work transferred

1.6.2.4. Energy change

Knowledge of and Understanding in: “Non-flow” equation and its application; solve simple problems concerning energy changes in practice.

1.6.2.5. Vapours

Knowledge of and Understanding in: Process of steam generation from water or generation of vapor from any other liquid at constant pressure, relationship between temperature change and different phases, molecular activity with regard to temperature change (solid to liquid / liquid to vapor and vice versa); Vapor phase, saturated vapor, dry vapor, wet vapor, dryness fraction and superheated vapor conditions; relationship between pressure and temperature of a saturated liquid or saturated vapor and demonstrating it using laboratory equipment; use of table of thermodynamic properties to determine values for enthalpy, internal energy and volume at any given condition of pressure and temperature.

Proficiency in: Sketching a temperature/enthalpy diagram depicting complete range of change of states from liquid to superheated vapor, (with regard to saturated vapor line, saturated liquid line, critical point of change of state, dryness fraction), effect of compression and expansion at constant temperature for a gas/ a vapor, effect of throttling a dry saturated vapor where total enthalpy is considered to remain constant.

1.6.2.6. Behavior of gases

Knowledge of: Boyle’s law, Charles’ law, characteristics equation of a perfect gas to problems related to marine engineering, meaning of the term: specific heat capacity at constant volume (c_v) and at constant pressure (c_p), effect of heating gases at constant volume and constant pressure (with regard to raise in temperature/raise in internal energy), $T_1/T_2 = (P_1/P_2)^{n-1}$ / $n = (V_1/V_2)^{n-1}$, behavior of a perfect gas when compressed or expanded adiabatically, polytropic process (where $n = c_p/c_v$), introduction of ($n = \gamma = 1.4$) for air, Dalton’s law of Partial Pressure.

Proficiency in: Solving problems related to above objectives and concerning marine heat-engine cycles. Ability to sketch a P-V diagram which shows isothermal, adiabatic and polytropic expansion/ compression from a common starting point, Solving simple problems concerning mixture of a gas and a vapor/ or mixture of two gases.

1.6.2.7. Thermodynamic processes

Knowledge of and Understanding in: Defining a thermodynamic process; the 2nd law of thermodynamics; constant pressure, volume and temperature processes; zero heat transfer process; polytropic expansion and compression; isothermal and adiabatic processes; solve simple numerical problems relating to objective.

1.6.2.8. Work transfer

Knowledge of and Understanding in: Calculating work by force x distance; relating the area of a P.V diagram to the work done when a fluid exerts constant pressure on a piston in a cylinder; work transfer for a vapor or ideal gas; work transfer; apply simple numerical calculations related to objective.

1.6.2.9. Thermal efficiency

Knowledge of: Irreversibility of thermodynamic processes, hypothetically reversible cycles, Carnot cycle, Carnot thermal efficiency.

Proficiency in: Calculating Carnot thermal efficiency, given the maximum and minimum temperatures.

1.6.2.10. Steam plant

Knowledge of: Thermal efficiency of a boiler and methods for calculating its value given steam conditions/ steam flow rate/ fuel combustion rate and fuel calorific value, meaning of equivalent evaporation of a boiler, Rankine efficiency.

Proficiency in: Calculating the Rankine thermal efficiency and its comparison to the Carnot efficiency.

1.6.2.11. Nozzles

Knowledge of: Identifying parts of a nozzle (entry, throat and exit), convergent nozzle, divergent nozzle, and combination of convergent-divergent nozzle.

Proficiency in: Developing the steady-flow equation to produce an expression for the exit velocity from a nozzle in terms of enthalpy, solving simple problems involving the expression in above objective, obtaining the max. mass flow of a liquid through a nozzle with regard to fluid velocity, sketching a diagram which shows the effect of different pressure gradients on liquid flow along the length of a nozzle.

1.6.2.12. Engine Trail Data

Knowledge of: The terms usually used in engine performance such as: dynamometers, brake power, indicated power, friction power, torque, brake mean effective pressure, calculation of brake power using the equation $\text{brake power} = 2\pi NT$, calculation of turbine indicated power by using changes of enthalpy from inlet to outlet, specific fuel consumption in terms of grams/kWh, energy balance of a diesel engine.

Proficiency in: Sketching the following graphs, drawing attention to the significant features and giving brief explanations where appropriate:

- Torque versus speed for a variable speed engine
- Torque versus brake power for a constant-speed engine
- Power versus speed for a variable-speed engine
- Indicated power versus brake power for a constant-speed engine
- Mechanical efficiency versus speed or brake power for variable and constant-speed engines
- Fuel consumption versus speed for a variable-speed engine
- Fuel consumption versus brake power for a constant-speed engine
- Specific fuel consumption versus speed or brake power for variable and constant-speed engines
- Thermal efficiency versus speed or brake power for variable and constant-speed engines.

1.6.3. Marine heat engines, refrigeration and air compressor

1.6.3.1. Heat engines

Knowledge and Understanding in: Ideal gas cycles as those which use perfect gaseous; Constant volume cycle (Otto Cycle), Constant Pressure (Diesel Cycle), Dual Combustion Cycle, Joule cycle (Gas Turbine Cycle), Carnot Cycle and thermodynamic processes in each cycle; practical engines modeled on the aforementioned cycles; processes in 2 and 4 stroke diesel and petrol engines showing with timing and PV diagrams; practical heat engines and their input energy; efficiency of heat engines; ideal output energy and proof “Work Done = Energy Supplied – Energy Rejected”; cycle efficiency as:

$$\frac{\text{Energy input}}{\text{Energy output}} = \frac{\text{ENERGY SUPPLIED} - \text{ENERGY REJECTED}}{\text{ENERGY SUPPLIED}}$$

Solve simple numerical problems related to objective.

Definition of swept volume and its unit; mean effective pressure (m.e.p) and its unit; Indicated power produced in a 4 and 2 stroke engines and its unit; indicator diagram and way of obtaining m.e.p from it; friction and brake power; mechanical efficiency of an engine; compression ratio in a cylinder $p_v n = a$ constant; solve simple numerical problems related to objective.

Knowledge and Understanding in: Rankine cycle and its application to steam power; four main components of steam plant and their function; Rankine cycle efficiency and output energy of the cycle; turbine work (w) as difference of energy contained in input superheated steam and energy contained in leaving exhaust steam; using of table of thermodynamic properties; solve simple numerical problems related to the objective.

1.6.3.2. Refrigeration

Knowledge and Understanding in: Reversed Carnot Cycle (Refrigeration cycle); working fluids used; using of tables of thermodynamic properties; four main components of refrigeration plant and their function; direction of flow of working fluid and energy level in the cycle; refrigeration plant performance evaluation; refrigerants commonly used in marine refrigeration system; solve simple numerical problems related to the objective.

Knowledge of: Sketching a practical refrigerating cycle (when a regulator is used), on a pressure-enthalpy diagram, indicating compression, cooling (condensation), throttling and evaporation, methods employed to transfer heat in the evaporator/ condenser and how the throttling is achieved (considering both large scale and domestic refrigeration plants), sketching a more effective refrigeration cycle on a pressure-enthalpy diagram with dry compression and under-cooling and advantages achieved.

Proficiency in: Using enthalpy tables to calculate the condition of refrigerant at stage points in the cycle and the coefficient of performance, describing (in simple terms) the principles of vapor absorption refrigerator.

1.6.3.3. Theory of air/gas compression

Knowledge and Understanding in: Compression of air/gas (isothermal, polytropic and adiabatic); corresponding pressure-volume diagram of an air compressor, showing suction, delivery, and clearance volume, factors governing valve opening and closing in a compressor,

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swept volume and effective swept volume, definition of volumetric efficiency and need for high volumetric efficiency, meaning of the term “free air delivery”; reason for cooling of air and need for using intercoolers; application of $Pv^n = C$ during compression process; application of $=C$ on air storage tank; solve simple numerical problems related to objective.

Proficiency in: Using the characteristic equation to convert free air delivery to actual delivery conditions and vice versa, sketching diagrammatic arrangement of a multi-stage compressor, sketching a pressure-volume diagram for a two stage compressor showing ideal isothermal/polytropic compression.

1.6.4.Industrial chemistry

1.6.4.1.Fundamentals

Knowledge of and Understanding in : Definition of an atom, a molecule, chemical element, chemical compound, mixture, an oxide and chemical reaction; meaning of solution, solubility, a saturated solution, suspension and precipitation.

1.6.4.2.Acidity/Alkalinity

Knowledge of and Understanding in: Composition of an atom and result of losing or gaining electron; hydrogen and hydroxyl ions; PH value of a solution.

1.6.4.3.Corrosion

Knowledge of and Understanding in: Formation of metallic hydroxide when iron is immersed in an acidic solution (state boiler water should be alkaline and free of oxygen); fundamental process of corrosion; common engineering materials which produce passive oxide films; main causes of corrosion; galvanic cell components; electrolyte; and anode and common metals selected as relative anodes; sacrificial anodes; galvanic action and means of reducing it; pitting corrosion; graphitization of cast iron; stress corrosion and metals commonly effected; dezincification and de-aluminification and preventive measures; fretting corrosion and factors causing increase of fretting; corrosion fatigue; major factors affecting the corrosion process; methods of surface protection.

1.6.4.4.Water testing and treatment

Knowledge of and Understanding in: Controlling the PH value of aqueous solution and chemical additives used; condition of water required for steam boiler and engine cooling system; methods used for conditioning the water; main metallic salt found in fresh water and average sea water; permanent and temporary hardness; scale and sludge formation in a steam boiler; effect of using sea water, fresh water and distilled water; principal objects of treatment of boiler feed water.

1.6.4.5.Fuels and lubricants

Knowledge of and Understanding in: Carbon, hydrogen, sulfur and ash content of marine fuels; flash point and its importance for marine fuels and lubricants; flash point temperature of petrol, kerosene, marine diesel fuel, boiler fuel oil and lubricating oil; minimum closed flash point of marine fuels when stored in engine room; viscosity and necessity for increase of temperature of some fuel oils; test of flash point and viscosity on fuels and lubricants;

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importance of them with respect to storage and transferring; water content tests for fuels and lubricants.

1.6.5. Main and auxiliary machinery

1.6.5.1. Marine plant and operation

Familiarization with: List of main and auxiliary machineries for propulsion, steering the ship and providing services; their individual function; correct procedures for the preparation, starting up, normal running and shutting down of marine machineries; importance of data recorded from running machineries (temperature, pressure and speed); using data to locate fault; appropriate procedure following discovery of fault.

1.6.5.2. Engine types

Knowledge of: Marine diesel engine types; large bore diesel engines and their major difference with smaller diesel engines; low, medium and high speed engines; their application and how can be used as main propulsion engines; approximate speed ranges related to low, medium and high speed engines; P-V diagram and relative processes; irregularities in P-V diagrams; ways and methods of scavenging 2- stroke and 4- stroke engines; reasons for a supercharging system; principle components of medium and high speed (4-stroke) diesel engines and the material of manufacture (main strength member, crank shaft, con. Rod, fuel pump, piston, cylinder, cylinder cover and mountings); principle components of a large bore 2- stroke diesel engines and the material of manufacture (Bed plate, Crank shaft, Frame, Connecting rod, Cross head arrangement, camshaft, chain and gear, piston, Cylinder block, Tie rod, Liner and cylinder head); principle parts, materials and operation of exhaust valves, cylinder lubricator, piston gland, fuel pump, fuel valve for diesel engines.

1.6.5.3. Starting and reversing

Knowledge of: How an engine is prepared for starting, started, stopped and reversed, when maneuvering and when at full speed; main components of an air starting system (Reversible) of large cross head type engines and their function; the purpose of a turning gear and the need for interlocks; safeties involved in such system.

Familiarization with: Typical starting air system of large cross head type engines.

1.6.5.4. Engine Control

Knowledge of: How engine speed and output power are controlled for normal condition (Governor); how engine over speed is prevented.

1.6.5.5. Engine Operation and Safeties

Knowledge of: Internal combustion engines; compression ignition engines and processes occur in such engine; spark ignition engines and processes in such engines; combustion process in compression ignition engines; processes in 2 and 4 stroke engines; interpretation of indicator diagrams with respect to engine timing diagrams.

Knowledge of: conditions which can lead to dangerous oil mists in crank case; principle of operation of oil mist detector, crank case relief door; importance of keeping scavenge air spaces drained and clean; correct procedure and actions during scavenge air space fire while engine is running; list of essential alarms, slow downs and shut downs .

Proficiency in: sketching typical indicator diagrams for 2- stroke and 4- stroke engines; calculating indicated power of an engine; using of engine builders manuals to obtain applicable information.

1.6.5.6.Engine Systems

Knowledge of: Line diagram of typical engine system (fuel oil, lubricating oil, piston cooling, jacket cooling, fuel valve cooling and camshaft oil); normal pressure and temperature of each system; safety devices employed in each system; purpose of lagging for hot surfaces and sheathing for high pressure pipes.

1.6.6.Power Transmission and propulsion

Familiarization with: The function of the main items of main propulsion machinery, methods of reversing the direction of thrust, line and thrust bearings; stern tube arrangement; comparison of fixed and controllable pitch propellers; propeller attachment.

1.6.7.Auxiliary machinery and systems

1.6.7.1.Evaporators and distillers

Knowledge and Understanding of: Construction and fittings of evaporators; approved standard for materials; construction and mountings of a shell and coil evaporators; methods of obtaining vapour from sea water; purpose of reducing orifice in steam supply line; reasons for using low-pressure evaporators; meaning of single and double effect evaporators; principle of flash evaporation and principle operation of single and twostage flash evaporators; multi-effect evaporations and its advantage over single evaporators; formation of scale on heating surfaces and means of controlling it; meaning of brine; reasons and ways of controlling brine density; types of scale depositing on heating surfaces and means of removing them; definition of "distillation" as used in marine engineering practice; uses of fresh water onboard ship; quality of drinking water and arrangement of making distillate water potable; constraint regarding low temperature production of drinking water from sea water near land.

1.6.7.2.Air compressors

Knowledge of: Air compressor and its function; shipboard uses of compressed air; principal types of air compressors; simple sketch of a single stage cylinder for a reciprocating air compressor; principle of compression process in a 2-stage reciprocating air compressors; reasons for using inter coolers and after cooler; Construction details and materials of reciprocating air compressors components; cylinder lubrication for correct and safe operation; cylinder lubricating oil flash point and its importance; procedures for starting-up and stopping; automatic operation of air compressor; quality of air required for control air system and how they are achieved; propose of relief valve, fusible plugs and water-space pressure relief facility; construction details of rotary compressors. Giving materials used for main component parts; means of drive and uses of centrifugal air compressors; means of storing compressed air; material and construction requirements of a reservoirs; important mountings of an air reservoir; means of protection of against corrosion, and overpressure; purpose of pressure reducing valve in air distribution systems; attention needed for filters fitted in air distribution system.

1.6.7.3.Steering gear

Knowledge of: Vitality of steering gear with respect to safety of ship and need for its correct operation; need for two means of steering; control of steering gear provided in steering compartment; steering system and function of major components and their relation; hydraulic telemotor system and properties of telemotor fluid; malfunction in hydraulic telemotor system (electrical telemotor system); particular requirements of oil tankers; hydraulic power operated rudder system; 2 and 4 ram steering system and materials used for main component parts; radial vane type steering system and materials used for main component parts; function of rotary

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positive-displacement pumps and their means of drive; principle operation of radial cylinder pump, swash plate pump and their means of pumping control; type and condition of oil used in a hydraulic system; means of absorbing shocks in the system; how a steering is tested according to IMO recommendation; electrical steering system based on a Wheatstone bridge; principle of the ward-Leonard and single motor system; emergency steering and its possible locations.

1.6.7.4.Refrigeration plant

Knowledge of: Distinguishing between refrigeration, air conditioning and ventilation; marine refrigeration systems operate on a reversed Rankine cycle (vapour-compression cycle); principle of operation of a refrigeration system; system components and their function; processes which take place in each part of the system; common primary and secondary refrigerants and the requirement of each; types of compressors in common use and their application; automatic control of the system using cold room temperatures; correct operating condition of the system; effect of air, moisture and oil in refrigeration circuit and means of removing them; principle of insulation of storage spaces; temperature range for meat, vegetable, fresh fruit, rooms.

1.6.7.5.Fuels and combustion systems Knowledge of: Types of crude oil and refining processes; Characteristics of marine residual fuel; undesirable elements in marine fuels; standard fuel; combustion process in an internal combustion engine; chemical reaction in a combustion; result of combustion; average proportions by percentage of oxygen and nitrogen in atmospheric air; combustion products; role of nitrogen in combustion process; effect of excess in combustion; signs of poor combustion; range of CO for good, poor and bad combustion; atomization of fuel and its importance; effect of viscosity, atomization, penetration and turbulence on good combustion; good combustion and its indication.

Knowledge of: Types of filters used and their relative advantages; differentiate between purifying and clarifying; purification process of fuel oil; correct and safe operating procedure for centrifuges; correct procedures for the disposal of waste oil, sludge residue, etc. place of storage of fuel oil; settling tank mountings; minimum flash point of marine fuels; minimum fuel oil temperature for transfer and settling.

1.6.7.6.Auxiliary steam boilers

Knowledge of: Uses of steam from an auxiliary boiler on board ships and steam pressure required; ranges of auxiliary steam boilers; principle difference between fire tube and water tube boilers; general constructional details of a fire-tube boiler and material used for construction; general requirements for construction of pressure vessels; different type of boiler tubes and method of expanding tubes in a tube plate; lay out and general constructional details of a water tube boilers; principle of operation and control of water and fire tube boilers; shell mountings of a water and fire tube boilers and their function; list and purpose of boiler mountings; methods of supporting, connections steam pipes; purpose and operation of reducing valve and steam traps; reason for water hammer and means of avoiding same; procedure for rising steam and coupling a boiler into the steam system; correct procedures for checking the water level; dangers involved with, low and high level of water and procedures to be followed when discovering it; principle aims of treating the water in a boiler and how the objectives are achieved; dangers of oil entering a boiler and how the objectives are achieved; dangers of oil entering a boiler and means used to minimize the possibility of oil contamination; systems associated with production of steam and safety devices and procedures involved in each; principle of operation of multi boiler waste heat systems using natural and forced circulation; meaning of blow back and how can be avoided;

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boiler fuel supply system and main components; types of burners and how they atomize the fuel; maintenance procedures for oil burning equipment; need and the use of soot blowers; boiler uptake fire and methods of detecting and avoiding; procedure for taking a boiler out of service; procedure for blowing down a boiler.

Competence 1.7: Operate pumping system and associated control system

1.7.1. Marine pumps and systems

Knowledge and Understanding in: Basic function of a pump; requirement of power supply to a pump; losses of head in pumping system; relation of fluid viscosity and pumps design. Types of pumps used on ships and the purpose of their use; basic action of displacement pump and necessity for fitting a relief valve on discharge of it; operation of a reciprocating pump and purpose of its attachments; characteristic of a reciprocating pump; principal of a rotary displacement pump; construction and principal parts of a gear pump, rotary vane pump; screw displacement pump; principles of operation of an axial flow pump; principles of a centrifugal pump (parts such as impeller, volute or diffuser) and its characteristics; single and double entry impeller; multi stage centrifugal pump; need and ways of air extraction from a centrifugal pump; central priming system; principles of an ejector. Importance of liquid temperature at pump suction in relation to its pressure; effect of viscosity on pump performance; effect of suction head on a centrifugal pump; procedure for starting up and stopping of pumps; care for satisfactory operation of adjustable and non-adjustable glands seals; reasons for loss of performance of a pump. Means by which lengths of pipes are joined together and materials used to seal joints for steam, sea water, fire main, bilge and ballast, starting air and control air pipes; way of supporting pipe to reduce vibration; way of controlling pipes expansion and contraction; material used for construction of pipes for carrying various liquids; principle of construction of a cock; features of a globe valve, screw lift valve, a screw down non return valve, a non-return valve, a gate valve; features of a gate valve; features of a relief valve; applications of quick closing valve; purpose and application of a change over chests; blanking of pipelines; features of a mud box.

Knowledge and Understanding in: Purpose of a bilge pumping system and reason for fitting non-return valves to bilge pipes in water tight compartments; diagrammatic arrangement of bilge pumping system; purpose, sitting and common principal connections of an emergency bilge suction; features of an emergency bilge pump; purpose of a ballast pumping system and its arrangement; purpose of a domestic fresh water pumping system and its arrangements; engine room central cooling system; a hydraulic system and properties of hydraulic fluid; fire main system and its cross connection with other systems; international law regarding number of independent driven fire pumps and means of their drive.

Knowledge and Understanding in: Heat exchange theory ($Q = U\theta A$); different flow patterns; definition of contact heat transfer; types of heat exchangers and cooling media used; principle of construction of shell and tube and flat plate heat exchangers; single and two pass heat exchangers; types of heat exchangers used on board for various media; materials used for shell, tubes and tube plate of heat exchangers; means of controlling temperature; correct cleaning procedure of heat exchanger; effect of air in cooling water and remedial action .

FUNCTION 2: ELECTRICAL, ELECTRONIC AND CONTROL ENGINEERING AT OPERATIONAL LEVEL

Competence 2.1: Operate alternators, generators and control system

2.1.1. Electro technology

2.1.1.1. Cables

Familiarization with and Understanding in: Cables parts (conductors, insulations, sheathing); safeguard against fire and cables reaction; cables connections (terminal box, consumers and sockets); Insulation resistance, IR measurement and associated equipment; temporary repair on cable insulation and its limitation.

2.1.1.2. Alternating current

Familiarization with and Understanding in: Meaning of alternating current; instantaneous voltage ($e = Blv$ to produce $e = E_{max} \sin \square$); definition of phasor and drawing of phasor diagram; definitions, symbols and conventions of rotation, angular velocity, periodic time, frequency, peak value and amplitude; expression $e = E_{max} \sin 2\pi ft$; solve simple problems in relation to above expression; phase difference between voltage and current values; simple sketch to present two sinus wave with same frequency but different amplitude and phase angle; meaning of Root Mean Square value (RMS); $RMS \text{ value} = 0.707 \text{ peak value}$.

2.1.1.3. Alternators

Familiarization with and Understanding in: Simple construction of three phase alternator; terms in three phase alternators i.e. stator, rotor, windings, excitation, air gap; how AC is produced; terms in AC generator i.e. magnetic flux, EMF (Electro magnetic force), frequency and its relation to speed of rotation, self excitation; function of

Automatic Voltage Regulator; block diagram of AVR and purpose of hand trimmer; cooling of generator; necessity of space heater; safeties incorporated in alternator; definition and arrangement of Delta and Star winding connections; parallel running of two power supply sources and required condition for such operation; auto load sharing; synchronization; emergency generator construction and its purpose, electrical safeties; usual voltage, frequency and no. of phases of it; emergency switch board and its consumers; safety interlock ; automatic and manual starting of emergency generator considering regulation; routine maintenance of alternator.

Proficiency in: Paralleling and synchronizing two generators by using synchroscope and lamp methods; load sharing procedure; off loading correct procedure; load reduction in parallel condition.

2.1.1.4. D.C. generator

Familiarization with and Understanding in: D.C. machine construction and identifying each associated parts; field system and armature; D.C. armature winding arrangement; difference between shunt and series coil.

2.1.1.5. Characteristics of shipboard electrical systems

Knowledge of: Care necessary when carrying out routine maintenance of generators and circuit breakers, Batteries, Magnetism and Electromagnetism, Electromagnetic Induction, Fundamentals of Generators and Motors, Alternating Current, Distribution, Transformers, requirements for electrical safety on Oil, Gas and Chemical Tankers.

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2.1.1.6. Maintenance of generators and circuit breakers

Familiarization with and Understanding in: Precaution necessary before maintenance; list the parts needed attention while maintenance; carbon brush checks and adjustments; IR test of generator; circuit breaker construction; various types of closing mechanism; routine maintenance of circuit breaker; tripping function of circuit breakers; interlocks; circuit breaker fault finding.

Proficiency in: Locating and selecting relevant drawing and manuals, checking and adjusting pressures on carbon brushes of generators, replacing and bending in new carbon brushes, test and record values of insulation resistance, routine maintenance of main circuit breakers, detecting and correcting faults implanted in circuit breakers.

2.1.1.7. A.C. Motors

Familiarization with and Understanding in: Induction motor principle operation; induction motor construction and its actual components; types of motor on board ship; different types of motor enclosure and their differences; relationship between speed and load, current and load, from no load to full load condition, production of driving torque; meaning of slip and why it is required; starting current and starting torque and their effect on electrical supply current; different means of starting motor (reduced voltage, direct on line, star – delta and auto transformer); motor protection devices and the reason for such protection; principle operation of over current relay and difference between possible over load current and fault current; function of the over current trip, time delays and fuses; fuse ratings; principle of thermal relay and its adjustment; single phasing and its effects on motor; single phasing protection; function of under voltage trip; application of different speeds (single fixed speed, two or three fixed speed and infinitely variable speed) for A.C. motors and methods attaining such ability.

2.1.1.8. D.C. Motors

Familiarization with and Understanding in: Meaning of back e.m.f of a motor; voltage current and speed equations; reason for the starting current to be high; speed controlling factors ($N \propto \frac{V}{\square}$ types D.C. motors (shunt, series and compound) and their typical applications; meaning of long shunt, short shunt and cumulatively connected in compound motors.

2.1.1.9. Maintenance of motors and starters

Familiarization with and Understanding in: Correct procedures and preparation of motors and starters for maintenance; components required particular attention; IR tests and causes of insulation failure; fault finding of motors, starters and protection equipment.

Proficiency in: Carrying out maintenance necessary for a cage electric motor, checking the insulation resistance of a 3- phase induction motor, carry-out the maintenance necessary and complete reports on starts and controllers, detecting and correcting faults implanted in motors, starters and protection equipment, carry out temporary repairs to cable insulation.

2.1.1.10. Insulation

Knowledge of: Insulation and its categories, exposed water tight fittings/ lighting fixtures. Maintenance equipment for motors, most common causes of failure of insulation, parts to be inspected and their common faults on motors and starters.

2.1.1.11. Impedance and Inductance

Familiarization with and Understanding in: “Impedance” and its symbol; comparison between impedance of an A.C circuit and resistance of a D.C circuit; relationship between impedance voltage and current; effect of simple and coiled resistance in an A.C and D.C circuit; “Reactance” and its symbol; impedance triangle (resistive, capacitive, inductive and their combination); effect of changing current and magnetic flux on induced e.m.f; effect of varying power factor on the power consumed

($power = V \times I \times \frac{R}{Z}$ or $V \times I \times \cos \Phi$); solve simple problems concerning power, current, resistance, impedance, reactance and power factor and verifying the solutions, using laboratory equipment.

2.1.1.12. Lighting

Familiarization with and Understanding in: Importance of correct level of lightening with regard to safety of working staff and their efficiency; principle of the incandescent lamps, discharge lamps and fluorescent tubes, including their circuit diagrams (emphasizing on power factor improvement in fluorescent tubes); effect of voltage variation; difference between lamps for general lighting and heavy duties; principle application and needed care when handling tungsten - halogen lamps; types of lamp cap; location, color and power of navigational lights; purpose of lights on the signal mast; marking of emergency lights; list of emergency lights on emergency switch board and battery circuit; testing frequency of emergency lights; care necessary when maintaining watertight fitting and portable hand lamps; routine testing and maintenance of lighting circuits and fittings; detecting and rectifying faults likely to be encountered at sea.

2.1.1.13. Fault protection

Familiarization with and Understanding in: Need for fault protection in electrical system; protection of main switch board and function of the main parts; fault protection equipments (over current relays, short circuit protection, under voltage protection, reverse power protection, thermister) and their types and associated parts; preferential tripping when overload occurs; dangers associated with the space in the vicinity of busbars; earthing of instruments; adjusting, maintaining and testing of various types of fault protection normally encountered.

2.1.2. Electronic engineering

knowledge of: Semi-conductors, diodes, transistors, thyristors and other components of simple electronic circuits (i.e. capacitors, inductors and resistors); operation of 1- ph and 3- ph rectifiers; silicon controlled rectifiers; operation of common electronic circuit; principles and application of oscillators; operation of multi vibrator circuits; use of logic function; photo electric devices; microprocessor systems.

FUNCTION 3: MAINTENANCE AND REPAIR AT OPERATIONAL LEVEL

Competence 3.1: Maintain marine engineering system including control system

3.1.1. Onboard training:

Proficiency in: Onboard training scheme according to requirement of Administration (Record book for engineering cadet).

3.1.2. Maintenance principle

Familiarization with: Reasons for maintaining the machinery; preparation for maintenance; points and parts of machinery require attention; inspection for tear and wear; non destructive tests; reason for genuine spare parts.

3.1.3. Principle of plant maintenance

Familiarization with: The basic principles of the components to be worked on; the application of safe practices at all times; the isolation of units and / or systems prior to the dangers inherent in systems which contain fluids under pressure or are of a hazardous nature.

3.1.4. The basic of maintenance technology

Familiarization with: Planned maintenance systems; condition monitoring; diagnostic testing; preventive maintenance.

3.1.5. Fundamentals of automation and control

3.1.5.1. Control engineering

Understanding in: Basic closed and open control loops; control terms;; types of control action available and their effect on system condition; energy forms commonly used in control systems aboard ship; essential components of a control and their purposes; essential requirements for the operation of unattended machinery.

3.1.5.2. Instrumentation

Familiarization with: Different type of pressure measuring instrument; principles of operation, application and methods of testing and installation i.e. U- tube manometer, well type manometer, burdon tube pressure gauge.

Familiarization with: Quantity and rate flow meters i.e. rotor meter, variable area flow meter.

Familiarization with: Bi- metal and filled system thermometers; i.e. thermal temperature sensor, Bi - metallic strip thermometers, liquid glass thermometer, liquid in steel thermometers, remote temperature recording device.

Familiarization with: Level measuring instrument used at sea; simple gauge glass, buoyancy type level indicating instrument, displacer and torque type of level indicating, igema gauge, intermittent and continuous air purge tank measuring system; the electrical pressure, temperature and level measuring equipments and their application on board ship.

FUNCTION 4: CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR PERSONS ON BOARD AT OPERATIONAL LEVEL

Competence 4.1: Ensure compliance with pollution prevention requirements

4.1.1 The precautions to be taken to prevent pollution of the marine environment

4.1.1.1 International convention for the prevention of pollution from ships, 1973, and the protocol of 1978 relating thereto (MARPOL 73/78) Knowledge of: Annex I (Regulation for the prevention of pollution by oil); Annex II (regulation for prevention of pollution by noxious liquid substances in bulk); Annex III (Regulation for the prevention of pollution by harmful substances carried by sea in packaged form); Annex IV (Regulation for the prevention of pollution by sewage); Annex V (Regulation for the prevention of pollution by garbage); Annex VI (Regulation for the prevention by emission from ships; Air pollution).

4.1.1.2 Oily water separator

Knowledge of: Function of an oily water separator; principle of operation of an oily water separator; general construction and material of components parts used; maintenance and care required.

4.1.1.3 Sewage treatment plant

Knowledge of: Principles of operation of a biological sewage treatment plant; discharge tests of aerobic sewage plant (suspended solid, biochemical oxygen demand, coliform count); principles of operation of zero discharge system; sewage retention system.

4.1.2 International convention relating to intervention on the high seas in cases of oil pollution casualties, 1969

4.1.3 International convention on civil liability for oil pollution damage, 1969 (CLC 1969)

Competence 4.2: Maintain seaworthiness of the ship

4.2.1 Stability, trim and stress tables

4.2.1.1 Displacement

Knowledge of and Understanding in: Archimedes' principle; applying Archimedes principle to floating bodies; the volume of displacement; displacement; relationship between displacement and mean draught; meaning of light displacement, loaded displacement and dead weight; TPC (Tones Per Centimeter immersion); water plane area (Aw); deriving formula for TPC; coefficients of form (water plane area coefficient; mid ship section area coefficient; block coefficient; prismatic coefficient); wetted surface area; calculating wetted surface area using Taylor's approximate formula; stating the rules for area, volume and second moment of area of similar bodies; solving problems relating to the above objectives.

4.2.1.2 Buoyancy

Knowledge of and Understanding in: Buoyancy; relationship between buoyancy and displacement; LCB (Longitudinal Centre of Buoyancy); VCB (Vertical Centre of Buoyancy); calculating the change in vertical center of buoyancy due to a change in mean draught; reserve buoyancy; free board and its relation to reserve buoyancy; load line; requirement for damage stability for Type A, B, B60, B100 and passenger vessels.

4.2.1.3 Fresh water allowance

Knowledge of and Understanding in: Changes of mean draught as related to water density; meaning of FWA (fresh water allowance); derivation formula for FWA; Solving problems involving vessels moving into water of different density.

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4.2.1.4 Centre of gravity

Knowledge of and Understanding in: Centre of gravity; Longitudinal center of gravity (LCG); vertical center of gravity (VCG); the importance of the position of the center of gravity in stability and trim calculation; moment of force; changes in vertical, longitudinal and transverse center of gravity due to loading, discharging or moving one or more masses; calculating or moving one or more masses; solving problems involving suspended masses.

4.2.1.5 Stability of ships

Knowledge of and Understanding in: Statical stability; Initial stability; righting moment and righting lever; tender and stiff ships; deriving an expression for the distance of the transverse meta-centre above the center of buoyancy; heights of center of buoyancy and meta-centre above the keel; meta-centric diagram; calculating height of meta-centre above keel for vessel of ship from and of simple geometric form; solving problems relating to stability at small angles of heel producing an expression for transverse metacentric height due to moving a small mass across the ship; inclining experiments; the effect of a slack tank (free surface effect); loss in meta-centric height due to the free surface; effective meta-centric height; effect of tank divisions on free surface; solving problems involving free surface effect; meaning of bilging and its effect on stability; curves of statical stability and how it is obtained; meaning of list; list correction; upsetting or capsizing moment; angle of loll; obtain values such as range of stability, maximum GZ and angle of loss of stability from a given curve of statical stability.

4.2.1.6 Trim

Knowledge of and Understanding in: Trim; Longitudinal center of floatation (LCF); moment to change trim of ship by one centimeter (MCT1); calculating change of trim resulting from added, discharged and transferred loads.

4.2.2 The principal structure members of a ship

4.2.2.1 Ship dimension and form

Familiarization with: The general arrangements of the most common type of ocean going merchant ships; forms and dimensional terms used in ship construction: free board, camber, rise of floor, bilge radius, tumble home, flare, sheer, rake, parallel middle body, run; forward perpendicular, after perpendicular, length between perpendicular, length overall, moulded and extreme breadth, depth and draught.

4.2.2.2 Ship stresses

Understanding in: Shear force and bending moments; meaning of following terms: hogging sagging, racking, panting, pounding; stress by localized loading; constructing shear force and bending moment diagrams; curves of weights, buoyancy and loads; preparing shear force and bending moment diagrams for box shape vessels only.

4.2.2.3 Hull structure

Familiarization with: Detailed components of main and minor ship's structure; standard steel sections; Framing system; deck freeing arrangement.

4.2.2.4 Bow and Stern

Familiarization with: Bow and stern arrangement and construction

4.2.2.5 Fittings

Familiarization with: Hatch cover arrangement and construction; Anchor, chain and mooring arrangement main components of derricks and deck crane; cargo hold bilges and ballast system; air pipe sounding pipes and container fitting arrangement; water tight doors and fittings.

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4.2.2.6 Rudder and Propeller

Familiarization with: Rudder types, construction and its function; principle of screw propulsion; terms and definitions of propeller; shaft tunnel arrangement.

4.2.2.7 Load Line and draught marks

Familiarization with: load line mark

Competence 4.3: Prevent, control and fight fires on board

According to STCW Code table A-VI/3 above competence (4.3) is included in Advanced fire fighting course.

Competence 4.4: Operate life – saving appliances

According to STCW Code table A-VI/2-1 above competence (4.3) is included in survival craft and rescue boat course other than fast rescue boat.

Competence 4.5: Applied medical first aid on board ship

According to STCW Code table A-VI/4-1 above competence (4.3) is included in proficiency in medical first aid course.

Competence 4.6: Monitor compliance with legislative requirements

4.6.1 Basic working Knowledge of UN (IMO / ILO conventions)

Familiarization with: Maritime law, United nations specialized agencies (International Maritime Organization and International Labour Organization), port state and flag state, law of the sea (UNCLOS) and related definitions, International Convention on Load Line, 1966 (LL 1966), as amended, International Convention on Standards of Training, Certification and Watch keeping for Seafarers, 1995 (STCW), International Convention on tonnage Measurement of ships, 1969, International Convention for the safety of life at sea, 1974 as amended (SOLAS), [Chapter1 (General Provisions), Chapter 2(Construction [subdivision and stability, machinery and electrical installation] and [fireprotection , fire detection and fire extinction]), Chapter 5 (Safety of Navigation), Chapter7 (Carriage of dangerous goods), Chapter 9 (ISM Code), Chapter 12 (ISPS)].

4.6.2 I.R.Iran legislation

Familiarization with: General knowledge of Islamic Republic of Iran national legislations for implementing international agreement and conventions.

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ماده ۲-۹ مواد درسی دوره افسر مهندس دوم در کشتی های با قدرت موتور ۳۰۰۰ کیلووات یا بیشتر-
سفرهای نامحدود

FUNCTION 1: MARINE ENGINEERING AT MANAGEMENT LEVEL

Competence 1.1: Plan and schedule operations, Start up and Shut down Main Propulsion and Auxiliary machineries including associated systems

1.1.1. Refrigeration and air conditioning

Knowledge of: Sketching a practical refrigerating cycle (when a regulator is used), on a pressure-enthalpy diagram, indicating compression, cooling (condensation), throttling and evaporation, methods employed to transfer heat in the evaporator/ condenser and how the throttling is achieved (considering both large scale and domestic refrigeration plants), sketching a more effective refrigeration cycle on a pressure-enthalpy diagram with dry compression and under-cooling and advantages achieved.

Proficiency in: Using enthalpy tables to calculate the condition of refrigerant at stage points in the cycle and the coefficient of performance, describing (in simple terms) the principles of vapor absorption refrigerator.

Knowledge of: Refrigerants and their properties; environmental limitations on the use of some refrigerants and alternatives; properties of suitable lubricating oil; vapour compression cycle; shipboard plant; system components and their function; capacity control; system performance; safeties incorporated in the system; operational problems; rectification of operational problems; commissioning a new or repaired system; defrosting; absorption type refrigeration system; brine and brine systems; carriage of refrigerated cargo; air conditioning and ventilation; Psychrometric chart; types of air handling unit; Legionella bacteria and related regulations.

1.1.2. Physics and chemical properties of fuels and lubricants

Knowledge of: Production of oils from crude oil; types of crude oil and chemical structure of hydrocarbons; simple distillation process.

Knowledge of: Main characteristics of fuel oil; effect of each fuel characteristics on system and engine performance; fuel oil standards; importance of ignition quality of fuel; poor quality fuel; common tests normally carried out on fuels.

Knowledge of: Combustion; combustible elements of residual fuel; effect of unwanted elements in residual fuel on engine and environment; ideal condition for diesel engine good combustion (viscosity, atomization, penetration and turbulence); evaluation of good combustion; combustion products; Stoichiometric and excess air for correct combustion.

Knowledge of: Fuel system from service tank to injector; blending system; homogenizer; automatic control of fuel viscosity; correct bunkering strategy (including correct sampling method, bunker delivery note and associated regulation as applied).

Knowledge of: Oil purification; purpose and use of a settling tank and its fittings; oil filtration method; principle of operation of a coalescer; operation of automatic oil filter; principle of an oil centrifuge (including those capable of separating fuel with density as high as 1010 kg/m³); operation of a self cleaning purifier.

Knowledge of: Production of lubricating oil; properties of lubricating oil; mineral oil; purpose of additives in lubricating oils; heavy duty oil; function of lubrication; boundary lubrication and

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where it occurs; hydrodynamics lubrication and where it occurs; factors influencing hydrodynamic lubrication; places where lubricating oil samples for test is taken; onboard and laboratory lubricating oil testing; oxidation of oil, its effect and remedy; microbial degradation of lubricating oils, its symptoms, means of prevention and remedy.

Proficiency in: performing appropriate laboratory test on fuel oil and lubricating oil on board.

1.1.3. Technology of materials

1.1.3.1. Metallurgy of steel and cast iron

Knowledge of: Metallurgy of steel and cast iron; principle process in steel making; open heart and Bessemer processes; production of cast iron; effect of adding carbon steel and cast iron .

1.1.3.2. Testing and properties of materials

Knowledge of: Material properties (ductility; ultimate tensile and yield stress); load – extension diagram of mild steel; ultimate tensile strength, breaking and fracture stress; testing of material (tensile, hardness, impact, creep, fatigue, bend); brittle fracture and ways to improve steel against it; non-destructive tests for surface cracks (visual, penetrant, magnetic crack detection); non-destructive test for cracks within a material (hammer, radiography, ultrasonic).

Proficiency in: Identifying from samples or pictures fatigue failure; perform nondestructive examination of surface for cracks.

1.1.3.3. Heat treatment of metals

Knowledge of: Hardening and tempering; critical temperature range; annealing and normalizing; black heart process; work hardening; nitriding; flame hardening; induction hardening; spheroidising anneal.

1.1.3.4. Alloying elements in irons and steels

Knowledge of: The principle reason for adding various elements (cobalt, nickel, chromium, molybdenum, vanadium, tungsten, copper, manganese, silicon, titanium) and their marine application.

1.1.3.5. Non-ferrous metals

Knowledge of: Effect of cold working or vibration on copper and means of rectifying it; effect of corrosive conditions on brass and way of reducing it; reasons for adding alloying elements to bronze; way of increasing aluminum strength; copper-nickel alloys application in marine engineering; white metal and its application in marine engineering; range of melting temperature of white metals.

1.1.3.6. Non-metallic materials

Knowledge of: Application of non-metallic materials, including polymers and composites; risk involved when working with asbestos and necessary precautions.

1.1.3.7. Welding

Knowledge of: Principle feature of the argon arc welding process; AC & DC welding machines; Automatic welding processes, electro-slag, TIG & MIG; types of welding employed in marine practice and their application; reasons for pre-heating and controlled cooling; edge preparation; welding techniques (butt, lap, fillet) and materials normally used on ship; flux material and reason for it; typical faults in a weld and way of avoiding or rectifying it; comparison of good and bad weld; gas cutting.

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1.1.3.8. Direct stress and strain

Knowledge of: Stress and strain; definition of direct stress, strain, hooks law; Young's modulus of elasticity; what is meant by factor of safety; Strain energy; resilience; impact and suddenly applied force; solve simple numerical examples related to above objectives.

1.1.3.9. Stress in pressure vessels

Knowledge of: Stress in pressure vessels; hook stress and axial stress in a thin walled cylindrical pressure vessels; joint efficiency; solve simple numerical examples related to above objectives.

1.1.3.10. Bending of beams

Knowledge of: Condition of equilibrium; concentrated and distributed load; shearing force and bending moment diagrams; solve simple numerical examples related to above objectives.

1.1.3.11. Stresses in beams

Knowledge of: Neutral axis; fundamental bending equation; modulus of section; combined bending and direct stress; solve simple numerical examples related to above objectives.

1.1.3.12. Torsion

Knowledge of: Fundamental torsion equation; relationships between torque, stress and power; torsional resilience; maximum and mean torque; coupling bolts; solve simple numerical examples related to above objectives.

1.1.4. Naval architecture and ship construction, including damage control

1.1.4.1. Floatation

Knowledge of: Archimedes principle; force of buoyancy , center of buoyancy; tones per centimeter immersion (TPC); effect of different densities of water on TPC; reserve buoyancy; effect of a change of density on draught; fresh water allowance; diagram of a load line identifying the various draught markings; solve problems related to above objectives.

1.1.4.2. Movement of the centre of gravity

Knowledge of: Centroid and center of gravity; effect of removing, adding and shifting masses on CG; effect of suspending masses; KG values in relation to ship's stability; solve problems related to above objectives.

1.1.4.3. Areas and volumes of ship shapes

Knowledge of: Simpson's 1st, 2nd and 3rd rules for determining areas and volumes of ship shapes, hulls, tanks, centroid and CG of homogenous masses and 1st and 2nd moments of area and volume; computer techniques for calculations using the rules; solve problems related to above objectives.

1.1.4.4. Form coefficients

Knowledge of: Coefficient of fineness of waterplane area; block coefficient; midship coefficient; prismatic coefficient; solve problems related to above objectives.

1.1.4.5. Transverse statical stability

Knowledge of: Heel and list; KB for box - shaped vessels; center of buoyancy of a ship shape; definition and position of metacentre and centre of buoyancy for small inclination angles; transverse BM; effect of changing the draught on KM; moment of static stability; righting lever; unstable equilibrium; neutral equilibrium; ways an unstable ship made stable; cause of stiff and tender ships; how the upsetting moments vary as a ship heels with a negative GM; angle of loll; stability of a ship at angle of loll; angle of loll correction; danger of a ship having a negative GM; mass moving transversely effecting the vessel list; purpose and principle of inclining experiment and precautions before taking; solve problems related to above objectives.

1.1.4.6. Effect of liquids on stability

Knowledge of: Effect on stability when a tank is full of liquid or when a tank is partially filled with liquid; free surface effect on GM during the filling of a double bottom tank; meaning of KG solid and KG fluid; effect of bilging on transverse stability; permeability and stowage factor; purpose of non watertight longitudinal subdivision of tanks; solve problems related to above objectives

1.1.4.7. TPC and displacement curves

Knowledge of: TPC's values at different draughts; change of mean draught; hydrostatic information on a ship's stability information; solve problems related to above objectives.

1.1.4.8. Moments of statical stability

Knowledge of: moment of statical stability; initial stability at large angles of heel; effect of varying freeboard on stability; movement of a ship with negative metacentric height; dynamical stability; load line rules for satisfactory stability; solve problems related to above objectives.

1.1.4.9. Trim

Knowledge of: Trim; center of flotation; longitudinal metacentre; longitudinal centre of buoyancy and metacentre; MCT1cm; changes of trim and draught when masses are moved, added or removed; effect of different densities on trim; effect of bilging on longitudinal stability (trim); effect of trim on tank sounding; solve problems related to above objectives.

1.1.4.10. Dry-docking and grounding

Knowledge of: Required condition of a ship when entering dry dock; process of lining up, supporting and pumping out when dry-docking; effect on a ship's stability when a dry dock is pumped out; critical period during dry docking or grounding; force on the ship's bottom and the GM when grounding takes place; supporting information to determine a ship is in a correct condition for dry docking; types of dock; action to be taken after vessel is grounded; solve problems related to above objectives.

1.1.4.11. Damage control

Knowledge of: Preparation for emergency action; ship's system and equipment for emergency action; procedure to follow when hull is holed (localizing flooding, usage of portable pumps); temporary repair and its limitation; possible repairs to hull damage; freeboard; condition of assignment; type A ship; type B ship; requirement for type B ship with reduced freeboard; reasons for a ship to sink when one compartment is flooded.

1.1.4.12. Ship motion

Knowledge of: Motion if unresisted rolling occurs in still water; variation of the roll; three principle movements of masses affects rolling and pitching; difficulties of obtaining unresisted rolling; necessary data to determines periods of rolling, pitching and heaving; large rolling, purposes and principle operations of fin and tank stabilizers; natural roll period.

1.1.4.13. Rudders

Knowledge of: Angle of heel when turning; factors govern the size and shape of a rudder; rudder angle limitation; force on rudder; torque on the rudder stock; effect on the torque when running astern; effect on the rudder stock of different rudder configurations; purpose of special rudders; types of rudders; stall angle; rudder bearings (pintle) and their clearances; rudder construction and repair; rudder protection against corrosion; solve problems related to above objectives.

1.1.4.14. Resistance, powering and fuel consumption

Knowledge of: Residuary and frictional resistance's; ship resistance estimation; boundary layer and fluids flow; relationship between frictional resistance and ship speed, the wetted area, the surface roughness and the length of the vessel; Freud's law; types of wave when a ship moves; reasons for fitting bulbous bows; fuel consumption at varying speeds; estimation of the potential fuel consumption and variations when running at different conditions; solve problems related to above objectives.

1.1.4.15. Propulsion and propellers

Knowledge of: Measuring turbine and diesel engine-delivered power, thrust power, effective power; relations of the different powers to each other; hull and propeller efficiency; fundamental principle of a propeller; wake; speed of the propeller through the wake; speed of the ship; left and right handed propellers; propellers in a twin screw ship; basic geometry of a propeller; apparent slip; cavitation; effect of cavitation on the thrust and torque and the propeller blades; procedure for speed, power and fuel consumption trials; highly skewed propeller; propeller matching with respect to engine and propeller curves; solve problems related to above objectives.

1.1.4.16. Ship structures

Knowledge of: Definition of ships terms; transverse section of different ships; forces on the hull; static and dynamical forces acting on the structure; hogging and sagging and induced stresses in the top and bottom plating.

Knowledge of: Bending moment; location of maximum bending moment; relation between stress and depths of the structure; role of classification societies in specifying scantlings; strengthening of structure against bending and shear stresses; principal longitudinal strength members; measurement of stress at sea; structural deformation by water pressure, rolling panting and pounding.

Knowledge of: Materials for ship construction; mild steel for construction; connection of steel to steel by welding; problems of welding; aluminum alloys for ship construction; problems of connections between aluminum and steel.

Knowledge of: Different types of keel construction in general use; duct keel and its advantages; construction of double bottom tanks (for longitudinally and transversely framed vessel) in different regions.

Knowledge of: Seams and butts in shell plating; continuity of strength in the vicinity of openings in the shell; different framing system; deep frames; connecting of frames to other part of the structure; bilge keel; deck plating support; effect of discontinuities in the main structures and ways to strengthen them; construction of hatchway openings, hinged watertight door and gas tight door; requirements with openings in the shell for suction and discharge fittings.

Knowledge of: Purpose of the different types of bulk head; minimum number and location of watertight bulk heads; construction of a watertight bulkheads; testing of bulkheads; access through watertight bulkheads; operation of water tight doors; penetration of pipes, electrical and air trunking through the bulkheads; examples of non water tight bulkhead; routine procedures for the use and testing of watertight doors.

Knowledge of: Panting and pounding or slamming; construction of a bow; principal features of bulbous bow, anchor and cable arrangements; principle of operation of bow thrusters; construction of a typical ship's stern; vertical and transverse support for rudder; water tight gland

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for a rudder stock ; attention necessary for a rudder in dry dock; supports for propeller shafts of twin screw ship.

Knowledge of: Typical strengthening in way of deck machinery, propulsion machinery, boiler and pumps; inlet box for ship side valve; deep tank and its purpose and construction; cargo oil, fuel oil, ballast and freshwater tanks arrangements (filling, emptying, sounding, air venting, gas freeing, isolation, heating, drainage at sea and in drydock and access) protective coating used for the different tanks; protection of tanks by fitted anodes; limitations on the application of anodes.

Knowledge of: Forming of separate oil tight tanks in a tanker; purpose of cofferdam in tankers; a typical pumping system in a tanker; inert gas system; ventilation of cargo tanks; carriage of liquefied gas and petroleum and required conditions; construction of LNG & LPG carriers; boil off;.

Knowledge of: Checking on board fittings for survey; annual survey; periods between dry docking; in water survey; special survey.

1.1.4.17. Vibration in ships

Knowledge of: Synchronous or resonant vibration; seriousness of vibration local vibration ; normal sources of vibration; ship's natural frequencies; main causes of ship vibration; prevention of vibration by constructional improvement such as increase in scantling, more framing, etc and engine related methods such as vibration dampers, axial vibration dampers and balance weights; reduction of vibration in vessels already built.

Competence 1.2: operate, monitor and evaluate engine performance and capacity.

Maintain safety of engine equipment, systems and service

1.2.1. Diesel engine

1.2.1.1. Engine performance

Knowledge of : Brake thermal efficiency, fuel consumption and specific fuel consumption; normal working power of main propulsion and electrical generation engines; heat balance for analysis of cooling water, loss to relation, heat in the exhaust and possible recovery of waste heat, brake power, mechanical efficiency; specific fuel consumption; compression ratio of two stroke(long / short stroke engines) and four stroke engines; calculating indicated powers; indicator diagrams and irregularities, light spring diagrams; out of phase diagrams; power balance; load diagram.

1.2.1.2. Engine components

Knowledge of: Engine bed plate; Engine frame ; Main strength member in different engines ; Holding down arrangements; Tie bolts (Single/Twin, Vertical/Horizontal); Cylinder liners; cylinder liner calibration and wear; cylinder liner lubrication; Pistons ; piston rings; Poppet exhaust valves (mechanical and hydraulic operated); Crankshaft ; Crankshaft manufacture, alignment (deflection) and slippage; Engine bearings including cross head arrangement) ; Cylinder covers and mountings ; Cylinder block and scavenging trunk ; Diaphragm and stuffing box ; Timing chain and gear ; Telescopic pipes and swinging arms.

1.2.1.3. Engine lubrication

Knowledge of: Lubricating systems and associated components used in diesel engines; Lubricating oil (properties, good and deteriorated oil); Need for oil analysis, L.O analysis as used for condition monitoring; Bearing's lubrication; Lubrication of top end bearing; concept of uni-lubrication.

1.2.1.4. Fuel injection

Knowledge of: Principle operation of fuel pumps in diesel engine (port and valve controlled); fuel pump parts; fuel cut off devices; Fuel timing; Variable injection timing (Theory, function and adjustment); hydraulically operated fuel valve (function, maintenance and pressure setting); importance of atomization, penetration and turbulence; pilot injection; high pressure pipes.

1.2.1.5. Scavenging and supercharging

Knowledge of: Scavenging process of four stroke and two stroke engines; valve timing diagrams for a naturally aspirated and a pressure charged engine; need for pressure charging and methods; Principle of turbo charging systems (Pulse and Constant pressure); tuned system; pulse converters; types of turbo charger (radial and axial); turbo charger operation; parts of a turbocharger, function of the different parts of a turbocharger and their material; comparison of different types of bearings and their location; cooled and uncooled turbo charger; turbo charger lubrication; turbo charger faults; turbo charger matching; turbo charger surging; turbo charger washing (wet and dry); immobilizing of a turbo charger; cares required when overhauling turbo charger; charge air cooler; moisture trap; scavenge temperature and its effect on engine performance; purpose relief devices fitted to scavenge trunks.

1.2.1.6. Starting and reversing

Knowledge of : Starting systems of two and four stroke diesel engines; Starting air overlap; Main components of starting air system and their function; safety features fitted in the system; Interlocks; Concept of reversing and need for retiming; reversing procedure of different main engines; slow turning; emergency maneuvering and crash astern procedure.

1.2.1.7. Cooling systems

Knowledge of: Cooling systems of piston (oil and water), cylinder, exhaust valve, turbocharger, and fuel valve; need for treatment; types of additives; cascade and split control system.

1.2.1.8. Diesel engine control

Knowledge of: Engine governor; principle of operation; meaning of speed droop; proportional and reset action governors; isochronous governor; governor maintenance; electric governor; bridge control of a direct drive diesel engine; safeties incorporated in bridge control system; load limit program; unattended machinery space requirement; over speed trip; purpose of a fly wheel; shut down and slow down devices.

1.2.1.9. Safeties

Knowledge of: Cause of crankcase explosion and how avoided; early warning of a potential explosion; procedure to follow if oil mist in crankcase; oil mist detector; scavenge fire and action should be taken; means of relieving the pressure in a crankcase and in scavenge trunk when explosion occur; cylinder relief valve purpose and construction; starting air line explosion and safety devices fitted; typical engine shut downs and slow downs.

1.2.1.10. Compressed air

Knowledge of: Simple sketch of a single and multi stage reciprocating air compressor and the corresponding pressure-volume diagram, showing suction, compression (isothermal, polytropic and adiabatic), delivery, and clearance volume, factors governing valve opening and closing in a compressor, swept volume and effective swept volume, definition of volumetric efficiency and need for high volumetric efficiency, meaning of the term "free air delivery", need for using intercoolers; different types of compressor; reciprocating and rotary compressors (operation,

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parts, lubrication, unloading mechanism, safeties, automatic water drain); two and three stage compressors; inter and after cooler; malfunction of suction and delivery valves; start/stop control; stress in pressure vessels; hook stress and axial stress in a thin walled cylindrical pressure vessels; air reservoirs construction and capacity based on regulation; reservoir mountings; reservoir inspection; reservoir common faults.

Knowledge of: Using the characteristic equation to convert free air delivery to actual delivery conditions and vice versa, sketching diagrammatic arrangement of a multi-stage compressor, sketching a pressure-volume diagram for a two stage compressor showing ideal isothermal/polytropic compression.

1.2.1.11. Multi-engine propulsion arrangements

Knowledge of: Arrangement of diesel engines coupled by gears for main propulsion, pumping and generation of electrical power; principle of operation of a fluid coupling; principles of a reverse reduction gear and friction clutch; purpose of a flexible coupling and the principle of its operation; different propulsion plants (diesel/turbo electric, podded drives, water jets); power take off.

1.2.2. Auxiliary steam boilers and evaporators

1.2.2.1. Types of boiler

Knowledge of: All marine boilers including: scotch boiler, composite boiler, Cochran smoke tube boiler / spheroid vertical boiler, Clarkson thimble tube boiler, spanner vertical smoke tube boiler, Aalborg vertical water tube boiler, Sunrod boiler, forced circulation boiler, forced circulation type composite boiler, packaged boiler, steam to steam generator.

1.2.2.2. Boiler Construction

Knowledge of: Furnace and combustion chamber; attachment of furnace to the water drum; types of tubes; tube and tube plates; water drum and steam drum; common defects and methods of repair of above sections.

1.2.2.3. Combustion of fuel in Boilers

Knowledge of: Combustion in a boiler furnace; pressure jet type fuel oil burner; rotating cup fuel oil burner; steam blast jet burner; air register; primary and secondary flame; fuel oil system; automatic combustion control system; refractory soot blowers.

1.2.2.4. Boiler Mountings

Knowledge of: Safety valves (high lift safety valve, full lift safety valve, full bore safety valve); main stop valve; auxiliary stop valve; feed check valve; feed water regulator; water level indicator (direct and indirect gauge glass); low water alarms; blow down valve; scum valve; drain valve; air vents; super heater / economizer circulating valve; chemical dosing valve; salometer valve; soot blower master steam valve; pressure gauge connection; thermometer; man hole and hand hole doors.

1.2.2.5. Waste heat utilization

Knowledge of: Normal minimum difference between the temperature of exhaust gas and water or steam being heated; acceptable temperature of the metal of a waste heat exchanger; steam pressure produced by waste heat systems.

1.2.2.6. Boiler Operation

Knowledge of: Safe procedure of raising steam from cold state; correct procedure of blowing down and opening up a boiler; boiler cleaning; hydraulic test; boiler repair, boiler survey and safety valve adjustment; accumulation of pressure test; soot blowing procedure;

correct procedure of gauge glass blowing; shrinkage and swelling of water level; watch keeping general precaution; taking a boiler out of service for examination; commissioning of new boiler; ingress of oil into boiler, its effect and cleaning procedures.

1.2.2.7. Corrosion in boilers

Knowledge of: Process of electrochemical corrosion; effect of dissolved oxygen in boiler water; effect of excessive acidity of boiler water; effect of infiltration of oils into boiler water; effect of mechanical straining in a boiler; caustic embrittlement; effect of sea water and fresh water in boiler; initial treatment given to fresh water and to sea water before being supplied to a feed system; how sea water could enter into a boiler.

1.2.2.8. Water treatment

Knowledge of: Purpose of treatment of feed water; effect of treating feed water with calcium hydroxide and sodium carbonate; treatment with caustic soda; using of phosphate and its advantage; boiler water chloride control; using of coagulants in boiler water; chemicals used to remove dissolved oxygen form boiler water; precautions for storing and handling hydrazine; effect of pH value of boiler water; purpose of antifoams; avoiding the caustic embrittlement.

1.2.2.9. Steam and condensation lines

Knowledge of: Water hammering and its prevention; steam line lagging and cladding; corrosion in wet steam lines and in the condensate system; how corrosion can be reduced in condensate system and wet steam lines; function of steam trap.

1.2.2.10. Water testing

Knowledge of: Function of a salino-meter; litmus paper; phenolphthalein and total alkalinity tests; chloride test; sulphite test; phosphate test; hardness test; PH value; dissolved oxygen test; total dissolved solids test; hydrazine test.

1.2.2.11. Boiler control and safety devices

Knowledge of: Automatic controls; methods available for pressure controlling of oil fired and exhaust gas boilers; sequence of firing a burner; furnace blow back; safeties (flame failure, high pressures alarms and cut out, low pressure alarm and cut out, high level alarm); emergency stop; principles of a remote water level (Igamma type remote water level indicator).

1.2.2.12. Marine High Pressure Boilers

Knowledge of: Water tube boilers and its mountings; super heaters; steam propulsion plants and auxiliaries involved; tests and treatment required for HP boilers; soot blowing of water tube boiler; inspection, survey and maintenance of water tube boiler.

1.2.2.13. Steam Turbine

Knowledge of: Procedures for warming through turbine installations; warming up procedure from cold, boilers and turbines; preparing the turbine for sea; standby period; H.P & L.P turbine components and materials used; turbine safety devices (over speed and excessive axial movement trip mechanism; low vacuum trip; loss of lubricating oil pressure trip).

1.2.2.14. Evaporators

Knowledge of: Fresh water production from sea water for domestic and boiler feed purposes (high and low temperature, double stage and reverse osmosis); scales deposited in evaporators; principal methods for reducing scale deposits in evaporators; purpose of the demister in an evaporator ; evaporator operational problems; protecting the shell of evaporation; materials used for the manufacture of the evaporators' heat exchangers; density control in evaporation plant; features to run an evaporator automatically; methods making water potable.

1.2.3. Operation and maintenance of auxiliary machinery

1.2.3.1. Shafting

Knowledge of: Limitations on shaft alignment in ships; meaning of off set; initial boring process of bulkheads by various methods; installation of stern tube; fitting of tail shaft and propeller; inter mediate shaft alignment; engine installation; various intermediate shaft alignment techniques; fair curve method of shaft alignment; water and oil lubricated stern tubes; seals and lubrication systems; plumber blocks; couplings; shaft strength; torque , power and angel of twist; torsion meter and dynamometer to obtain shaft power; thrust block; thrust indicator; controllable pitch propeller; CPP bridge control; survey of shafting system components; securing of shaft while the vessel is being towed; propellers fitting and removal.

1.2.3.2. Pumps, pumping systems and prevention of pollution

Knowledge of: Types of pump; reciprocating pumps; centrifugal pumps; axial flow pumps; mixed flow pumps; air extraction; gear and screw displacement pumps; pumps used for discharging chemical and LPG; emergency fire pumps including capacity, rules and regulations; emergency bilge pumps; emergency bilge suction valve; pump characteristics; net positive suction head (NPSH); heat exchangers; means to control heat exchanger corrosion; sea water pipes; domestic water supply; ejectors; sewage and sludge; ballast; bilge; fire main; international shore connection; central cooling system; central priming system.

1.2.3.3. Steering gear

Knowledge of: Electro-hydraulic/electrical telemotor system; steering gear control system; power units (Radial and Axial flow pumps); rudder actuators (ram type, rotary vane); hunting gear mechanism; emergency operation; rudder carrier bearing; steering gear testing, drills and examination; steering gear failure and safeguard (single failure criteria concept, 100% redundancy); international regulation.

1.2.3.4. Cargo handling equipment and deck machinery

Knowledge of: Definition of deck or hull machinery; list of deck machineries; different media of powering deck machineries; limitation on the use of some medias for the powering such machineries; typical points to consider for deck machinery design; benefits gained by using electro-hydraulic as the main source of powering of major deck machineries; hydraulic oil properties, its tests and analysis; hydraulic system components; hydraulic system valves and their function; basic hydraulic systems; shipboard applications of different hydraulic systems; general guidelines on hydraulic systems maintenance; speed and load control; hydraulic cylinders extraction/ retraction equal speed control; passenger ship's typical water tight doors system; basic electric control of hydraulic circuits; different kinds of windlass arrangements; windlass brake; constant tension mooring winch; cargo gear electrical/mechanical safeties (limit switches, relays, stoppers, etc.) .

1.2.4. Fundamentals of automation, instrumentation and control systems

1.2.4.1. Control theory

Knowledge of: Control terminology; closed and open loop control systems; two step control system; simple automatic control system; proportional, integral and derivative action; proportional plus integral action; proportional plus derivative action; proportional plus integral plus derivative action; split range and cascade control.

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1.2.4.2. Operation, testing and maintenance of control systems

Knowledge of: Principles of pneumatic control and components, including valve positioner; controllers (electro pneumatic controller, fuel air ratio controller, viscosity controller); control circuits for controlling temperature and level of marine machinery and systems; load dependant cooling water control system; remote control (pneumatic, electronic, hydraulic); communication between bridge and engine room control system; airsupply unit.

1.2.4.3. Instrumentation and monitoring systems

Knowledge of: Data logger; sequence of alarm signals; pressure measuring devices; temperature measuring devices; level measuring devices; flow measuring devices; strain gauge; types of RPM detectors; various gas detectors.

Proficiency in: Routine setting-up, testing and maintenance of the measuring devices i.e. pressure, temperature, flow, level; performing routine test, maintenance, and fault-finding procedures for pneumatic controllers and control systems.

Competence 1.3: Use of internal communication system

1.3.1. Transmission and reception of messages

Knowledge of: Means to be provided for communicating orders from navigating bridge to the position in the machinery space or in the control room; principle operation of an engine room telegraph; appropriate mean of communication provided to any other positions from which the engines controlled, purpose of using engineer's alarm and where they are located; means of communication provided between the navigation bridge and the steering gear compartment; means of local communication provided between the main machinery control room and the engineer officer's accommodation; means provided in a centralized control position with alarm panels and instrumentation indicating any alarm; alarm system provided for all important pressures, temperatures and other essential parameters; alarm for automatic change-over; communicating through the medium of normal ship board reporting procedure; the officers and crew should communicate with each other in a common language; principles of using public address, talk back system; sound power phone, internal walkie talkie and telephone exchange on board the ship; distinguishing between the various alarms.

1.3.2. Communication recordings

Knowledge of: Ship's movement recording during maneuvering and passage in the navigation bridge and in engine control room; automatic and manual recording of important and essential parameters in engine log book; standing orders and special instructions of the chief engineer officer; recording of reports for ship staff and machinery performances; records of any events related to the main and auxiliary machinery occurred during the engineering watch.

FUNCTION 2: ELECTRICAL, ELECTRONIC AND CONTROL ENGINEERING AT THE MANAGEMENT LEVEL

Competence 2.1: operate electrical and electronic control equipment, test, detect faults and maintain and restore electrical and electronic control equipment to operating condition

2.1.1. Marine Electro technology, electronics and electrical equipment

2.1.1.1. Application of Ohm's and Kirchhoff's laws

Knowledge of: Applications of Ohm's and Kirchhoff's laws; Maxwell's circulating current theorem; super-position of current theorem; application of Wheatstone bridge and its principle of

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operation; principles of a potentiometer; principle of the thermocouple; need for compensation and use of compensating lead.

Proficiency in: Using Kirchhoff's and Ohm's law to solve problem as applicable; use a Wheatstone bridge to measure resistance; use a potentiometer to measure e.m.f.s.

2.1.1.2. Electromagnetism

Knowledge of: Theory of electromagnetism; flux density and ampere turns per meter; core material e.g. air, cast iron, cast steel, mild steel; magnetic fringing; magnetic leakage; hysteresis loss; hysteresis loops for steel and iron; losses in electrical machines and transformers.

2.1.2. Practical knowledge, operation, testing and maintenance of electrical, electronic control equipment including fault diagnostics

2.1.2.1. Electronics

Knowledge of: Properties and structural of crystals; semiconductors and their examples commonly used; properties of semiconductors and their behavior at various temperature; intrinsic conduction in a semi-conductor crystal; electrical equilibrium of semiconductors; properties of most commonly used semiconductors; impurities into a semi conductors and meaning of the term "doping"; N-type and P-type semiconductors and their properties; meaning of the term "junction" and hence PN junction; "diodes" and their behaviors; "avalanch" or "zener" and their behaviors; "avalanch" or "zener" voltage in diodes; important uses of "diodes" in electrical supplies; meaning of "passive components and their features; examples of "passive components" and their common uses; meaning of "active" components and their features; examples of "active" components and their uses; rectifier and their uses; zener diodes and their characteristics; uses of zener diodes; the light-emitting diodes (leds) and their characteristics uses of "leds" transistors and their structure types of transistors and their structure; type of transistors and the principle of operation; uses of transistors; the uni-junction and field effect structure and principle of operation; thyristors; and their constructions; the principle of operation of thyristors; uses of thyristors; electronic circuits and their components parts; printed circuit boards and the assembling technique used; "hybrid" and "monolithic" integrated electronic circuits (ICS); application of integrated circuits as "digital" or "analogue"; programmable logic controllers (PLC) function; comparison of relay and PLC controlled circuits; shipboard application of PLCs.

Proficiency in: Solving numerical problems related to semi conductors' devices circuits; carrying-out supervised program of practical work on electronic used in machinery control and alarm systems.

2.1.2.2. Power Factor Improvement

Knowledge of: Ways of improving power factor; relationship between power factor and line current; disadvantages of low power factor; effects of capacitor in parallel with inductive load on the line and motor currents, line power loss and motor power; relationship between active power and reactive power; power factor; solve problems related to above objectives.

2.1.2.3. Poly-phase Supplies

Knowledge of: The principles of the circuits in a 3-pH alternator, the phase difference and usual color coding; arrangement of star-connector alternator; line and phase, voltage and current of delta connected arrangement; power in 3-phase star and delta connected machines; solve problems in relation to power, KVA, power factor, and current in star and delta loads.

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2.1.2.4. D.C. Generators

Knowledge of: Types of generator used on ships and their application; diagrammatic arrangement of a compound generator; effect of high ambient temperature on field regulation; relationship between voltage and current with shut and series fields; purpose of communicating poles; effect of load changes on D.C generators running in parallel without equalizer connection; procedure to run compound D.C generators in parallel; causes of unsatisfactory load sharing.

2.1.2.5. D.C. Switch gear

Knowledge of: Types and function of D.C switchboards; open-front and dead-front switchboards; construction, operation and maintenance of main switches and circuit breakers; arrangement of typical switchboard connections for a compound wound generator operating in parallel; the purpose and operation of a reverse-current trip; insulation resistance testing device and alarm system; essential instruments for paralleling purposes; sequence of preferential tripping; relationship between time delay and over current; use of earth lamps; protections against short circuits; purpose of fuses and circuit breakers on a distribution board; meaning of rating of a fuse; purpose of filling powder in a cartridge fuse; factors influence the size of fuse fitted to a motor circuit; the principles of construction of busbars; means of cooling busbars and effect of overheating; correct operation of protective devices.

2.1.2.6. A.C. Generators

Knowledge of: Principles of construction of synchronous A.C generators; alternator and motor connections in a 3-wire system; power factor and effect of various loads on power factor of an A.C generator; effect of varying power factor on load/voltage curve of A.C generators; effect of starting a large induction motor on the current and voltage of an A.C generator and other electrical equipment's; types of load on board ship causing excessive voltage dip; approximate power factor of an induction motor during starting; advantage of self-excited compound generators with regard to voltage dip and recovery time; main criteria affecting the parallel operation of A.C generators; the requirement for satisfactory lower sharing between generators; effect of unbalanced loading in 3-pH of a generator; functional and error-operated voltage regulating systems; function of an excitation system; basic principles of self-excited generators; basic principles of separately excited A.C generators; excitations systems in common use; uses of shaft driven generators; method of drive and control of A.C and D.C generators; requirement for diesel driven generator is shaft driven; need for emergency generator, its safeties and different means of starting with regard to regulation.

Knowledge of: The essential parts of an automatic voltage regulator and their function; basic operating principle of A.V.R.; principle of voltage-comparison circuit; purpose of excitation control element; features controlling the load sharing when generators running in parallel; deviation of load sharing and voltage droop; reason for excitation system to carry short circuit current.

2.1.2.7. A.C. Switchgear

Knowledge of: Fittings on an A.C switch board; characteristic of a circuit breaker used for A.C switchboard; main criteria governing the operation of a circuit breaker; the function of a circuit breaker; the purpose of short-time-fault current rating; the purpose of interlocks and their possible misuse; use of earthing of circuit breakers; maintenance and testing of circuit breaker; correct procedure of working with switchgear; the purpose of examining insulators and possible causes of overheating; the procedure for isolation and safety before allowing work on equipment.

Proficiency in: Demonstrating the operation of an A.C circuit breaker and method of closing circuit breaker; performing the safety precautions necessary when a circuit breaker is removed ; demonstrate the safety precautions necessary before commencing work on switch gear; demonstrating the inspection and maintenance of circuit breakers and routine testing of circuit breakers; detect, analyze and correct fault symptoms.

2.1.2.8. Generator protection

Knowledge of: Sequence of events after an overload trips of a generator; preferential trips and alarms; regulation for setting of time delays of preferential trips; over current relay fitted to a circuit breaker; need for instantaneous over current protection; restricted and un-restricted earth fault system; protection, detect and handle loss of power which can occur in a generator and its effect when running in parallel with others; reverse power trip and the need for a time delay; over and under voltage protection and the need for a time delay; list of instrumentation for generators working in parallel; use of current and voltage transformers and their earthing requirements.

Proficiency in: Detecting, analyzing, and correcting faults in generators protection gear.

2.1.2.9. Single and Parallel Operation of Generator

Knowledge of: Determination of power factor, voltage, load and frequency when generator is running alone or running in parallel; controls necessary at the main switchboard for single or parallel operation of generators; conditions required before switching two generators into parallel operation; operation of “lamps bright”, “lamps dark” and “sequence lamps”, purpose of a check synchronizer; the system of automatic selection of diesel generator; automatic starting and putting on load of stand by generator set; emergency shut down.

2.1.2.10. Transformer

Knowledge of: Arrangement of a simple single-phase transformers and its principles of operation; typical applications of transformers; 3-phase transformer; delta-star connections in 3-pH transformers; applications of delta-star 3-pH transformers; advantages of deltastar transformer; liquid-cooled transformers and their potential hazards; attentions required by a transformer.

2.1.2.11. Rectification

Knowledge of: Uses of direct current on board a ship with A.C power supply; purpose of a rectifier; modern rectifiers; construction and function of diodes; effect of over-current and over voltage on rectifiers; environmental conditions adversely affect diodes; use of transformers in rectifier circuits; the principle operation if a rectifier circuit; principle of operation of a four-diode-bridge full wave rectifier; advantage of bridge rectifiers over two-diode rectifiers; circuit used for rectification of 3-pH supply; protective devices required for rectifiers; principle operational characteristics of rectifier materials used.

2.1.2.12. Distribution

Knowledge of: Principle of D.C distribution cable system used on ships; principle of A.C distribution systems and voltages used on ships (including emergency distribution board); the alternator and motor connections in a three wire system; the power frequencies in common use; dangers of running a 50 HZ system from 60 HZ supply; distribution systems with insulated neutral and earthed neutrals, their application and features; normal limit allowed for an earth-fault current; arrangement of earthing system with a resistor for a 3.3 KV system; mixed earthing system.

2.1.2.13. Circuit Protection

Knowledge of: Function of a high rupturing-capacity fuse; meaning of current rating and minimum fusing current of a fuse; re-wireable fuses and associated problems; miniature circuit breakers uses and principle of operation; the protection provided to the feed from a main switch board for: A 3-pH system and two-wire system fed from one phase to an earthed neutral; meaning of a steady load circuit and its protection; size of motors on board ship requiring protection against overload and short circuit; criteria in selection of protection devices for motors and transformers; requirement of circuits for navigational lights; arrangement of a navigational light circuit requirement of circuits for supplying the steering gear; permissible circuit protection for steering gear supply; protection and information required at a shore supply connection box; arrangement of connections for taking on an A.C shore supply, earthing requirement when taking a 3-pH shore supply; emergency control necessary for ventilating fans; fuel and cargo pumps.

2.1.2.14. Cables

Knowledge of: Materials used as conductors in cables; applications for multi-stranded and single-wire cables; commonly used insulation materials; types of PVC insulating compounds used in ship's cables; effect of (temperature variation, oxidation, fire, oil, seawater, acids, solvent); purpose of sheathing electric cables and common sheathing materials; reduction of radio interference; meaning flexible cables and acceptable type of flexible cords; construction of welding cables; obtaining current ratings of cables from approved tables of Administration; care necessary with lay-outs and cable runs in machinery spaces, holds and cold-storage chambers; regulations regarding the recommended use of conduit and trunking; principles of passing cables through bulkheads and decks; the need to bond and earth the sheathing of cables; the potential dangers of passing 3-pH single core cables through steel bulkheads; problems of passing high currents through single core metal sheathed cable.

2.1.2.15. D.C. and A.C. Motors

Knowledge of: Meaning of "dip proof" when applied to a motor; types of motors and their essential differences; ventilation and cooling of totally enclosed motors; the usual speed control methods for D.C motors and typical applications; methods of field control of D.C motors on ships; use of Ward-Leonard system on ships; main types of A.C motors and their use in marine engineering; factors governing speed of synchronous and induction motors; single-cage motors and the behavior of their starting current and torque; the advantages of double cage construction; uses of slip-ring motors; effect of varying supply frequency on speed, temperature, torque, power output, and centrifugal forces of A.C motors; effect of varying the supply voltage in starting torque, starting time, ability to start, speed and current; the effect of accumulation of dirt in a motor; the process of maintaining a motor including initial cleaning fluid, re-varnishing and adjustment of brushes; common causes of trouble with commutators; meaning of single phasing; the causes and the effect of running a 3-pH motor with one phase open-circuited, cause and symptoms of single phasing.

2.1.2.16. Motor Control and Protection

Knowledge of: The purpose of motor protection; arrangement of a D.C motor starter, the principle components and their function; applications of drum and contactor starters; overload setting for cage motors; the overload-protection devices in use on board ship; arrangement of a direct-on-line starter for a cage motor, the principle components and their function, protection against short circuit of A.C motor; criteria used for setting thermal protection relays and their

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advantage compared to magnetic types; the principle of operation of magnetic overload relays; use of thermistors, thermostat and thermocouples as temperature-sensing device for motors; process of replacing a fuse in a 3-pH supply; the principle of star-delta starting and the reasons for its use; need for under voltage protection in motors; effect of prolonged and repeated starting periods on motor windings; the principle of and auto transformer starter and its limitation in frequent starting; the reasons for slip-ring motors and the principles of the starter; effect of making incorrect phase and starter connections; the principle and application of synchros; the function and principles of induction regulator; contact breakers.

Proficiency in: performing maintenance on copper and silver faced contact breakers; detect and rectify faults implanted in motors, starters and controllers.

2.1.2.17. Cells and Batteries

Knowledge of: Difference between primary and secondary cells; construction of an alkaline battery and materials used; care to be taken with cell containers and cover; type of lead-acid battery normally used for marine work; construction of flat-plate battery and materials used; tubular-plate battery and materials used; tubular-plate battery and materials used; tubular-plate battery and its principle difference with flat-plate battery; connecting cells in series, parallel and series-parallel to from a battery; emergency and stand-by duties provided by batteries; maintenance of lead-acid and alkaline batteries for readiness in case of emergency/stand-by conditions; capacity of a battery; range of voltage commonly used for general emergency lighting, engine room lighting, telephone and call system; requirement for capacity of emergency batteries for passenger ships, cargo ships of 500 GT and more and cargo ships of less than 500 GT; the charge and discharge method; automatic switching of batteries including trickle charging and recharging; warning devices and the need for them when batteries are being charged; location of batteries; care necessary when both lead-acid and alkaline batteries are installed in a ship; battery spaces requirements; safety precautions necessary in battery compartments; type of electrolyte in a lead acid and alkaline batteries; dangers of mixing of sulphuric acid and water; care necessary for lead acid and alkaline batteries; the discharge-recharge procedure for lead acid batteries; chargerecharging procedure for alkaline batteries; characteristic and charging procedure of nickelcadmium batteries; battery repairs; action to be taken if dilute sulphuric acid and alkaline electrolyte splashed on the skin and in the eye.

Proficiency in: Examining and reporting on the condition of battery casings, terminal etc.; carry-out topping-up process for lead-acid batteries.

2.1.2.18. Lamps

Knowledge of: General requirements for the areas requiring emergency lighting; means of identifying emergency lighting; effect of varying voltage on lamp life; the principles of incandescent, gas discharging, fluorescent and neon lamps.

2.1.2.19. Tankers, Electrical Safety Systems

Knowledge of: Requirements of Administration and Class for electrical installations on tankers; how generators, switchboards and batteries are separated from cargo tanks; protection necessary for cables which may be exposed to cargo oil, vapor or gas; separation of cables Associated with intrinsically safe circuits; protection necessary to install electrical equipment in flammable atmosphere; requirement in a dangerous spaces of a tanker carrying LNG or LPG; protection necessary to install electrical equipment in a gasdangerous space; the need to isolate electrical equipment before commencing maintenance; the requirements for portable electrical equipment;

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safety measures when a tanker is alongside the terminal; stray electrical energy; meaning of earthing and bonding.

Proficiency in: Identifying cage electrical equipment from data on the name plate; the basic principle and carries-out periodic examination, maintenance and care of flame proof, increased safety; intrinsically safe and pressurized protective equipment.

2.1.2.20. Insulation Testing

Knowledge of: The principles of an instrument for measuring insulation resistance; the common causes of reduction of insulation resistance; the principles of an instrument for measuring insulation resistance; the common causes of reduction of insulation resistance; information to be entered on a record of insulation resistance; satisfactory and minimum values of insulation resistance; drying-out and cleaning procedure for machines exposed or immersed in sea water.

Proficiency in: Testing and recording resistance values of insulated cables in various conditions and temperatures.

Knowledge of: Common electrical graphical symbols and their meaning.

2.1.2.21. Electric Shock

Knowledge of: Effect of D.C and A.C on victims of electric shock; the attention and care necessary for a person who has suffered electric shock; dangers of surface burn as a result of electric shock; procedure to be followed when finding someone who is receiving an electric shock.

FUNCTION 3: MAINTENANCE AND REPAIR AT THE MANAGEMENT LEVEL

Competence 3.1: Organize safe maintenance and repair procedures

3.1.1. Ships Maintenance

3.1.1.1. Preparation for maintenance

Knowledge of: Permit to work system; precaution required when entering into enclosed spaces; work planning; job distribution according to work plan; various maintenance strategies; analysis of work: Statutory and non-statutory requirements; watch keeping; maintenance; cargo work; testing systems; training of others on board; associated work such as: mooring and unmooring, food and hygiene, storing and bunkering, preparing for dry docking and surveys, administration, evaluation of personnel and personal safeties.

3.1.1.2. Planned maintenance

Knowledge of: Meaning of planned maintenance system; practical knowledge (instruction manual consideration, history of machinery, appropriate tool, spare parts availability, legal and safety consideration); dismantling and inspection strategy; assembly and testing.

3.1.1.3. Condition monitoring / predictive maintenance

Knowledge of: Meaning of condition monitoring; information obtained from actual working condition; various methods or measuring instrument reflecting working condition (oil analysis, vibration analysis, acoustic emission, pressure, temperature, etc.); predictive maintenance based on condition monitoring; comparison between planned maintenance and predictive maintenance.

3.1.1.4. Dry docking

Knowledge of: Preparations for dry docking and repair; phases normally acted in relation to dry-docking or major ship repair; how work to be carried out at a ship repair yard; distribution of

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work between ship yard and ship's crew; importance of an accurate and comprehensive specification; main parts of repair specification; general conditions items; general services items; activities at the yard; major preparations by the shipping company before ship's arrival at the yard; major preparations for repair work on board before arrival at the yard; organization and actions during stay at the yard; main points discussion at the daily meeting between responsible personnel from both sides; means of communication between yard and vessel when in dry dock; checks on completion of dry docking; pre-departure check list before leaving dry dock.

3.1.1.5. Hull Protection

Knowledge of: Corrosion theory; ships hull corrosion; section of ships require more attention; methods of hull protection against corrosion (sacrificial anodes, impressed current system, coating); fouling; effect of fouling on ships performance and environment; anti fouling systems; regulation concerning anti fouling coating.

3.1.1.6. Painting

Knowledge of: Paints components; surface preparation; methods of surface preparation; paint application methods; atmospheric condition when applying paint; thickness measurement.

Competence 3.2: Detect and identify the cause of machinery malfunction and correct faults

The required practical knowledge of this competence shall be obtained from in-service experience, approved training ship or simulator training where appropriate.

Competence 3.3: Ensure safe working practices

The required practical knowledge of this competence shall be obtained from in-service experience, approved training ship or simulator training where appropriate.

FUNCTION 4: CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR PERSONS ON BOARD AT THE MANAGEMENT LEVEL

Competence 4.1: Control trim, stability and stress

The required knowledge, understanding and proficiency of this competence have been brought in the function 1 under the section 1.1.4 (Naval architecture and ship construction, including damage control).

Competence 4.2: Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment.

4.2.1. Introduction to maritime law

Knowledge of: Maritime law basis; matters of safety, protection of the marine environment and conditions of employment covered by statute law; international conventions as the main source of maritime law; adoption of international conventions and agreements; main originators of international conventions concerned with maritime law.

Knowledge of: National maritime legislations for implementing international conventions and agreements.

4.2.2. Certificates and documents required to be carried on board ships by international conventions

Knowledge of: Classification society certificates for hull and machinery, where appropriate, refrigerating machinery and cargo. Handling appliances; anchor and chain cable certificate; inflatable life raft inspection certificate; stability, loading and ballasting information; damage

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control plan and booklets; document of authorization for grain loading; oil record book; official log books; seamen's discharge books; certificates of competency of officers and ratings; minimum safe manning document; certificate of nationality (ship's register); International tonnage certificate; international load line certificate; passenger ship safety certificate; cargo ship safety construction certificate; cargo ship safety equipment certificate; cargo ship safety radiotelegraphy certificate; international oil pollution prevention certificate; ISM related certificates; any other appropriate certificates depends on ships type as applied by SOLAS.

4.2.3. International conventional for the safety of life at sea,1974 (SOLAS 74)

Knowledge of: Regulations for ships engaged on international voyages; passenger ship, cargo ship and tanker ship; surveys for enforcement of the provisions of SOLAS; requirement for surveys of hull, machinery and equipment of cargo ships; period of validity of each of the certificates; procedures to be followed by officers authorized by a port state in exercising control regarding convention's certificates; minimum manning requirements; procedure for testing of the ship's steering gear before departure; requirements for emergency steering drills; entries to be made in the log book regarding the checks and tests of the steering drills; entries to be made in the log book regarding the checks and tests of the steering gear and the holding of emergency drills. Regulations for the carriage of dangerous goods; international bulk chemical tanker; international bulk chemical code (IBC code); chemical tanker; international gas carrier code (IGC code); gas carrier; requirement of the IBC code and IGC code.

4.2.4. International convention on standards of training, certification and watch keeping for seafarers 1978, as amended by the resolution 1 of the 1995 conference (STCW 95)

Knowledge of: General obligations under the convention; purpose of the convention; application of the convention; mandatory minimum requirements for the certification of masters, officers, radio operations and ratings forming part of a navigational watch or an engineering watch; mandatory minimum requirements for the training and qualifications of masters, officers and ratings of oil, chemical and gas tankers; requirements for continued proficiency and updating of masters, deck, engineer and radio officers; basic principles in keeping engineering watches; company and officer's responsibilities under the convention.

4.2.5. International convention for the prevention of pollution from ships, 1973 and the protocol of 1978 (MARPOL 73/78)

Knowledge of: Purpose of MARPOL 73/78, violation of the convention and the consequences; inspection by port state authorities; provisions for the detection of violations and enforcement of the convention; reports on incidents; ANNEX I (requirements for the prevention of pollution by oil); meaning of oil content or oily mixture, oil fuel, oil tanker, combination carrier, nearest land special area, instantaneous rate of discharge of oil content, wing tank, center tank slop tank, clean ballast, segregated ballast; surveys and inspections under the provisions of MARPOL convention; master's duty to report when an accident occurs or a defect is discovered regarding the equipment covered by MARPOL; regulations regarding the discharging of clean or segregated ballast; conditions which allow the bilge water discharge from machinery space in a special area; circumstances in which the regulations in the discharge of oil or oily mixture do not apply; regulations for new crude oil tankers of 20,000 tons deadweight and above; requirements for the provision of oil record books; entries required for machinery space operations in part I of the oil record book; requirement for SOPEP manual and procedures; ANNEX II (requirements for ships carrying noxious liquid substances in bulk); ANNEX III (provisions for the carriage of

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harmful substances in package form); ANNEX IV (provisions regarding the discharge of sewage into the sea); ANNEX V (garbage handling and disposal regulations); ANNEX VI (air pollution regulations and possible reduction methods).

4.2.6. Maritime labour conventions and recommendations

Knowledge of: Convention concerning minimum standards in merchant ships; national laws or regulations for seagoing ships; regulations and laws for safety standards, convention fixing the minimum age for the admission of young persons to employment; hours of work on board ship and manning; convention concerning the prevention of occupational accidents to seafarers; convention concerning the medical examination of seafarers.

4.2.7. Classification societies

Knowledge of: Reasons for classing a ship with a classification society; ships building under survey; classification society duties; cargo handling equipment survey; periodical survey, annual survey, docking survey, intermediate survey; special survey; occasional survey after any damage to the hull, machinery or equipment; repair or alterations survey; surveys for issuing of statutory certificates on behalf of governments; types of certificates issued by class (interim, conditional,..).

Competence 4.3: Develop emergency and damage control plans and handle emergency situation.

Emergency preparedness plan

Knowledge of : Planning in preparation for emergency action; ship's system and equipment in preparations for emergencies; availability of emergency equipment; procedure to follow if a ship's hull is holed; importance of localizing the flooding; using of portable pumps; limiting factors on temporary repairs; possible repairs to hull damage; the position and operation of cross flooding arrangements.

Fire protection, detection and extinction

Knowledge of: Basic principles of the regulations on fire protection; properties of "A" class and "B" class divisions; main vertical zones, accommodation spaces; public spaces; service spaces, cargo spaces; RO- RO cargo spaces, both open and closed; special category spaces; machinery spaces of category A; control stations; information in fire control plans or booklets; instructions for the maintenance and operation of all firefighting equipment and installations on board; fire control plans or a booklet for the assistance of shore side fire fighting personnel; all fire extinguishing appliances availability for using at all times during the voyage; responding to fire alarm on passenger ship; training for fire patrol; training for fire patrol; special requirements for ships carrying dangerous goods.

Function and use of life-saving appliances

Knowledge of: The functions, launching and use of life saving appliances.

Competence 4.4: Organize and manage the crew

4.4.1. Personnel management

4.4.1.1. Principles for controlling subordinates and maintaining good relationships

Understanding in: Giving orders and dealing with offenders; being firm; treating the staff; keeping staff well informed; considering and making allowances for differences in nationality language, religion and other cultural matters affecting behavior and attitude; controlling the staff; factors governing attitudes of staff; appreciating staff's services.

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4.4.1.2. Staff attitudes

Understanding in: Why people work; being useful member of society; security and standard of living; manual and mental skills of staff; the need to achieve ambitions and improve their status.

4.4.1.3. Exercise of authority

Understanding in: Why a person must use his own authority; the real authority of a rank.

4.4.1.4. Group behavior

Understanding in: Group behavior; performance of individuals

4.4.2. Organization of staff

4.4.2.1. Manning arrangements

Knowledge of: Organization on board depends on ship design manning arrangements; manning of ships with unattended machinery space and bridge control of main engines; manning for hatch covers operation, cargo valves operation on a tanker, tank cleaning in a tanker, painting by crew, engine-room day work staff; conventional department system manning arrangement; general purpose (GP) manning; inter departmental flexibility (IDF) manning arrangements; systems acceptable to administration.

4.4.2.2. Allocation of staff

Knowledge of: Chief engineer officer (all work associated with machinery, including deck machinery); chief officer (in addition to watch keeping all work associated with deck equipment and cargo handling); catering officer (all work associated with obtaining, storing and processing food).

4.4.2.3. Organization for safety and emergencies

Knowledge of : Appointment of safety officers, fire officer, chief engineer as technical adviser to the fire officer (chief officer) for fires in machinery spaces; display the muster list and distribution of muster card; fire and abandon ship drills.

4.4.2.4. Organizing for staff duties

Knowledge of: Watch keeping officers and their duties for deck and engine room; helmsmen's; deck maintenance, radio room maintenance, engine-room maintenance and catering.

4.4.2.5. Organizing for maintenance

Knowledge of: Checklists, skill of staff and work schedules for safety equipments, deck maintenance, radio room maintenance, engine-room maintenance and catering.

4.4.2.6. Ship's records

Knowledge of : Records and certificates kept on board and maintained in good order such as document of nationality (ship's register), official logbook, drawing diagrams and instruction books supplied by shipyard, company's instructions and circulars, test certificates for wires, shackles and lifting gear, administration and classification society certificates.

4.4.2.7. Organizing communications on the ship

Knowledge of: Regular meeting on board; safety meetings and management meetings; safety committee.

4.4.2.8. Meeting techniques

Knowledge of: Performing at meetings; training on meeting technique; a successful meeting; types of meeting; objective of the meeting; sequence of the meeting.

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4.4.3. Training on board ships

4.4.3.1. Training methods

Knowledge of : Purpose of on-board training; preparation before the start of a training relevant to the trainee's work and duties; conducting training session; routine training such as fire and abandon ship drills; methods for training, areas in which is required for training.

4.4.3.2. Training in safety

Knowledge of: Training in use of life-saving appliances such as lifejackets, immersion suits, muster stations, boarding, launching and clearing the survival craft and rescue boats, use of all survival equipment, radio life saving appliances; other functions in the muster list and emergency instructions, emergency repair of the life saving appliances; abandon ship drills on cargo and passenger ships; instructions to each member of crew regarding using of life saving appliances.

4.4.3.3. Emergency drills training in ships operations

Knowledge of: Avoiding routine exercises; essential tasks at each drill; emergency teams; examples of fire drills; examples of boat drills.

4.4.3.4. Training in ship operations

Knowledge of: Departmental training for operations including deck department, engine department, catering department.

4.4.3.5. Training in ship maintenance

Knowledge of: Departmental training for maintenance including deck, engine and catering department.

4.4.3.6. Teaching and assessment techniques

Knowledge of: Preparing the appropriate lesson plans; teaching aids improving the efficiency of teaching/learning; body language; establishing eye contact with trainees; practical steps to efficient teaching; continuous assessment; final assessment.

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ماده ۳-۹ مواد درسی دوره افسر سر مهندس در کشتی‌های با قدرت موتور ۳۰۰۰ کیلووات یا بیشتر - سفرهای نامحدود

1. ADVANCED ENGINEERING MANAGEMENT

1.1. National and international maritime regulations and requirements

Knowledge of: International and national laws governing shipping; Significance of maritime law; International maritime organization; flag state, coastal state and port state jurisdiction.

1.2. Classification societies and their functions

Knowledge of: Reasons for having a ship classed with a classification society; classification society's approval of plants, examination and test of manufacture parts and materials during building of hull, machinery, refrigerating machinery and equipments such as anchors, chain cables, mooring ropes, mooring arrangements, windlass, mooring winches and cargo handling; certificate of class and its content; surveys of existing ships; periodical survey; Annual survey intermediate survey, 2.5 years docking and 4 years special surveys; continuous survey of hull and machinery; occasional survey after any damage to the hull and machinery or equipment which can affect the ship seaworthiness; repairs or alterations must be carried out under survey; loading port survey.

1.3. Personnel management, Organization and Training on board ships, safety management, Technical management, human reactions and prevention of human error

Knowledge of: Principles for controlling subordinates and maintaining good relationships; staff attitudes; exercise of authority; group behavior; condition of employment; manning arrangements; organizing for safety and emergencies; ship's record; organizing for safety and emergencies; ship's record; organizing communication on the ship; meeting techniques; training on board ships emergency drills; The nature of accidents, accident reporting, investigation and analysis ;Fleet management, dry dock specification, vessel technical management.

1.4. Ship's filing system and documentation Knowledge of: proper working condition, and all repairs of machineries in engine room, propeller, major fire fighting equipment (fixed CO2 flooding and foam systems, all fire pumps), deck machinery, cargo pumping plants, all electrical equipment, lifeboat motors, galley and pantry equipment, steam, electrical or fuel connection and/or machinery, laundry machinery, refrigerating machinery and domestic refrigerators.

Knowledge of: Technical report writing methods; Daily and end of the month report; Documentation; Defect lists; Filing system; Stores and spare parts requisition with regard to R.O.B; Dry dock specification list; Monthly status of survey.

1.5. International convention on standards of training, certification and watch keeping for seafarers 1978, as amended by the resolution 1 of the 1995 conference (STCW 95)

Knowledge of: General obligations under the convention; purpose of the convention; application of the convention; mandatory minimum requirements for the certification of masters, officers, radio operations and ratings forming part of a navigational watch or an engineering watch; mandatory minimum requirements for the training and qualifications of masters, officers and ratings of oil, chemical tankers and gas carriers; requirements for continued proficiency and

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updating of masters, deck, engineer and radio officers; basic principles in keeping engineering watches; company and officer's responsibilities under the convention.

1.6. ISM code Knowledge of: Definitions; objectives; applications; functional requirement for a safety management system (SMS); safety and environmental protection policy; designated persons; master's responsibility and authority; resources and personnel development of plans for shipboard operations; emergency preparedness; reports and analysis of nonconformities, accidents and hazardous occurrences; maintenance of the ship and equipment; documentation; company verification, review and evaluation; certification, verification and control.

1.7. P&I club, charter party and marine insurance Familiarity with: Handling of claims, legal dispute (claims) outside Iranian water; charter party disputes; operation/ post fixture disputes; hull and machinery claims; general average claims; particular average claims; collision claim together with the P&I club; P&I cargo claims; deserter claims; fines for oil pollution and claims; non-marine war risk insurance CLC certificates; lay time return premium.

1.8. Safety regulations, SOLAS convention and other maritime conventions Knowledge of: Convention applies to different ships; purposes of regulations for freeboard; regulations applied to ships engaged on international voyages; load line mark appropriate to the particular voyage and condition of service; provisions regarding the fitting of watertight doors in passenger ships; the requirements for drills, operation and inspection of watertight doors and other openings in passenger ships; side scuttles and other openings, related drills and inspections required by the regulations; basic principles of the regulations on fire protection; special requirements for ships carrying dangerous goods; training required by the fire patrol; the instructions concerning the maintenance and operation of all fire fighting equipment and installation; the procedure for testing of the ship's steering gear before departure; convention concerning the minimum requirements of professional capacity for masters and officers on board merchant ships; I.L.O convention: regulations concerning crew wages, hours of work on board merchant ships; crew accommodation on board ship; convention concerning the prevention of occupational accidents to seafarers; convention concerning the medical examination of seafarers; united nations convention on the law of the sea (UNCLOS).

1.9. Ship's surveys and inspection for class and certificates to be carried on board

1.9.1. Port and flag state control

Knowledge of: Port/ flag state inspection; frequency of inspections and factors governing the inspection; certificates and documents which required to be carried by international conventions and agreement and their purpose; Certificates to be carried out on board ship (Statutory and Trade certificates); International Load lines convention; International health regulation.

1.9.2. Surveys Knowledge of: Requirements for initial and periodical surveys; list the surveys to which a passenger ship must be subjected; extent of the surveys of passenger ships; requirements for survey; extent of the surveys of hull, machinery and other equipment of cargo ships; issuing certificates after survey to ships; the period of validity of each of the certificates; validity of an exemption certificate; the circumstances under which other certificates may be extended and the maximum extension permitted; the

circumstances in which certificates cease to be valid; inspections which may be made by port state authorities and outlines actions they may take; surveys and inspections required under the provisions of MARPOL 73/78; Pollution of the main environment; force majeure; rights of

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coastal states to adopt laws and regulations for the prevention of pollution and seaworthiness of vessels.

1.10. Emergency preparedness for oil spill, fire, flooding, collision, grounding and accidents involving personnel.

Knowledge of: The allocation of duties and responsibilities of individuals to identified plans in cases of: oil tank over flow, hull leakage, grounding, pipe line leakage, fire, flooding, collision and actions to be taken to gain control in each defined emergency; primary and secondary communication methods; third party support agencies and method of contact; procedures for notifying and maintaining contact with the company; procedures for handling the media; extensive list(s) of contacts on a global basis who may be called on to render assistance; company program of emergency drills specific to each ship type in addition to those in SOLAS; emergency drills and proper training to tackle such emergencies.

1.11. Watch keeping arrangements for safe engineering watch

Knowledge of: Organizing engineering watch-keeping under different conditions such as restricted visibility, efficient engineering watch, assisting the officer in charge of the engineering watch when engine damage, watch keeping officers responsibilities and their duties; in UMS condition, officers in charge; day work officers and staff and their duties; arranging engine room watches for officers and ratings considering the following criteria; type of ship and condition of the engineering watch; the safety of life, ship, cargo, port and protection of environment; international, national and local regulations; preventing fatigue of person in complying with the minimum rest hours.

1.12. Marpol 73/78 convention and related certificates

Knowledge of: Annex I: Prevention of pollution by Oil; Annex II: Prevention of pollution by noxious substances carried in bulk; Annex III: Prevention of pollution by harmful substances carried in packaged form; Annex IV: Prevention of pollution by sewage; Annex V: Prevention of pollution by garbage; Annex VI: Air pollution; Certificates related to Marpol conventions

1.13. Maintenance policy and ship's operation performance

Knowledge of: The need for an optimal maintenance policy; Planned maintenance system; performance monitoring of machinery and main engine; maintenance based on condition monitoring; fuel consumption calculation; Measuring engine power; Power balance of engine; theory of matching propeller to the engine; Load diagram and load limits; new developments in propulsion systems.

1.14. Bunkering procedure

Knowledge of: Calculating bunker requirement for a voyage; fuel oil tank capacity and correct usage of approved sounding table for related calculations; safe margin of bunkering capacity with regard to vessel's trim; precautions to be taken before/ during and after bunkering operation.

1.15. Reporting procedure of emergencies

Knowledge of: When to report; whom to report; how to report and what to report, initial and follow up report, national and international coordination.

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ماده ۴-۹ مواد درسی دوره افسر مهندس سوم در کشتیهای با قدرت موتور کمتر از ۳۰۰۰ کیلووات- سفرهای نزدیک به ساحل

FUNCTION 1: MARINE ENGINEERING AT OPERATIONAL LEVEL

Competence 1.1: Use appropriate tools for fabrication and repair operations typically performed on ships

1.1.1. Use of hand power tools, basic workshop practice and fitting, including safe working practice.

Knowledge of: Hazards in an engineering environment; responsibility of the employee under the health and safety at work (Occupational Health and Safety), dangers associated with unsuitable clothing, long hair, ordinary foot wear (instead of safety shoes), jewelry, need for eye protection and types of eye protection; safety on electricity; coping with emergency situations, correct and safe practice when using a grinding , drilling and lathe machine, identify start/ stop and emergency stop buttons; use of protective clothing, gloves and machine guards Marking-out process; care of a vee blocks, a surface plate, scribes, dividers, odd-leg calipers; uses of 60° and 90° center punches.

Proficiency in: marking out exercises using a surface plate, vee blocks, scribes, dividers, odd-leg calipers and 60° and 90° center punches. Types of hacksaw, hammer, taps, die, scrapers, chisels and their applications;

Proficiency in: using correct technique for sawing common materials; using of files, scrapers, hammer, taps, dies, chisels, correctly on given exercises, sharpening of scrapers and chisels safety and correctly.

Knowledge of: types of power used in hand tools, processes for which powered hand tools are used, care necessary for the (electric, pneumatic or hydraulic) supply line of powered hand tools.

Proficiency in: using powered hand tools safely and correctly.

Knowledge of: need for dimensional control; functional and non-functional dimensions; principles and uses of a ruler, outside and inside calipers, non-digital micrometers, verniers, feeler gauges, dial test indicator and care necessary for each.

Proficiency in: using steel rule, inside and outside micrometers, tri-square to check 90° angles, bevel gauge and a plain protractor, small scale vernier calipers to measure internal and external dimensions, checking and adjusting the zero reading of a micrometer, a standard dial test indicator.

1.1.2. Machine tools

Knowledge of: Uses of drilling machine, types of drilling machines; component parts and drive system of a drilling machine, operations can be carried out by different types of drilling machine; features of twist drill, trepanning (drill bit) tools and reamers; cares necessary when using automatic feed; care necessary when drilling soft materials; care necessary when sharpening twist drills.

Proficiency in: Inserting and removing drills with parallel and tapered shanks; sharpening correctly and safety twist drills; clamping and work holding safely; using drilling machines to produce through and blind holes; use of drill selection charts for threads and holes; use of drill selection charts for threads and holes.

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Knowledge of: Function of a center lathe; the component parts and drive system of a center lathe, essential movement of a center lathe for various tasks, the purpose and uses of 3 and 4 jaws chucks, carriers, centers and face plate, finding cutting speed for different tasks, using center lathe for thread cutting and taper turning, safety precautions necessary when using a center lathe.

Proficiency in: Using center lathe to produce a mild steel bar with good surface finish, cutting threads, taper turning; use of drills, boring tools on a lathe machine to produce holes to a given specifications.

Knowledge of: Function of a shaping machine; basic cutting action of a shaping machine; component parts of a shaping machine; cares and safety precautions necessary when using a shaping machine.

Proficiency in: Using a shaping machine correctly and safely to produce simple forms to a given specification.

Knowledge of: Selection of appropriate cutting tools for various cutting operations by hand and machine tools; profile of a cutting edge; essential requirements when setting-up a tool and dimensional tolerances; uses of straight knife-edge and oblique cutting tools; difference between grinding and sharpening tools; function and types of cutting fluid.

Proficiency in: Identifying using and maintaining the appropriate cutting tools for various cutting operations by hands and machine tools; using published tables for obtaining the correct cutting speeds.

1.1.3. Marine engineering materials and processes

Knowledge of: Choice of materials for marine engineering components, mechanical properties of a material and their definition, uses and principle mechanical properties of low, medium and high carbon steel, properties and uses of cast iron, meaning of alloys, uses and components metals of brass, bronze and with metal, normal range of carbon content in mild steel, cast steel, and cast iron, ferrous and non-ferrous basic difference, purpose of alloying elements and nickel chromium and molybdenum in steels used in marine engineering.

Knowledge of: Various characteristics of metals such as ductility, tensile stress, brittleness, vibration, differentiation between ferrous and non-ferrous metals, and their etc (only a simple comparison of those metals commonly used in workshop fabrication and repairs).

1.1.4. Fabrication, welding, jointing and cutting

Knowledge of: Ways of making permanent joints, Riveting, Soldering, Welding, the principle of common forms of riveted joints and range of rivets commonly used, the basic principle of soldering, basic types of soldering and their applications, the main hazards of and precautions necessary when soldering, self secured joints.

Proficiency in: Making riveted joints; making soft and hard soldered joints, making self secured joints.

Knowledge of: Types of threaded fasteners, use of black and bright nuts and bolts and set screws, factors for identify nuts and bolts, use of studs, positive locking device and friction locking.

Proficiency in: Identifying the different bolt or screw, fitting studs and bolts using correct tightening procedure, removing intact and broken studs and split nuts and protecting finished surfaces.

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Knowledge of: Principles of electric arc welding, suitability of low, medium and high carbon steels, A.C and D.C welding and voltages used, electrodes classifications and purpose of electrode covering, correct storage of electrode, tools commonly used when welding. Welded joints in Low-Carbon steel, Common Faults in Welded Joints. Principles of thermal cutting

Knowledge of: Gas welding, low pressure and high pressure systems, proportions of oxygen and acetylene to produce various flame, dangers of handling acetylene gas and method of its storage, safety fittings for an acetylene gas cylinder, safety features of a gas pressure gauge, principle parts of light pressure blow pipe and care necessary for blow pipe nozzles and hoses, purpose of flash back arrestors, purpose of the cylinder manifold system, recognition of different gases using color codes, left hand and right hand gas welding techniques and their respective limitations and advantages, principle of cutting ferrous metals using oxy-acetylene equipment.

Proficiency in: Preparing plate edges for welding, using correct techniques to make welded butt and fillet joints using electric arc/gas welding technique, carry out destructive tests on welded joints, Condition necessary in order to cut when using a oxygen fuel gas mixtures, list of gases commonly used as fuel, factors effecting the quality of cutting.

Proficiency in: Thermal Cutting, using an oxygen-fuel gas cutting torch to cut straight and curves in mild steel plate up to 10 mm thick and to crop mild steel sections. Observing Safety and Health when Welding, protective clothing which should be worn when welding at a bench or in difficult situation/ odd positions, measures necessary to protect other personnel when welding, dangers and effect of radiation from welding and fume on human and means of dealing with it, precautions necessary when handling and storing compressed gas cylinders of oxygen and acetylene, welding and cutting of tanks safety measures.

1.1.5. Marine engineering drawing

Knowledge of: Purpose of general arrangement, component and assembly drawings; user of collective and pictorial drawings; standard sizes of drawing paper; application of lines, meaning of projection and their symbols of auxiliary projection.

Knowledge of: Common terminology related to screw threads, name of threads which are common on nuts and bolts and pipes; threads used for power transmission and their application; meaning of multiple thread and its use; range of socket; head screw; range of machine screws.

Proficiency in: Identifying left and right hand screw threads; drawing a nut, stud and washer assembly in a tapped hole.

Knowledge of: Uses of lock washer, spring washer and tab washers, locking by adhesive, peening and wire; uses of taper pins, parallel pins, and split pins; uses of locking rings; identifying common rivet heads and the application; Sketching common riveted joints; Symbols used for various welded connections; need for limits and fitting; meaning of tolerance, actual size, basic size and normal size; meaning of clearance fit, transition fits and interference fits, meaning of geometrical tolerances learning and related symbols.

Competence 1.2: Use of hand tools and measuring equipment for dismantling, maintenance repair and re-assembly of shipboard plant and equipment

1.2.1. Marine engineering maintenance

Knowledge of: Identifying relevant manuals and drawings; preparation which is required for work on machinery and equipment; safety measures required before, during and after for maintenance; identifying the correct tools for dismantling, inspection, repairing and reassembling; recording the maintenance activity.

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Proficiency in: Dismantling the unit according to instruction manual; erecting safe working platform; select and use correct spanners and screwdriver; lifting machinery and components employing correct techniques; transport machinery; examine components taking measurement as appropriate and report on their condition; protects opened-up machinery; renew components; reassemble components; cut new joints or gasket; check and adjust running clearances; fit seals; gland packing; apply jointing compounds; tighten cover bolts in correct sequence; apply correct tightening torques to nuts; apply pressure tests and purge air; check free movement of moving parts by hand; run unit off-load and on load; make unit available for use, removing blank; make entry in log book.

Competence 1.3: Use of hand tools electrical and electronic measuring and testing equipment for fault finding.

1.3.1. Use of electrical measuring and testing equipment

Knowledge of: Range of voltages used for testing ships equipment; function and uses of insulation tester, continuity tester, digital and analogue multi meters, clamp meter and a live line tester.

Proficiency in: Using correctly and safety an insulation tester and making entries of test readings into a record card, a continuity tester and making entire of test reading into record card; digital and analogue multi meters and checking the meter and a live line tester, ammeters and voltmeters.

1.3.2. Safety requirements for working on shipboard electrical system

Knowledge of: essential safety precautions when working in electrical equipment; causes of electric shock.

Competence 1.4: Maintain a Safe Engineering Watch

1.4.1. Duties associated with taking over and accepting a watch **Understanding in:** ensuring the members of the relieving engineering watch are fully capable of performing their duties effectively standing orders and special instructions of the chief engineer officer relating to the operation of the ship's system and machinery; the nature of all work being performed on machinery and systems, the personnel involved and potential hazards; the level and the condition of water or residues in bilges, ballast tanks, slop tanks, reserve tanks, fresh water tanks, sewage tanks and any special requirements for or disposal of the contents there of; the condition and level of fuel in the reserve tanks, settling tank, day tank and other fuel storage facilities; special requirements relating to sanitary system disposal; condition and mode of operation of the various main and auxiliary systems, including the electrical power distribution system; the condition of monitoring and control console equipment, and which equipment is being operated manually; the condition and mode of operation of automatic boiler controls such as flame safeguard control systems, limit control systems, combustion control systems, fuel supply control systems and other equipment related to the operation of steam boilers; any special modes of operation dictated by equipment failure or adverse ship conditions; the availability and use of fire fighting appliances; the state of completion of engine room log.

1.4.2. Routine duties undertaken during a watch.

Knowledge of and Proficiency in: The assigned watch keeping duties. Use of appropriate internal communication system; escape routes from machinery spaces; engine room alarm systems and be able to distinguish between the various alarms, with special reference to the fire extinguishing media alarm; the number, location and types of fire fighting equipment and

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damage control gear in the machinery spaces to be observed; operating the propulsion equipment in response to needs for changes in direction or speed; keeping the main propulsion plant and auxiliary system under constant supervision until properly relieved and periodically inspect the machinery and steering gear spaces are made for the purpose of observing and reporting equipment malfunctions or break downs, performing or directing routine adjustment, required upkeep and any other necessary task; take the necessary action to contain the effects of damage resulting from equipment malfunction or failure and take immediate remedial actions to ensure the safety of the ship, cargo operation, the port and its environment when vessel in port.

1.4.3. Maintenance of the machinery space log book and significance of the readings

Taken Understanding and Proficiency in: Co-operating with any engineer in charge of maintenance work during all preventive maintenance, damage control or repairs; isolating and bypassing machinery to be worked on; adjusting the remaining plant to function adequately and safety during the maintenance period, recording in the engine room log book, importance of log book, the equipment worked on and the personnel involved, and safety steps have been taken, for the benefit of relieving officers and for record purposes; testing and putting into service when necessary the repaired machinery or equipment; ensuring any engine room rating who perform maintenance duties are available to assist in the manual operation of machinery in the event of automatic equipment failure; detailed repair maintenance involving repairs to electrical, mechanical, hydraulic, pneumatic or application electronic equipment throughout the ship shall be performed and recorded.

1.4.4. Duties associated with handing over a watch

Knowledge of: The officer in charge of the engineering watch should not hand over the watch to the relieving officer if there is reason to believe that the latter is not capable of carrying out the watch keeping duties effectively, in which case the chief engineer officer to be notified; the state of any special modes of operation dictated by equipment failure to be reported to take over officer; condition and mode of operation of the various main and auxiliary systems including the electrical power distribution system to be reported to take over officer; ensuring that all events related to the main and auxiliary machinery which have occurred during the watch are suitably recorded.

1.4.5. Safety and emergency procedures

Knowledge of and Proficiency in: Taking action necessary to limit the effects of damage resulting from equipment breakdown, fire flooding rupture, collision, stranding, or other cause; when the engine room put in a stand by condition, the officer in charge of an engineering watch shall ensure that all machinery and equipment which may be used during maneuvering is in a state of immediate readiness and that an adequate reserve of power is available for steering gear and other requirements; direct any other member of the engineering watch to inform them of potentially hazardous conditions which may adversely affect the machinery or jeopardize the safety of life or the ship; changing in speed resulting from machinery malfunction or any loss of steam which may impair the safety of the ship and life at sea, bridge and chief engineer should be immediately notified, in the event of fire and of any impending action in machinery spaces that may cause reduction in the ship's speed, imminent steering failure, stoppage of the ship's propulsion system or any alteration in the generation of electric power or similar threat to safety; Chief engineer to be notified, when engine damage or a malfunction occurs; Ensuring all machinery involved with the maneuvering of the ship is facing troubles; emergency steering,

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generator and other auxiliary equipment should be ready for immediate operation; measures to be taken to protect the environment from pollution by the ship and that applicable pollution prevention regulations are complied with; all damage control equipment and available fire fighting systems are in readiness; in emergencies, sound the alarm when the situation so demands and take all possible measures to prevent damage to the ship, its cargo and persons on board; be aware of the cargo officer's needs relating to the equipment repaired in the loading or unloading of the cargo and the additional requirements of the ballast and other ship stability control system; Entry into enclosed space.

Competence 1.5: Communications

1.5.1. Oral communication

Proficiency in: Using English to communicate with members of watch correctly in normal emergency situations.

1.5.2. Written communication

Proficiency in: Using engineering publications, operational manuals and fault finding instructions written in English; writing technical statements.

1.5.3. Marine engineering vocabulary

Knowledge of: Standard communicative and technical marine words used during watch keeping repair, maintenance and emergency.

Competence 1.6: operate main and auxiliary machinery and associated control systems

1.6.1. Main and Auxiliary Machinery

1.6.1.1. Marine Plant and Operation

Familiarization with: List of main and auxiliary machineries for propulsion, steering the ship and providing services (auxiliary boilers, pumps air compressors and evaporators); their individual function; correct procedures for the preparation, starting up, normal running and shutting down of marine machineries; importance of data recorded from running machineries (temperature, pressure and speed); using data to locate fault; appropriate procedure following discovery of fault.

Proficiency in: detect and locate malfunctioning from recorded running data such as temperature, pressure and speed, noise, vibration and smell.

1.6.1.2. Engine types

Knowledge of: Marine diesel engine types; low, medium and high speed engines; their application and how can be used as main propulsion engines; approximate speed ranges related to low, medium and high speed engines; P-V diagram and relative processes; ways and methods of scavenging 4- stroke engines; reasons for a supercharging system; principle components of medium and high speed (4-stroke) diesel engines and the material of manufacture (main strength member, crank shaft, con. Rod, fuel pump, piston, cylinder, cylinder cover and mountings, bearings, cam shaft drive, horizontal tie bolts, etc.); principle parts, materials and operation of exhaust valves, fuel pump, fuel valve for diesel engines.

1.6.1.3. Starting

Knowledge of: How a 4 stroke engine is prepared for starting, started and stopped; main components of an air starting system; turning bar interlock and other safeties involved in such system.

Familiarization with: Starting systems of 4 stroke type engines (air/electric etc.).

1.6.1.4.Engine Control

Knowledge of: How engine speed and output power are controlled for normal condition (Governor); how engine over speed is prevented.

1.6.1.5.Engine Safeties

Knowledge of: Conditions which can lead to dangerous oil mists in crank case; crank case relief door; list of essential alarms, slow downs and shut downs.

1.6.1.6.Engine Systems

Knowledge of: Line diagram of typical engine system (fuel oil, lubricating oil, jacket cooling, fuel valve cooling); normal pressure and temperature ranges of each system; safety devices employed in each system; purpose of lagging for hot surfaces and sheathing for high pressure pipes.

1.6.2.Power Transmission and propulsion

Familiarization with: the function of the main items of main propulsion machinery, methods of reversing the direction of thrust (reversible reduction gears, water jet and associate components, CPP, electric drives), line and thrust bearings; stern tube arrangement; comparison of fixed and controllable pitch propellers; propeller attachment; twin screw vessel.

1.6.3.Auxiliary machinery and systems

1.6.3.1.Air compressors

Knowledge of: shipboard uses of compressed air; principle of types of air compressors; principle of compression process in a 2-stage reciprocating air compressors; reasons for using inter coolers and after cooler; Construction details and materials of reciprocating air compressors components; cylinder lubrication for correct and safe operation; cylinder lubricating oil flash point and its importance; procedures for starting-up and stopping; automatic operation of air compressor; quality of air required for control air system and how they are achieved; propose of relief valve, fusible plugs and water-space pressure relief facility; construction details of centrifugal compressors. Giving materials used for main component parts; means of drive and uses of centrifugal air compressors; means of storing compressed air; material and construction requirements of a reservoirs; important mountings of an air reservoir; means of protection of against corrosion, and overpressure; purpose of pressure reducing valve in air distribution systems; attention needed for filters fitted in air distribution system.

1.6.3.2.Steering gear

Knowledge of: Vitality of steering gear with respect to safety of ship and need for its correct operation; control of steering gear provided in steering compartment; steering system and function of major components and their relation; hydraulic telemotor system and properties of telemotor fluid; malfunction in hydraulic telemotor system (electrical telemotor system); hydraulic power operated rudder system; ram type steering system and materials used for main component parts; radial vane type steering system and materials used for main component parts; function of rotary positive-displacement pump and their means of drive; principle operation of radial piston pump, swash plat pump (axial piston) and their means of pumping control; type and condition of oil used in a hydraulic system; means of absorbing shocks in the system; steering tests; emergency steering and its locations; regulations involved.

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1.6.3.3.Refrigeration plant

Knowledge of: distinguishing between refrigeration, air conditioning and ventilation; marine refrigeration systems operate on a reversed Rankine cycle (vapour-compression cycle); principle of operation of a refrigeration system; system components and their function; processes which take place in each part of the system; primary refrigerants and their requirements ; types of compressors in common use and their application; automatic control of the system using cold room temperatures; correct operating condition of the system; effect of air, moisture and oil in refrigeration circuit and means of removing them; principle of insulation of storage spaces; temperature range for meat, vegetable, fresh fruit, rooms.

1.6.3.4.Fuels and combustion systems and bunkering

Knowledge of: Types of crude oil and refining processes; Characteristics of marine distillate fuels; undesirable elements in marine fuels; standard fuel; combustion process in an internal combustion engine; chemical reaction in a combustion; result of combustion; average proportions by percentage of oxygen and nitrogen in atmospheric air; combustion products; role of nitrogen in combustion process; effect of excess air in combustion; signs of poor combustion; range of CO for good, poor and bad combustion; atomization of fuel and its importance; effect of viscosity, atomization, penetration and turbulence on good combustion; good combustion and its indication.

Knowledge of: Types of filters used and their relative advantages; purification process of fuel oil; correct and safe operating procedure for centrifuges; correct procedures for the disposal of waste oil, sludge residue, etc. place of storage of fuel oil; minimum flash point of marine fuels.

1.6.3.5.Water heating and steam generators

Knowledge of: Small package type boilers; water heaters/calorifiers; burners; safeties of small boilers and heaters.

1.6.3.6.Control engineering and Instrumentation

1.6.3.6.1.Control engineering

Understanding in: Basic closed and open control loops; control terms; types of control action available and their effect on system condition; energy forms commonly used in control systems on board ship; essential components of a control and their purposes.

1.6.3.6.2.Instrumentation

Familiarization with: Different type of pressure measuring instrument; principles of operation, application and methods of testing and installation i.e. U- tube manometer, well type manometer, burdon tube pressure gauge.

Familiarization with: Quantity and rate flow meters i.e. rotor meter, variable area flow meter.

Familiarization with: Bi- metal and filled system thermometers; i.e. thermal temperature sensor, Bi - metallic strip thermometers, liquid glass thermometer, liquid in steel thermometers, remote temperature recording device.

Familiarization with: Level measuring instrument used at sea; simple gauge glass, buoyancy type level indicating instrument, displacer and torque type of level indicating, intermittent and continuous air purge tank measuring system; the electrical pressure, temperature and level measuring equipments and their application on board ship.

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Competence 1.7: operate pumping system and associated control system

1.7.1. Marine pumps and systems

Knowledge and Understanding in: Basic function of a pump; requirement of power supply to a pump; losses of head in pumping system; relation of fluid viscosity and pumps design. Types of pumps used on ships and the purpose of their use; basic action of displacement pump and necessity for fitting a relief valve on discharge of it; operation of a reciprocating pump; construction and principal of a rotary displacement pump, gear pump, rotary vane pump, screw displacement pump; principles of operation of an axial flow pump and centrifugal pump (parts such as impeller, volute or diffuser) and its characteristics; need and ways of air extraction from a centrifugal pump; principles of an ejector.

Procedure for starting up and stopping of pumps; care for satisfactory operation of adjustable and non-adjustable glands seals; reasons for loss of performance of a pump. Means by which lengths of pipes are joined together and materials used to seal joints for different pipes; way of supporting pipes to reduce vibration; way of controlling pipes expansion and contraction; material used for construction of pipes for carrying various liquids; principle of construction of a cock; features of a globe valve, screw lift valve, a screw down non return valve, a non-return valve, a gate valve; features of a relief valve; applications of quick closing valve; purpose and application of a change over chests; blanking of pipelines; features of a mud box.

Knowledge and Understanding in: Purpose of a bilge pumping system ;diagrammatic arrangement of bilge pumping system; purpose of an emergency bilge suction; emergency bilge pump; ballast pumping system and its arrangement; domestic fresh water pumping system and its arrangements; a hydraulic system and properties of hydraulic fluid; fire main system and its cross connection with other systems.

Knowledge and Understanding in: Heat exchange theory ($Q = U\theta A$); different flow patterns; definition of contact heat transfer; types of heat exchangers and cooling media used; principle of construction of shell and tube and flat plate heat exchangers; single and two pass heat exchangers; types of heat exchangers used on board for various media; materials used for shell and tubes and plate types heat exchangers; means of controlling temperature; correct cleaning procedure of heat exchanger; effect of air in cooling water and remedial action .

FUNCTION 2: ELECTRICAL, ELECTRONIC AND CONTROL ENGINEERING AT OPERATIONAL LEVEL

Competence 2.1: operate alternators, generators and control system

2.1.1. Electro Technology

2.1.1.1. Cables

Familiarization with and Understanding in: Cables parts (conductors, insulations, sheathing); safeguard against fire and cables reaction; cables connections (terminal box, consumers, sockets); Insulation resistance, IR measurement and associated equipment; temporary repair on cable insulation and its limitation.

2.1.1.2. Alternating Current

Familiarization with and Understanding in: meaning of alternating current; instantaneous voltage ($e = Blv$ to produce $e = E_{max} \sin \square$); definition of phasor and drawing of phasor diagram; definitions, symbols and conventions of rotation, angular velocity, periodic time,

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frequency, peak value and amplitude; expression ($e = E_{max} \sin 2\pi ft$); solve simple problems in relation to above expression; phase difference between voltage and current values; simple sketch to present two sinus wave with same frequency but different amplitude and phase angle; meaning of Root Mean Square value (RMS); RMS value = 0.707 peak value.

2.1.1.3. Alternators

Familiarization with and Understanding in: simple construction of three phase alternator; terms in three phase alternators i.e. stator, rotor, windings, excitation, air gap; how AC is produced; terms in AC generator i.e. magnetic flux, EMF (Electro magnetic force), frequency and its relation to speed of rotation, self excitation; function of Automatic Voltage Regulator; block diagram of AVR and purpose of hand trimmer; cooling of generator; necessity of space heater; safeties incorporated in alternator; definition and arrangement of Delta and Star winding connections; parallel running of two power supply sources and required condition for such operation; auto load sharing; synchronization; electrical safeties; usual voltage, frequency and no. of phases of it; routine maintenance of alternator.

Proficiency in: paralleling and synchronizing two generators by using synchroscope and lamp methods; load sharing procedure; off loading correct procedure; load reduction in parallel condition.

2.1.1.4. Maintenance of generators and circuit breakers

Knowledge of: need for maintenance; meaning of break down maintenance, planned maintenance and vibration monitoring; safety precautions before commencing work; principle maintenance equipment for motors; most common causes of failure of insulation; parts to be inspected and their common faults on motors and starters, routine maintenance required on a circuit breaker, principle of various types of closing mechanism of circuit breaker, care necessary when handling circuit breakers; purpose of interlocks fitted to circuit breakers.

Proficiency in: Locating and selecting relevant drawings and manual; checking and adjusting pressures on carbon brushes of generators, replacing and embedding in new carbon brushes, test and record values of insulation resistance, carry out routine maintenance on main circuit breakers, detecting and correcting faults implanted in circuit breakers.

2.1.1.5. A.C. Motors

Familiarization with and Understanding in: Induction motor principle operation; induction motor construction and its actual components; types of motor on board ship; different means of starting motor (reduced voltage, direct on line, star – delta and auto transformer); motor protection devices and the reason for such protection; principle operation of over current relay and difference between possible over load current and fault current; function of the over current trip, time delays and fuses; fuse ratings; principle of thermal relay and its adjustment; single phasing and its effects on motor; single phasing protection; function of under voltage trip.

2.1.1.6. Maintenance of motors and starters

Familiarization with and Understanding in: Correct procedures and preparation of motors and starters for maintenance; components required particular attention; IR tests and causes of insulation failure; fault finding of motors, starters and protection equipment.

Proficiency in: Locate and selecting relevant drawing and manuals; carrying out maintenance necessary for a cage electric motor; checking the insulation resistance of a 3- phase induction motor; carry-out the maintenance necessary and complete reports on starts and controllers;

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detecting and correcting faults implanted in motors, starts and protection equipment; carry out temporary repairs to cable insulation.

2.1.1.7. Lighting

Familiarization with and Understanding in: Importance of correct level of lighting with regard to safety of working staff and their efficiency; principle of the incandescent lamps, discharge lamps and fluorescent tubes, including their circuit diagrams (emphasizing on power factor improvement in fluorescent tubes); effect of voltage variation; difference between lamps for general lighting and heavy duties; principle application and needed care when handling tungsten - halogen lamps; types of lamp cap; location, color and power of navigational lights; purpose of lights on the signal mast; marking of emergency lights; list of emergency lights on emergency switch board and battery circuit; testing frequency of emergency lights.

2.1.1.8. Maintenance of lighting

Knowledge of: Routine testing and maintenance of lighting circuits and fittings; detecting and rectifying faults likely to be encountered at sea; common deterioration in lamp holders and wire connections; care necessary when maintaining exposed water tight fittings and portable hand lamps; Carrying out routine testing and maintenance of lighting circuits and fittings; detecting and rectifying implanted faults likely to be encountered at sea.

FUNCTION 3: MAINTENANCE AND REPAIR AT OPERATIONAL LEVEL

Competence 3.1: Maintain marine engineering system

3.1.1. Onboard training:

Proficiency in: onboard training scheme according to requirement of Administration.

3.1.2. Maintenance principle

Familiarization with: Reasons for maintaining the machinery; preparation for maintenance; points and parts of machinery require attention; inspection for wear and tear; non destructive tests; reason for genuine spare parts.

3.1.3. Principle of maintenance

Familiarization with: the basic principles of the plant components to be worked on; the application of safe practices at all times; the isolation of units and / or systems prior to dismantling; the security of all personnel and materials during a maintenance operation; the dangers inherent in systems which contain fluids under pressure or are of a hazardous nature.

3.1.4. The basic of maintenance technology

Familiarization with: Planned maintenance systems; condition monitoring; diagnostic testing; preventive maintenance.

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FUNCTION 4: CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR PERSONS ON BOARD AT OPERATIONAL LEVEL

Competence 4.1: Ensure compliance with pollution prevention requirements

4.1.1 The precautions to be taken to prevent pollution of the marine environment

4.1.1.1 International convention for the prevention of pollution from ships, 1973, and the protocol of 1978 relating thereto (MARPOL 73/78)

Knowledge of: Annex I (Regulation for the prevention of pollution by oil); Annex II (regulation for prevention of pollution by noxious liquid substances in bulk); Annex III (Regulation for the prevention of pollution by harmful substances carried by sea in packaged form); Annex IV (Regulation for the prevention of pollution by sewage); Annex V (Regulation for the prevention of pollution by garbage); Annex VI (Regulation for the prevention by emission from ships; Air pollution).

4.1.1.2 Oily water separator

Knowledge of: function of an oily water separator; principle of operation of an oily water separator; general construction and material of components parts used; maintenance and care required.

4.1.1.3 Sewage treatment plant

Knowledge of: principles of operation of a biological sewage treatment plant; discharge tests of aerobic sewage plant (suspended solid, biochemical oxygen demand, coliform count); principles of operation of zero discharge system; sewage retention system.

Competence 4.2: Ship construction

4.2.1 The principal structure members of a ship

4.2.1.1 Ship dimension and form

Familiarization with: The general arrangements of the most common type of nearcoastal merchant ships; forms and dimensional terms used in ship construction of above mentioned vessels.

4.2.1.2 Ship stresses

Understanding in: Meaning of following terms: hogging sagging, racking, panting, pounding; stress by localized loading.

4.2.1.3 Hull structure

Familiarization with: Detailed components of main and minor ship's structure; standard steel sections; Framing system; deck freeing arrangement.

4.2.1.4 Bow and Stern

Familiarization with: Bow and stern arrangement and construction.

4.2.1.5 Fittings

Familiarization with: Hatch cover arrangement and construction; Anchor, chain and mooring arrangement main components of derricks and deck crane; cargo hold bilges and ballast system; air pipe sounding pipes and container fitting arrangement.

4.2.1.6 Rudder and Propeller

Familiarization with: Rudder types, construction and its function; principle of screw propulsion; terms and definitions of propeller.

Competence 4.3: Prevent, control and fight fires on board

According to Administration requirements.

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Competence 4.4: Operate life – saving appliances

According to Administration requirements.

Competence 4.5: Applied medical first aid on board ship

According to Administration requirements.

.Competence 4.6: Monitor compliance with legislative requirements

4.6.1. Basic working Knowledge of UN (IMO conventions)

Familiarization with: Maritime law, United nations specialized agencies (International Maritime Organization), port state and flag state, International Convention for the safety of life at sea, 1974 as amended (SOLAS), [Chapter 1 (General Provisions), Chapter 2 (Construction [subdivision and stability, machinery and electrical installation] and [fire protection, fire detection and fire extinction]), Chapter 5 (Safety of Navigation), Chapter 9 (ISM Code), Chapter 12 (ISPS)].

ماده ۵-۹ مواد درسی دوره افسر مهندسی دوم در کشتیهای با قدرت موتور کمتر از ۳۰۰۰ کیلووات- سفرهای نزدیک به ساحل

FUNCTION 1: MARINE ENGINEERING AT MANAGEMENT LEVEL

Competence 1.1: Plan and Schedule operations, Start up and Shut down Main Propulsion and Auxiliary Machineries including Associated Systems

1.1.1. Thermodynamics and heat transmission

1.1.1.1. Steady-flow Energy Equation

Knowledge of: The term “the conservation of energy” and its application to the flow of fluid in a system, steady-flow energy equation (SFEE), potential /kinetic energy, internal energy, displacement energy, heat transfer, external work done.

Proficiency in: Developing the (SFEE) to incorporate specific enthalpy, solving simple problems which prove sufficient understanding of the principles of (SFEE). Explaining the equation: heat transferred= change of internal energy + work transferred.

1.1.1.2. First and Second Laws of Thermodynamics

Knowledge of: First and second law of thermodynamics and its application.

Proficiency in: Identifying practical adiabatic processes in marine engineering application.

1.1.1.3. Engine Trail Data

Knowledge of: The terms usually used in engine performance such as: dynamometers, brake power, indicated power, friction power, torque, brake mean effective pressure, calculation of brake power using the equation $\text{brake power} = 2\pi NT$, calculation of turbine indicated power by using changes of enthalpy from inlet to outlet, specific fuel consumption in terms of grams/kWh, energy balance of a diesel engine.

Proficiency in: Sketching the following graphs, drawing attention to the significant features and giving brief explanations where appropriate:

- Torque versus speed for a variable speed engine
- Torque versus brake power for a constant-speed engine
- Power versus speed for a variable-speed engine
- Indicated power versus brake power for a constant-speed engine
- Mechanical efficiency versus speed or brake power for variable and constant-speed engines
- Fuel consumption versus speed for a variable-speed engine
- Fuel consumption versus brake power for a constant-speed engine
- Specific fuel consumption versus speed or brake power for variable and constant speed engines
- Thermal efficiency versus speed or brake power for variable and constant-speed engines.

1.1.1.4. Heat Transfer

Knowledge of: Methods of heat transfer (induction, radiation and conduction), factors influencing the rate of heat transfer by conduction/ convection and radiation, developing an equation for the temperature drop across the outer surfaces of a three-layer composite wall.

Proficiency in: solving simple problems concerning above objectives to determine surface and interface temperatures and the heat transfer, application of above to a simple treatment of thin cylinders with not more than one layer of insulation attached to the cylinder, sketching diagrams showing the nature of temperature gradients across a two layer composite wall and surface films.

1.1.1.5. Behavior of Gases

Knowledge of: Boyle's law, Charles' law, characteristics equation of a perfect gas to problems related to marine engineering, meaning of the term: specific heat capacity at constant volume (c_v) and at constant pressure (c_p), effect of heating gases at constant volume and constant pressure (with regard to raise in temperature/raise in internal energy), $T_1/T_2 = (P_1/P_2)^{n-1/n} = (V_1/V_2)^{n-1/n}$, behavior of a perfect gas when compressed or expanded adiabatically, polytropic process (where $n = c_p/c_v$), introduction of ($n = \gamma = 1.4$) for air, Dalton's law of Partial Pressure.

Proficiency in: solving problems related to above objectives and concerning marine heat engine cycles. Ability to sketch a P-V diagram which shows isothermal, adiabatic and polytropic expansion/ compression from a common starting point, Solving simple problems concerning mixture of a gas and a vapor/ or mixture of two gases.

1.1.1.6. Air Compressor

Knowledge of: Simple sketch of a single stage and multi stage reciprocating air compressor and the corresponding pressure-volume diagram, showing suction, compression (isothermal, polytropic and adiabatic), delivery, and clearance volume, factors governing valve opening and closing in a compressor, swept volume and effective swept volume, definition of volumetric efficiency and need for high volumetric efficiency, meaning of the term "free air delivery", need for using intercoolers; solve simple numerical problems.

1.1.1.7. Refrigeration

Knowledge of: Refrigerants and their properties; environmental limitations on the use of some refrigerants and alternatives; vapor compression cycle; shipboard plant; system components and their function; capacity control; system performance; safeties incorporated in the system; operational problems; rectification of operational problems; commissioning a new or repaired system; defrosting; air conditioning and ventilation; Psychrometric chart; types of air handling unit; Legionella bacteria and related regulations. Vapor compression refrigerating cycle; pressure-enthalpy diagram; methods employed to transfer heat in the evaporator/ condenser; throttling; under-cooling and supercharging; describing (in simple terms) the principles of vapor absorption refrigerator.

Proficiency in: Using enthalpy tables to calculate the condition of refrigerant at stage points in the cycle and the coefficient of performance.

1.1.2. Mechanics and hydro-dynamics

1.1.2.1. Friction

Knowledge of: Categories of friction, relation between kinetic and limiting values of friction force, apparent friction force with regard to rolling resistance, principles of ball and roller bearing, effect of area and surface finish on dry friction, boundary friction, effect of heavy loading and low speed on bearing s working under boundary conditions.

1.1.2.2. Inertia

Knowledge of: Definition of mass in terms of inertia, relation of mass to weight, inertia force, active and reactive forces, tractive resistance and its components.

Proficiency in: Applying the principles of inertia force to connected bodies, solving simple problems which illustrate the effect of inertia forces.

1.1.3. Physics and chemical properties of fuels and lubricants

Knowledge of: Main characteristics of fuel oil; effect of each fuel characteristics on system and engine performance; fuel oil standards; importance of ignition quality of fuel; poor quality fuel.

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Knowledge of: Combustion; combustible elements of fuel; effect of unwanted elements in fuel on engine and environment; ideal condition for diesel engine good combustion (viscosity, atomization, penetration and turbulence); evaluation of good combustion; combustion products; Stoichiometric and excess air for correct combustion.

Knowledge of: Fuel system from service tank to injector; correct bunkering strategy.

Knowledge of: Oil purification; purpose and use of a settling tank and its fittings; oil filtration method; principle of operation of a coalescer; operation of automatic oil filter; principle of an oil centrifuge; operation of a self cleaning purifier.

Knowledge of: Base mineral oil; properties of lubricating oil; purpose of additives in lubricating oils; function of lubrication; boundary lubrication and where it occurs; hydrodynamics lubrication and where it occurs; factors influencing hydrodynamic lubrication; places where lubricating oil samples for test is taken; oxidation of oil, its effect and remedy; microbial degradation of lubricating oils, its symptoms, means of prevention and remedy.

1.1.4. Naval Architecture and Ship Construction, including Damage Control

1.1.4.1. Rudders

Knowledge of: Angle of heel when turning; factors govern the size and shape of a rudder; rudder angle limitation; force on rudder; torque on the rudder stock; effect on the torque when running astern; effect on the rudder stock of different rudder configurations; purpose of special rudders; types of rudders; stall angle; rudder bearings (pintle) and their clearances; rudder construction and repair; rudder protection against corrosion; solve problems related to above objectives.

1.1.4.2. Resistance, powering and fuel consumption

Knowledge of: Residuary and frictional resistance's; ship resistance estimation; boundary layer and fluids flow; relationship between frictional resistance and ship speed, the wetted area, the surface roughness and the length of the vessel; Freud's law; types of wave when a ship moves; reasons for fitting bulbous bows; fuel consumption at varying speeds; estimation of the potential fuel consumption and variations when running at different conditions; solve problems related to above objectives.

1.1.4.3. Propulsion and propellers

Knowledge of: Measuring turbine and diesel engine-delivered power, thrust power, effective power; relations of the different powers to each other; hull and propeller efficiency; fundamental principle of a propeller; wake; speed of the propeller through the wake; speed of the ship; left and right handed propellers; propellers in a twin screw ship; basic geometry of a propeller; apparent slip; cavitation; effect of cavitation on the thrust and torque and the propeller blades; procedure for speed, power and fuel consumption trials; propeller matching with respect to engine and propeller curves; solve problems related to above objectives.

1.1.4.4. Ship structures

Knowledge of: Definition of ships terms; transverse section of near coastal vessels; forces on the hull; statical and dynamical forces acting on the structure; hogging and sagging and induced stresses in the top and bottom plating.

Knowledge of: Bending moment; location of maximum bending moment; relation between stress and depths of the structure; role of classification societies in specifying scantlings; strengthening of structure against bending and shear stresses; principal longitudinal strength members; structural deformation by water pressure, rolling panting and pounding.

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Knowledge of: Materials for ship construction; mild steel for construction; connection of steel to steel by welding; AC & DC welding machines; reasons for pre-heating and controlled cooling; edge preparation; welding techniques (butt, lap, fillet) and materials normally used on ship; flux material and reason for it; typical faults in a weld and way of avoiding or rectifying it; comparison of good and bad weld; gas cutting; aluminum alloys for ship construction; problems of connections between aluminum and steel.

Knowledge of: Seams and butts in shell plating; continuity of strength in the vicinity of openings in the shell; different framing system; deep frames; connecting of frames to other part of the structure; bilge keel; deck plating support; effect of discontinuities in the main structures and ways to strengthen them; construction of hatchway openings, hinged watertight door and gas tight door; requirements with openings in the shell for suction and discharge fittings.

Knowledge of: Purpose of the different types of bulk head; construction of a watertight bulkheads; testing of bulkheads; access through watertight bulkheads; operation of water tight doors; penetration of pipes, electrical and air trunking through the bulkheads.

Knowledge of: Panting and pounding or slamming; construction of a bow; anchor and cable arrangements; principle of operation of bow thrusters; construction of a typical small ship's stern; vertical and transverse support for rudder; water tight gland for a rudder stock; attention necessary for a rudder in dry dock; supports for propeller shafts of twin screw ship.

Knowledge of: Typical strengthening in way of deck machinery, propulsion machinery, boiler and pumps; inlet box for ship side valve; deep tank and its purpose and construction; cargo oil, fuel oil, ballast and freshwater tanks arrangements (filling, emptying, sounding, air venting, gas freeing, isolation, heating, drainage at sea and in drydock and access) protective coating used for the different tanks; protection of tanks by fitted anodes; limitations on the application of anodes.

Knowledge of: Forming of separate oil tight tanks in a tanker; purpose of cofferdam in tankers; a typical pumping system in a tanker; inert gas system; ventilation of cargo tanks.

1.1.4.5. Vibration in ships

Knowledge of: Synchronous or resonant vibration; seriousness of vibration local vibration ; normal sources of vibration; ship's natural frequencies; main causes of ship vibration; prevention of vibration; reduction of vibration in vessels already built.

Competence 1.2: Operate, monitor and evaluate engine performance and capacity.

Maintain safety of engine equipment, systems and service

1.2.1. Diesel engine

1.2.1.1. Engine performance

Knowledge of : Brake thermal efficiency, fuel consumption and specific fuel consumption; normal working power of main propulsion and electrical generation engines; heat balance, heat in the exhaust and possible recovery of waste heat, brake power, mechanical efficiency; specific fuel consumption; compression ratio; calculating indicated powers; indicator diagrams; power balance; load diagram.

1.2.1.2. Engine components

Knowledge of: Different engine configurations(vee / in line); Main strength member in different engines ; Holding down arrangements; Cylinder liners; cylinder liner calibration and wear; cylinder liner lubrication; Pistons ; piston rings; Poppet exhaust and intake valves; Crankshaft ; Crankshaft manufacture, alignment; engine bearings ; Cylinder covers and mountings ; Timing chain and gear; Vee engines connecting rod attachment.

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1.2.1.3. Engine lubrication

Knowledge of: Lubricating systems used in diesel engines; lubricating oil (properties, good and deteriorated oil); Need for oil analysis; Bearing's lubrication.

1.2.1.4. Fuel injection

Knowledge of: Principle operation of fuel pumps in diesel engine; fuel pump parts; fuel cut off devices; Fuel timing; hydraulically operated fuel valve (function, maintenance and pressure setting); importance of atomization, penetration and turbulence; pilot injection; high pressure pipes.

1.2.1.5. Scavenging and supercharging

Knowledge of: Scavenging process of four stroke; valve timing diagrams for a naturally aspirated and a pressure charged engine; need for pressure charging and methods; Principle of turbo charging systems (Pulse and Constant pressure); types of turbo charger (radial and axial); parts of a turbocharger, function of the different parts of a turbocharger and their material; comparison of different types of bearings and their location; cooled and un-cooled turbo charger; turbo charger lubrication; turbo charger faults; turbo charger matching; turbo charger surging; turbo charger washing (wet and dry); immobilizing of a turbo charger; cares required when overhauling turbo charger; charge air cooler; moisture trap; scavenge temperature and its effect on engine performance.

1.2.1.6. Starting

Knowledge of: Starting systems of four stroke diesel engines (electric and air); Starting air overlap; Main components of starting air system and their function; safety features fitted in the system; Interlocks.

1.2.1.7. Cooling systems

Knowledge of: Cooling systems of cylinder, cylinder head, turbocharger, and fuel valve; need for treatment; types of additives.

1.2.1.8. Diesel engine control

Knowledge of: Engine governor; meaning of speed droop; proportional and reset action governors; isochronous governor; electric governor; bridge control of a diesel engine; safeties incorporated in bridge control system; over speed trip; purpose of a fly wheel; shut downs.

1.2.1.9. Safeties

Knowledge of: Cause of crankcase explosion and how avoided; means of relieving the pressure in a crankcase when explosion occur.

1.2.1.10. Compressed air

Knowledge of: P.V diagram for a compressor; volumetric efficiency; clearance volume; different types of compressor; reciprocating and rotary compressors (operation, parts, lubrication, unloading mechanism, safeties, automatic water drain); two and three stage compressors; inter and after cooler; malfunction of suction and delivery valves; start/stop control; air reservoirs construction and capacity based on regulation; reservoir mountings; reservoir inspection; reservoir common faults.

1.2.1.11. Multi-engine propulsion arrangements

Knowledge of: Arrangement of diesel engines coupled by gears for main propulsion, pumping and generation of electrical power; principle of operation of a fluid coupling; principles of a reverse reduction gear; purpose of a flexible coupling and the principle of its operation; different

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propulsion plants (diesel/turbo electric, podded drives, water jets); Principles of dual fuel engines.

1.2.2. Operation and maintenance of auxiliary machinery

1.2.2.1. Shafting

Knowledge of: Limitations on shaft alignment in ships; initial boring process of bulkheads by various methods; installation of stern tube; fitting of tail shaft; inter mediate shaft alignment; engine installation; various intermediate shaft alignment techniques; water and oil lubricated stern tubes; seals and lubrication systems; plumber blocks; couplings; thrust block; controllable pitch propeller; CPP bridge control; securing of shaft while the vessel is being towed; propellers fitting and removal.

1.2.2.2. Pumps, pumping systems and prevention of pollution

Knowledge of: Types of pump; reciprocating pumps; centrifugal pumps; axial flow pumps; mixed flow pumps; air extraction; gear and screw displacement pumps; emergency fire pumps and its capacity; emergency bilge pumps; emergency bilge suction valve; pump characteristics; net positive suction head (NPSH); heat exchangers; means to control heat exchanger corrosion; sea water pipes; domestic water supply; ejectors; sewage and sludge; ballast; bilge; fire main; international shore connection.

1.2.2.3. Steering gear

Knowledge of: Electro-hydraulic / electrical telemotor system; power units (Radial and Axial flow pumps); rudder actuators (ram type, rotary vane); hunting gear mechanism; rudder carrier bearing; steering gear testing, drills and examination; steering gear failure and safeguard.

1.2.3. Fundamentals of automation, instrumentation and control systems

1.2.3.1. Control Theory

Knowledge of: Control terminology; closed and open loop control systems; two step control system; simple automatic control system; proportional, integral and derivative action; proportional plus integral action; proportional plus derivative action; proportional plus integral plus derivative action.

1.2.3.2. Operation, Testing and Maintenance of Control systems

Knowledge of: Principles of pneumatic control and components, including valve positioner; controllers; control circuits for controlling temperature and level of marine machinery and systems; load dependant cooling water control system; remote control (pneumatic, electronic, hydraulic); communication between bridge and engine room control system; air supply unit.

1.2.3.3. Instrumentation and monitoring systems

Knowledge of: Pressure measuring devices; temperature measuring devices; level measuring devices; flow measuring devices; strain gauge; types of RPM detectors; various gas detectors.

Proficiency in: Routine setting-up, testing and maintenance of the measuring devices i.e. pressure, temperature, flow, level; performing routine test, maintenance, and fault-finding procedures for pneumatic controllers and control systems.

Competence 1.3: Use of internal communication system

1.3.1. Transmission and reception of messages

Knowledge of: Means to be provided for communicating orders from navigating bridge to the position in the machinery space or in the control room; principle operation of an engine room telegraph; means of communication provided between the navigation bridge and the steering gear compartment; means of local communication provided between the main machinery control

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room and the engineer officer's accommodation; alarm for automatic change-over; principles of using public address, talk back system; sound power phone, internal walkie talkie and telephone exchange on board the ship; distinguishing between the various alarms.

1.3.2. Communication recordings

Knowledge of: Ship's movement recording during maneuvering and passage in the navigation bridge and in engine control room; recording of important and essential parameters in engine log book; standing orders and special instructions of the chief engineer officer; recording of reports for ship staff and machinery performances; records of any events related to the main and auxiliary machinery occurred during the engineering watch.

FUNCTION 2: ELECTRICAL, ELECTRONIC AND CONTROL ENGINEERING AT THE MANAGEMENT LEVEL

Competence 2.1: Operate electrical and electronic control equipment, test, detect faults and maintain and restore electrical and electronic control equipment to operating condition

2.1.1. Marine Electro technology, electronics and electrical equipment

2.1.1.1. Application of Ohm's and Kirchhoff's laws

Knowledge of: Applications of Ohm's and Kirchhoff's laws; Maxwell's circulating current theorem; super-position of current theorem; application of Wheatstone bridge and its principle of operation; principles of a potentiometer; principle of the thermocouple; need for compensation and use of compensating lead.

Proficiency in: Using Kirchhoff's and Ohm's law to solve problem as applicable; use a Wheatstone bridge to measure resistance; use a potentiometer to measure e.m.f.s.

2.1.1.2. Electromagnetism

Knowledge of: Theory of electromagnetism; flux density and ampere turns per meter; core material e.g. air, cast iron, cast steel, mild steel; magnetic fringing; magnetic leakage; hysteresis loss; hysteresis loops for steel and iron; losses in electrical machines and transformers.

2.1.2. Practical Knowledge, operation, Testing and Maintenance of Electrical, Electronic Control Equipment including Fault Diagnostics

2.1.2.1. Electronics

Knowledge of: Properties and structural of crystals; semiconductors and their examples commonly used; properties of semiconductors and their behavior at various temperature; intrinsic conduction in a semi-conductor crystal; electrical equilibrium of semiconductors; properties of most commonly used semiconductors; impurities into a semi conductors and meaning of the term "doping"; N-type and P-type semiconductors and their properties; meaning of the term "junction" and hence PN junction; "diodes" and their behaviors; "avalanch" or "zener" and their behaviors; "avalanch" or "zener" voltage in diodes; important uses of "diodes" in electrical supplies; meaning of "passive components and their features; examples of "passive components" and their common uses; meaning of "active" components and their features; examples of "active" components and their uses; rectifier and their uses; zener diodes and their characteristics; uses of zener diodes; the light-emitting diodes (leds) and their characteristics uses of "leds" transistors and their structure types of transistors and their structure; type of transistors and the principle of operation; uses of transistors; the uni-junction and field effect structure and

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principle of operation; thyristors; and their constructions; the principle of operation of thyristors; uses of thyristors.

Proficiency in: Solving numerical problems related to semi-conductors devices circuits.

2.1.2.2. Power Factor Improvement

Knowledge of: Ways of improving power factor; relationship between power factor and line current; disadvantages of low power factor; effects of capacitor in parallel with inductive load on the line and motor currents, line power loss and motor power; relationship between active power and reactive power; power factor; solve problems related to above objectives.

2.1.2.3. Poly-phase Supplies

Knowledge of: The principles of the circuits of the circuits in a 3-pH alternator, the phase difference and usual color coding; arrangement of star-connector alternator; line and phase, voltage and current of delta connected arrangement; power in 3-phase star and delta connected machines; solve problems in relation to power, KVA, power factor, and current in star and delta loads.

2.1.2.4. A.C. Generators

Knowledge of: Principles of construction of synchronous A.C generators; alternator and motor connections in a 3-wire system; power factor and effect of various loads on power factor of an A.C generator; effect of varying power factor on load/voltage curve of A.C generators; effect of starting a large induction motor on the current and voltage of an A.C generator and other electrical equipment's; types of load on board ship causing excessive voltage dip; approximate power factor of an induction motor during starting; advantage of self-excited compound generators with regard to voltage dip and recovery time; main criteria affecting the parallel operation of A.C generators; the requirement for satisfactory lower sharing between generators; effect of unbalanced loading in 3-pH of a generator; functional and error-operated voltage regulating systems; function of an excitation system; basic principles of self-excited generators; basic principles of separately excited A.C generators; excitations systems in common use.

Knowledge of: The essential parts of an automatic voltage regulator and their function; basic operating principle of A.V.R.; principle of voltage-comparison circuit; purpose of excitation control element; features controlling the load sharing when generators running in parallel; deviation of load sharing and voltage droop; reason for excitation system to carry short circuit current.

2.1.2.5. A.C. Switchgear

Knowledge of: Fittings on an A.C switch board; characteristic of a circuit breaker used for A.C switchboard; main criteria governing the operation of a circuit breaker; the function of a circuit breaker; the purpose of short-time-fault current rating; the purpose of interlocks and their possible misuse; use of earthing of circuit breakers; maintenance and testing of circuit breaker; correct procedure of working with switchgear; the purpose of examining insulators and possible causes of overheating; the procedure for isolation and safety before allowing work on equipment.

Proficiency in: Demonstrating the operation of an A.C circuit breaker and method of closing circuit breaker; performing the safety precautions necessary when a circuit breaker is removed ; demonstrate the safety precautions necessary before commencing work on switch gear; demonstrating the inspection and maintenance of circuit breakers and routine testing of circuit breakers; detect, analyze and correct fault symptoms.

2.1.2.6. Generator Protection

Knowledge of: Sequence of events after an overload trips of a generator; preferential trips and alarms; regulation for setting of time delays of preferential trips; over current relay fitted to a circuit breaker; need for instantaneous over current protection; restricted and un-restricted earth fault system; protection, detect and handle loss of power can occur in a generator and its effect when running in parallel with others; reverse power trip and the need for a time delay; over and under voltage protection and the need for a time delay; list of instrumentation for generators working in parallel; use of current and voltage transformers and their earthing requirements.

Proficiency in: detecting, analyzing, and correcting faults in generators protection gear.

2.1.2.7. Single and Parallel Operation of Generator

Knowledge of: Determination of power factor, voltage, load and frequency when generator is running alone or running in parallel; controls necessary at the main switchboard for single or parallel operation of generators; conditions required before switching two generators into parallel operation; operation of “lamps bright”, “lamps dark” and “sequence lamps”, purpose of a check synchronizer; the system of automatic selection of diesel generator; automatic starting and putting on load of stand by generator set; emergency shut down.

2.1.2.8. Transformer

Knowledge of: Methods of providing 110/220V supply; arrangement of a simple singlephase transformers and its principles of operation; typical applications of transformers; 3- phase transformer; delta-star connections in 3-pH transformers; applications of delta-star 3-pH transformers; advantages of delta-star transformer; liquid cooled transformers and their potential hazards; attentions required by a transformer.

2.1.2.9. Rectification

Knowledge of: Uses of direct current on board a ship with A.C power supply; purpose of a rectifier; modern rectifiers; construction and function of diodes; effect of over-current and over voltage on rectifiers; environmental conditions adversely affect diodes; use of transformers in rectifier circuits; the principle operation if a rectifier circuit; principle of operation of a four-diode-bridge full wave rectifier; advantage of bridge rectifiers over two-diode rectifiers; circuit used for rectification of 3-pH supply; protective devices required for rectifiers; principle operational characteristics of rectifier materials used.

2.1.2.10. Distribution

Knowledge of: Principle of D.C distribution cable system used on ships; principle of A.C distribution systems and voltages used on ships; the alternator and motor connections in a three wire system; the power frequencies in common use; dangers of running a 50 HZ system from 60 HZ supply; distribution systems with insulated neutral and earthed neutrals, their application and features; normal limit allowed for an earth-fault current; arrangement of earthing system.

2.1.2.11. Circuit Protection

Knowledge of: Function of a high rupturing-capacity fuse; meaning of current rating and minimum fusing current of a fuse; re-wireable fuses and associated problems; miniature circuit breakers, uses and principle of operation; the protection provided to the feed, from a main switch board for: A 3-pH system and two-wire system fed from one phase to an earthed neutral; meaning of a steady load circuit and its protection; size of motors on board ship requiring protection against overload and short circuit; criteria in selection of protection devices for motors and transformers; requirement of circuits for navigational lights; circuits for supplying the

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steering gear; permissible circuit protection for steering gear supply; protection and information required at a shore supply connection box; arrangement of connections for taking on an A.C shore supply, earthing requirement when taking a 3-pH shore supply; emergency control necessary for ventilating fans; fuel and cargo pumps.

2.1.2.12. Cables

Knowledge of: Materials used as conductors in cables; applications for multi-stranded and single-wire cables; commonly used insulation materials; types of PVC insulating compounds used in ship's cables; effect of (temperature variation, oxidation, fire, oil, seawater, acids, solvent); purpose of sheathing electric cables and common sheathing materials; reduction of radio interference; meaning flexible cables and acceptable type of flexible cords; construction of welding cables; obtaining current ratings of cables from approved tables of Administration; care necessary with lay-outs and cable runs in machinery spaces, holds and cold-storage chambers; regulations regarding the recommended use of conduit and trunking; principles of passing cables through bulkheads and decks; the need to bond and earth the sheathing of cables; the potential dangers of passing 3-pH single core cables through steel bulkheads; problems of passing high currents through single core metal sheathed cable.

2.1.2.13. D.C. and A.C. Motors

Knowledge of: Meaning of "dip proof" when applied to a motor; types of motors and their essential differences; ventilation and cooling of totally enclosed motors; the usual speed control methods for D.C motors and typical applications; methods of field control of D.C motors on ships; use of Ward-Leonard system on ships; main types of A.C motors and their use in marine engineering; factors governing speed of synchronous and induction motors; single-cage motors and the behavior of their starting current and torque; the advantages of double cage construction; uses of slip-ring motors; effect of varying supply frequency on speed, temperature, torque, power output, and centrifugal forces of A.C motors; effect of varying the supply voltage in starting torque, starting time, ability to start, speed and current; the effect of accumulation of dirt in a motor; the process of maintaining a motor including initial cleaning fluid, re-varnishing and adjustment of brushes; common causes of trouble with commutators; meaning of single phasing; the causes and the effect of running a 3-pH motor with one phase open-circuited, cause and symptoms of single phasing.

2.1.2.14. Motor Control and Protection

Knowledge of: The purpose of motor protection; arrangement of a D.C motor starter, the principle components and their function; applications of drum and contactor starters; overload setting for cage motors; the overload-protection devices in use on board ship; arrangement of a direct-on-line starter for a cage motor, the principle components and their function, protection against short circuit of A.C motor; criteria used for setting thermal protection relays and their advantage compared to magnetic types; the principle of operation of magnetic overload relays; use of thermistors, thermostat and thermocouples as temperature-sensing device for motors; process of replacing a fuse in a 3-pH supply; the principle of star-delta starting and the reasons for its use; need for under voltage protection in motors; effect of prolonged and repeated starting periods on motor windings; the principle of and auto transformer starter and its limitation in frequent starting; the reasons for slip-ring motors and the principles of the starter; effect of making incorrect phase and starter connections; the principle and application of synchros; the function and principles of induction regulator; contact breakers.

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Proficiency in: Performing maintenance on copper and silver faced contact breakers; detect and rectify faults implanted in motors, starters and controllers.

2.1.2.15. Cells and Batteries

Knowledge of: Difference between primary and secondary cells; construction of an alkaline battery and materials used; care to be taken with cell containers and cover; type of lead-acid battery normally used for marine work; construction of flat-plate battery and materials used; tubular-plate battery and materials used; tubular-plate battery and materials used; tubular-plate battery and its principle difference with flat-plate battery; connecting cells in series, parallel and series-parallel to form a battery; emergency and stand-by duties provided by batteries; maintenance of lead-acid and alkaline batteries for readiness in case of emergency/stand-by conditions; capacity of a battery; range of voltage commonly used for general emergency lighting, engine room lighting, telephone and call system; requirement for capacity of emergency batteries for passenger ships, cargo ships of 500 GT and more and cargo ships of less than 500 GT; the charge and discharge method; automatic switching of batteries including trickle charging and recharging; warning devices and the need for them when batteries are being charged; location of batteries; care necessary when both lead-acid and alkaline batteries are installed in a ship; battery spaces requirements; safety precautions necessary in battery compartments; type of electrolyte in a lead acid and alkaline batteries; dangers of mixing of sulphuric acid and water; care necessary for lead acid and alkaline batteries; the discharge-recharge procedure for lead acid batteries; charge-recharging procedure for alkaline batteries; characteristic and charging procedure of nickel-cadmium batteries; battery repairs; action to be taken if dilute sulphuric acid and alkaline electrolyte splashed on the skin and in the eye.

Proficiency in: Examining and reporting on the condition of battery casings, terminal etc.; carry-out topping-up process for lead-acid batteries.

2.1.2.16. Lamps

Knowledge of: General requirements for the areas requiring emergency lighting; means of identifying emergency lighting; effect of varying voltage on lamp life; the principles of incandescent, gas discharging, fluorescent and neon lamps.

2.1.2.17. Tankers, Electrical Safety Systems

Knowledge of: Requirements of Administration and Class for electrical installations on tankers; how generators, switchboards and batteries are separated from cargo tanks; protection necessary for cables which may be exposed to cargo oil, vapor or gas; separation of cables associated with intrinsically safe circuits; protection necessary to install electrical equipment in flammable atmosphere; requirement in a dangerous space of a tanker carrying LNG or LPG; protection necessary to install electrical equipment in a gas-dangerous space; the need to isolate electrical equipment before commencing maintenance; the requirements for portable electrical equipment; safety measures when a tanker is alongside the terminal; stray electrical energy; meaning of earthing and bonding.

Proficiency in: Identifying cage electrical equipment from data on the name plate; the basic principle and carries-out periodic examination, maintenance and care of flame proof, increased safety; intrinsically safe and pressurized protective equipment.

2.1.2.18. Insulation Testing

Knowledge of: The principles of an instrument for measuring insulation resistance; the common causes of reduction of insulation resistance; the principles of an instrument for measuring

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insulation resistance; the common causes of reduction of insulation resistance; information to be entered on a record of insulation resistance; satisfactory and minimum values of insulation resistance; drying-out and cleaning procedure for machines exposed or immersed in sea water.

Proficiency in: Testing and recording resistance values of insulated cables in various conditions and temperatures.

Knowledge of: Common electrical graphical symbols and their meaning.

2.1.2.19. Electric Shock

Knowledge of: Effect of D.C and A.C on victims of electric shock; the attention and care necessary for a person who has suffered electric shock; dangers of surface burn as a result of electric shock; procedure to be followed when finding someone who is receiving an electric shock.

FUNCTION 3: MAINTENANCE AND REPAIR AT THE MANAGEMENT LEVEL

Competence 3.1: Organize safe maintenance and repair procedures

3.1.1. Ships maintenance

3.1.1.1. Preparation for maintenance

Knowledge of: Permit to work system; work planning; job distribution according to work plan; various maintenance strategies.

3.1.1.2. Planned maintenance

Knowledge of: Meaning of planned maintenance system; practical knowledge (instruction manual consideration, history of machinery, appropriate tool, spare parts availability, legal and safety consideration); dismantling and inspection strategy; assembly and testing.

3.1.1.3. Condition monitoring / predictive maintenance

Knowledge of: Meaning of condition monitoring; information obtained from actual working condition; various methods or measuring instrument reflecting working condition (oil analysis, vibration analysis, acoustic emission, pressure, temperature, etc.); predictive maintenance based on condition monitoring; comparison between planned maintenance and predictive maintenance.

3.1.1.4. Dry-docking

Knowledge of: Preparations for dry docking and repair; phases normally acted in relation to dry-docking or major ship repair; how work to be carried out at a ship repair yard; distribution of work between ship yard and ship's crew; importance of an accurate and comprehensive specification; main parts of repair specification; general conditions items; general services items; activities at the yard; major preparations by the shipping company before ship's arrival at the yard; major preparations for repair work on board before arrival at the yard; organization and actions during stay at the yard; main points discussion at the daily meeting between responsible personnel from both sides; checks on completion of dry docking.

3.1.1.5. Hull protection

Knowledge of: Corrosion theory; ships hull corrosion; section of ships require more attention; methods of hull protection against corrosion (sacrificial anodes, impressed current system, coating); fouling; effect of fouling on ships performance and environment; anti fouling systems; regulation concerning anti fouling coating.

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3.1.1.6. Painting

Knowledge of: Paints components; surface preparation; methods of surface preparation; paint application methods; atmospheric condition when applying paint; thickness measurement.

Competence 3.2: Detect and identify the cause of machinery malfunction and correct faults

The required practical knowledge of this competence shall be obtained from in-service experience, approved training ship or simulator training where appropriate.

Competence 3.3: Ensure safe working practices

The required practical knowledge of this competence shall be obtained from in-service experience, approved training ship or simulator training where appropriate.

FUNCTION 4: CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR PERSONS ON BOARD AT THE MANAGEMENT LEVEL

Competence 4.1: Control trim, stability and stress

The required knowledge, understanding and proficiency of this competence have been brought in the function 1 under the section 1.1.4 (Naval architecture and ship construction, including damage control).

Competence 4.2: Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment.

4.2.1. Introduction to maritime law

Knowledge of: National maritime legislations for implementing international conventions and agreements.

4.2.2. Certificates and documents required to be carried on board ships by international conventions

Knowledge of: Classification society certificates for hull and machinery, where appropriate, refrigerating machinery and cargo. Handling appliances; anchor and chain cable certificate; inflatable life raft inspection certificate; stability, loading and ballasting information; damage control plan and booklets; oil record book; official log books; seamen's discharge books; certificates of competency of officers and ratings; minimum safe manning document; certificate of nationality (ship's register); International tonnage certificate; international load line certificate; passenger ship safety certificate; cargo ship safety construction certificate; cargo ship safety equipment certificate; cargo ship safety radiotelegraphy certificate; international oil pollution prevention certificate.

4.2.3. International conventional for the safety of life at sea, 1974 (SOLAS 74)

Knowledge of: Regulations for ships engaged on international voyages; passenger ship, cargo ship and tanker ship; surveys for enforcement of the provisions of SOLAS; requirement for surveys of hull, machinery and equipment of cargo ships; period of validity of each of the certificates; procedures to be followed by officers authorized by a port state in exercising control regarding convention's certificates; minimum manning requirements; procedure for testing of the ship's steering gear before departure; requirements for emergency steering drills; entries to be made in the log book regarding the checks and tests of the steering drills; entries to be made in

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the log book regarding the checks and tests of the steering gear and the holding of emergency drills.

4.2.4. International convention for the prevention of pollution from ships, 1973 and the protocol of 1978 (MARPOL 73/78)

Knowledge of: Purpose of MARPOL 73/78 for harmful substance, violation of the convention and the consequences; inspection by port state authorities; provisions for the detection of violations and enforcement of the convention; reports on incidents; meaning of oil content or oily mixture, oil fuel, oil tanker, combination carrier, nearest land special area, instantaneous rate of discharge of oil content, wing tank, center tank slop tank, clean ballast, segregated ballast; surveys and inspections under the provisions of MARPOL convention; master's duty to report when an accident occurs or a defect is discovered regarding the equipment covered by MARPOL; regulations regarding the discharging of clean or segregated ballast; conditions which allow the bilge water discharge from machinery space in a special area; circumstances in which the regulations in the discharge of oil or oily mixture do not apply; requirements for the provision of oil record books; entries required for machinery space operations in part I of the oil record book; requirements for ships carrying noxious liquid substances in bulk; provisions for the carriage of harmful substances in package form; provisions regarding the discharge of sewage into the sea; garbage handling and disposal regulations; air pollution regulations.

4.2.5. Classification societies

Knowledge of: Reasons for classing a ship with a classification society; ships building under survey; classification society duties; cargo handling equipment survey; periodical survey, annual survey, docking survey, intermediate survey; special survey; occasional survey after any damage to the hull, machinery or equipment; repair or alterations survey; surveys for issuing of statutory certificates on behalf of governments.

Competence 4.3: Develop emergency and damage control plans and handle emergency situation.

4.3.1. Emergency action following hull damage

Knowledge of : Planning in preparation for emergency action; ship's system and equipment in preparations for emergencies; availability of emergency equipment; procedure to follow if a ship's hull is holed; importance of localizing the flooding ; using of portable pumps; limiting factors on temporary repairs; possible repairs to hull damage; the position and operation of cross flooding arrangements.

4.3.2. Fire protection, detection and extinction

Knowledge of: Basic principles of the regulations on fire protection; properties of "A" class and "B" class divisions; main vertical zones, accommodation spaces; public spaces; service spaces, cargo spaces; RO- RO cargo spaces, both open and closed; special category spaces; machinery spaces of category A; control stations; information in fire control plans or booklets; instructions for the maintenance and operation of all fire fighting equipment and installations on board; fire control plans or a booklet for the assistance of shore side fire fighting personnel; all fire extinguishing appliances availability for using at all times during the voyage; responding to fire alarm on passenger ship; training for fire patrol; training for fire patrol; special requirements for ships carrying dangerous goods.

4.3.3. Function and use of life-saving appliances

Knowledge of: The functions and use of lifeboats (ordinary davit type/free fall); rescue boats; life rafts; buoys; line throwing apparatus and other L.S.A.

Competence 4.4: Organize and manage the crew

4.4.1. Personnel management

4.4.1.1. Principles for controlling subordinates and maintaining good relationships

Understanding in: Giving orders and dealing with offenders; being firm; treating the staff; keeping staff well informed; considering and making allowances for differences in nationality language, religion and other cultural matters affecting behavior and attitude; controlling the staff; factors governing attitudes of staff; appreciating staff's services.

4.4.1.2. Staff attitudes

Understanding in: Why people work; being useful member of society; security and standard of living; manual and mental skills of staff; the need to achieve ambitions and improve their status.

4.4.2. Organization of staff

4.4.2.1. Analysis of work

Knowledge of : Statutory and non-statutory requirements; watch keeping; maintenance; cargo work; testing systems; training of others on board; associated work such as: mooring and unmooring, food and hygiene, storing and bunkering, preparing for dry docking and surveys, administration, evaluation of personnel.

4.4.2.2. Organizing for maintenance

Knowledge of: Checklists, skill of staff and work schedules for safety equipments, deck maintenance, radio room maintenance, engine-room maintenance and catering.

4.4.2.3. Ship's records

Knowledge of : Records and certificates kept on board and maintained in good order such as document of nationality (ship's register), official logbook, drawing diagrams and instruction books supplied by shipyard, company's instructions and circulars, test certificates for wires, shackles and lifting gear, administration and classification society certificates.

4.4.2.4. Organizing communications on the ship

Knowledge of: Regular meeting on board; safety meetings and management meetings; safety committee.

4.4.2.5. Meeting techniques

Knowledge of: Performing at meetings; training on meeting technique; a successful meeting; types of meeting; objective of the meeting; sequence of the meeting.

4.4.3. Training on board ships

4.4.3.1. Training methods

Knowledge of : Purpose of on-board training; preparation before the start of a training relevant to the trainee's work and duties; conducting training session; routine training such as fire and abandon ship drills; methods for training.

4.4.3.2. Training in safety

Knowledge of: Training in use of life-saving appliances such as lifejackets, immersion suits, muster stations, boarding, launching and clearing the survival craft and rescue boats, use of all survival equipment, radio life saving appliances; other functions in the muster list and emergency instructions, emergency repair of the life saving appliances; abandon ship drills on cargo and passenger ships; instructions to each member of crew regarding using of life saving appliances.

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4.4.3.3. Emergency drills training in ships operations

Knowledge of: Avoiding routine exercises; essential tasks at each drill; emergency teams; examples of fire drills; examples of boat drills.

4.4.3.4. Training in ship operations

Knowledge of: Departmental training for operations including deck department, engine department, catering department.

4.4.3.5. Training in ship maintenance

Knowledge of: Departmental training for maintenance including deck, engine and catering department.

4.4.3.6. Teaching and assessment techniques

Knowledge of: Preparing the appropriate lesson plans; teaching aids improving the efficiency of teaching/learning; body language; establishing eye contact with trainees; practical steps to efficient teaching; continuous assessment; final assessment.

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ماده ۶-۹ مواد درسی دوره ملوان موتور در کشتیهای با قدرت موتور بیشتر از ۷۵۰ کیلووات-
سفرهای نامحدود

FUNCTION 1: MARINE ENGINEERING AT THE SUPPORT LEVEL (KW>750)

1- Carry out a watch routine appropriate to the duties of a rating forming part of an engine room watch and being familiarized with following

- 1.1 - Terms and abbreviations used in machinery space and names of machinery and equipment fitted in these areas.
- 1.2- Engine room watch keeping procedures.
- 1.3- Safety measures required and safe working practices as related to engine room operations and other members in team work.
- 1.4- Basic environmental protection procedures
- 1.5- Basic personal safety & protection in engine room.
- 1.6- Use of appropriate internal communication system.
- 1.7- Engine room alarm systems and ability to distinguish between the various alarms, with special reference to fire extinguish media alarms.

2- Keeping a boiler watch

- 2.1- Safe operation of boilers including maintaining the correct levels and steam pressure.
- 2.2- Familiar with boiler safety valve and its easing gear to release under supervision of engineer on watch in case of emergency.
- 2.3- To inform the engineer on watch on any abnormalities.

3- Assisting the engineers in engine room and daily duties

- 3.1 Having ability to prepare the required tools for overhauling different machinery in engine room and being able to dismantle the equipment as per instruction given by engineers in-charge of engine room watch or day work
- 3.2 Having ability to connect and disconnect the bunker line and follow the instruction regarding bunkering and other related activity.
- 3.3 Having ability to transfer and lift heavy parts safely with appropriate tools and gears in engine room under supervision of engineers.

4- Operate emergency equipment and follow emergency procedure

- 4.1- Having knowledge of emergency duties
- 4.2- To be able to point out the emergency escape route from engine room.
- 4.3- Familiar with location and use of portable fire fighting equipment machinery spaces.
- 4.4- Familiar to locate and operate the general alarm.

5- Basic workshop practice

- 5.1- Familiar to use all hand and power tools in workshop.
- 5.1- Ability to choose the correct tool for appropriate job.
- 5.2- Having primary skill in arc and gas welding.
- 5.3- Having good skill in piping, valve overhauling, changing gland packing of valves and engine room pumps.
- 5.4- Having skill in turning different metals on lathe machine.

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5.5- Having good ability in fitting jobs such as filing, cutting and forming the different metal used on board.

5.6- Having good knowledge of how to protect the engine room tools and equipment against corrosion and rust.

6- Basic marine engineering English

6.1- Familiarity with terminologies and definitions used in engine room during working.

6.2- Having ability to communicate with others in case of emergency.

6.3- Ability to read and understand duties on muster list and other safety Sign posted on board the ship.

6.4- Ability to communicate with officer in charge of an engineering watch in matters relevant to watch keeping duties.

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ماده ۷-۹ مواد درسی دوره کاربر موتورهای دریایی در کشتیهای با قدرت موتور کمتر از ۷۵۰ کیلووات

1. Use of hand and power tools, basic working practice and basic fitting including safe working practices

Knowledge of : - Hazards in an engineering environment; responsibility of the employer and employee under the health and safety at work; dangers associated with unsuitable clothing, hair, shoes; jewelry, gloves and machine guards; need for eye protection and types of eye protection; safety on electricity; correct and safe practice when using a grinding machine, drilling and emergency stop buttons; use of protective clothing;

- Marking; out process; care of a vee blocks; a surface plate, scribers, dividers, odd; leg calipers; uses of 60° and 90° center punches.

- Types of hacksaw, Hammer, taps, die, files, chisels and their application; Use and selection of files, hacksaw, hammer, taps, die, scrapers, chisel; safety measure when using die and scrapers.

Proficiency in : Using correct technique for sawing common materials, using of files, scrapers, and chisels safely and correctly.

Knowledge of: Types of power used in hand tools, processes for which powered hand tools are used; care necessary for the supply cables of powered hand tools.

2. Basic marine engineering maintenance

.1- Fastening

Knowledge of : Types of threaded fasteners; uses of black and bright nuts and bolts and set screws; factors for identify nuts and bolts; uses of studs, positive locking device and friction locking.

Proficiency in : Identifying the different bolt or screw; fitting studs and bolts using correct tightening procedure; removing intact and broken studs and split nuts;

.2- Preparation for work on machinery

Knowledge of : Identifying relevant manuals and drawings; preparatory work required for work on machinery and equipment; safety measures required before, during and after for maintenance required; identifying the correct tools for dismantling, inspection, repairing and reassembling; recording the maintenance activity.

.3- General maintenance procedure

Familiarization with : The basic principles of the components to be worked on; the application of safe practices at all times; the isolation of units and/ or systems prior to

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dismantling; the security of all personnel and materials during a maintenance operation; the dangers inherent in systems which contain fluids under pressure or are of a hazardous nature.

Proficiency in: Dismantling the unite according to instruction manual; select and use correct spanners and screwdriver; lifting machinery and components employing correct techniques; transport machinery; examine components taking measurements as appropriate and report on their condition; protects opened-up machinery; cut new joints or gasket; check and adjust running clearances; fit seals; pack glands; apply jointing compounds; tighten cover bolts in correct sequence; apply correct tightening troques to nuts; check free movement of moving parts by correct tightening troques to nuts; check free movement of moving parts by hand; make unit available for use, removing blank; entry in log book.

.4- Use of electrical measuring and testing equipment

Knowledge of: Range of voltages used for testing ship's equipment; function and uses of insulation tester, continuity tester, digital and analogue multi meters, clamp meter and a live line tester.

Proficiency in: Using correctly and safely: An insulation tester and making entries of test reading into a record card, a continuity tester and making entries of test reading into a record card, digital and analogue multi meters and checking the meter function and accuracy, a clamp meter and a live line tester, ammeters and voltmeters.

3. Marine diesel engines and marine auxiliary equipment/machinery

.1- Marine diesel engines

Familiarization with: Principles of operating and the essential of compression ignition engines for marine use; internal combustion engine; spark ignition engine; compression ignition; function of the essential components of reciprocating compression infection engine I.E. cylinder, piston rod; crankshaft; 4 stroke cycle and timing diagram; systems and components associated with main propulsion engine I.E.. lubricating oil system, fuel oil system, diesel main engine safety devices i.e.

.2- Engine types

Knowledge of: Marine diesel engine types; high speed engines, their application and how can be used as main propulsion engine; approximate speed ranges related to high speed engines;

.3- Engine principles

Principle features of a typical "v-type" high speed diesel engine; means of power starting of an diesel engine; correct preparation of an diesel engine; normal operating condition of a diesel engine;

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.4- Engine systems

Knowledge of: Detail of systems and main components associated with engine system and operation pressure and temperatures for the systems; safety features employed in each system and maintenance required;

.5- Operation

Knowledge of: How and engine is prepared for starting, started, stopped and reversed, when maneuvering and when at full speed; how engine speed and output power are controlled for normal condition;

.6- Air compressors

Familiarization with: Shipboard uses of compressed air; principle of types of air compressors; procedure for starting-up and stopping;

.7- Steering gear

Familiarization with: Function of steering gear with respect to safety of ship and need for its correct operation; control of steering gear; steering system and function of major components and their relation;

.8- Fuels and combustion systems

Knowledge of: Combustion process an engine cylinder; combustion products; signs of poor combustion of fuel and its importance; diesel engine fuel atomization through a typical injector nozzle; care necessary with injector nozzle holes; correct procedures for the disposal of waste oil, sludge residue, etc; place of storage of fuel oil;

.9- Marine pumps principles and type of pumps

Familiarization with: Types of pumps used on ships and the purpose of their use; operation of a reciprocation pump and purpose of its attachments; principal parts of a gear pump, principles of a centrifugal pump.

.10- Pipes, valves, etc.

Knowledge and understanding of : Means by which lengths of pipes are joined together and materials used to seal joints for, way of supporting pipe to reduce vibration; way of controlling pipes expansion and contraction; material used for construction of pipes for carrying various liquids; principle of construction of a cock; features of a globe valve, screw sown non rerun valve, a gate valve; features of a gate valve, features of a relief valve; blanking of pipe lines;

.11- Petrol engine

Familiarization with: Operation and servicing of petrol engines.

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.12- Oils

Familiarization with: different types of oil used on board; care necessary for storage of oil; oil filters and care necessary.

.13- Engine structure:

Familiarization with: Identifying engine parts; general construction of a high speed engine.

4. Basic Elector technology

.1- Basic safety

Knowledge of: Essential safety precautions when working on electrical equipment; causes of electric shock; range of safe voltage.

.2- Batteries

Familiarization with: Construction of a difference between primary and secondary cells; routing and emergency services supplied by batteries; range of voltage produced by batteries; lead-acid and alkaline batteries and their uses; parallel and series operation of batteries; capacity of batteries and its meaning; dangers which may exists in a battery compartment and precautions necessary; process of recharging of recharging of batteries; first aid equipment available in battery compartment.

5. Pollution prevention requirements

.1- Oily water separator

Familiarization with: Principle of operation of an oily water separator; general construction of components parts used; maintenance and care required.

.2- Sewage treatment plant Familiarization plant

Familiarization with: sewage-retention system of an oily water separator; general construction of effluent from a sewage plant.

.3- IMO regulations

Knowledge of: prohibition of dumping of oil or oil water mixture to sea; legal maximum oil content of water to be discharged overboard; requirement of pumping bilges through an approved oily water separator; recording of information witch must be entered in the oil record book when pumping bilges;

6. Introduction to ship structure

Familiarization to ship structure: - The essential features and general arrangements of the most common type of merchant ships; collision bulkhead; purpose of various storage tanks forming part of the ship and their position, displacement and dead weight definitions;

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- Dimensional and form terms used in ship construction; length overall, a mid ship, moulded extreme breath; moulded and extreme depth, moulede and extreme depth, moulded and extreme draught, free board, anchor and cable arrangement;
- Meaning of Draught, trim,
- Need for standard condition applied to a ship; function of classification society; need for regular surveys and dry; docking of ships.

7. Maintain a safe engineering watch

Understanding in : - The nature of all work being preformed by machinery and systems; the level and the condition of water or residues in bilge's reserve tanks, fresh water tanks, sewage tanks and any special requirements for use or disposal of the contents there of; condition and mode of operation of the various main and auxiliary systems, the availabilty and use of fire; fighting appliances; the state of completion of engine room log; The assigned watch keeping duties; use of appropriate internal communication system; determine possible equipment malfunction or failure and take immediate remedial actions to ensure the safety of the ship;

