

## سازمان بنادر و دریانوردی

دستور العمل اجرایی برگزاری دوره آموزشی و آزمونهای شایستگی دریانوردی سمت

افسر مهندس دوم بر روی کشتی های با قدرت رانش ... ۳ کیلووات یا بیشتر - سفرهای نامحدود

The Code of Practice for Conducting Second Engineer Officer on Ships of  $KW \geq 3000$  Engaged on Unlimited Voyage Training Course and Competency Assessments

کد مدرک : P6-W78

شماره بازنگری	تاریخ بازنگری	شرح تغییرات (علت و ممل)	تهیه کننده	تأیید کننده	تصویب کننده
۱	۹۳/۵/۰۶	ایجاد مدرک	رئیس اداره استانداردهای دریانوردان نصرت الله علی پور	مدیرکل امور دریانوردان حسین میرزایی	معاون امور دریایی سید علی استیری

صفحه: ۱ از ۱۷





فهرست مندرجات

ماده/بند	عنوان	صفحه
	کنترل مدرک	۱
	فهرست مندرجات	۲
	مقدمه	۳
۱	هدف از تدوین	۴
۲	دامنه کاربرد	۴
۳	تعاریف	۴
۴	مسئولیت ها	۸
۵	روش اجرا	۹
۵-۱	هدف از برگزاری دوره آموزشی	۹
۵-۲	طول دوره	۹
۵-۳	تعداد شرکت کنندگان دوره	۹
۵-۴	شرایط ورود به دوره	۹
۵-۵	دانش، درک و مهارت مورد انتظار	۱۰
۵-۶	عناوین دروس و ریز مواد درسی	۱۰
۵-۶-۱	جدول نمایانگر تعداد سئوالات، مدت، نوع، حدنصاب قبولی و مواد امتحانی آزمونهای شایستگی درجه افسر مهندس دوم بر روی کشتیهای با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر - سفرهای نامحدود	۱۱
۵-۶-۲	مواد درسی دوره افسر مهندس دوم بر روی کشتی های با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر - سفرهای نامحدود	۱۳
۵-۷	امکانات مورد نیاز جهت برگزاری دوره	۱۳
۵-۸	شرایط مدرسین و مربیان دوره	۱۵
۵-۹	ارزیابی و صدور گواهینامه	۱۶
۵-۱۰	شرایط تمدید/تجدید گواهینامه	۱۶
۵-۱۱	روش تایید دوره	۱۶
۶	سوابق	۱۷
۷	مراجع	۱۷
۸	ضمائم	۱۷





## مقدمه

سازمان بنادر و دریانوردی در راستای اجرای وظایف و اختیارات قانونی ناشی از ماده ۱۹۲ قانون دریایی جمهوری اسلامی ایران مصوب شهریور ماه ۱۳۴۳ و بند ۱۰ ماده ۳ آئین نامه تشکیل سازمان بنادر و دریانوردی مصوب بهمن ماه ۱۳۴۸ کمیسیون های خاص دو مجلس که صدور هرگونه سند یا گواهینامه و پروانه مربوط به کشتی، فرماندهان، افسران و کارکنان کشتی ها را در صلاحیت این سازمان قرار داده و در راستای رعایت مفاد کنوانسیون بین المللی استانداردهای آموزش، صدور گواهینامه و نگرهبانی دریانوردان (STCW- as amended) مصوب مرداد ماه سال ۱۳۷۵ مجلس شورای اسلامی و با عنایت به مقرره III/2 کنوانسیون مذکور " دستورالعمل اجرایی برگزاری دوره های آموزشی و آزمون های شایستگی دریانوردی سمت افسر مهندس دوم بر روی کشتیهای با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر - سفرهای نامحدود " را تدوین نموده و پس از تصویب هیأت عامل قابل اجرا می باشد.

**یادداشت:** قانون تغییر نام سازمان بنادر و دریانوردی و کشتیرانی به سازمان بنادر و دریانوردی در تاریخ ۱۳۸۷/۰۲/۱۰ به تصویب مجلس شورای اسلامی رسید.





## ۱- هدف از تدوین

هدف از تدوین این دستورالعمل ارائه حداقل نیازمندیهای برگزاری دوره های آموزشی و آزمونهای شایستگی دریانوردی سمت افسر مهندس دوم بر روی کشتی های با قدرت رانش  $\geq 3000$  کیلووات یا بیشتر - سفرهای نامحدود می باشد.

## ۲- دامنه کاربرد

این دستورالعمل برای کلیه مراکز آموزشی مورد تایید سازمان و مجری برگزاری دوره آموزش سمت افسر مهندس دوم بر روی کشتی های با قدرت رانش  $\geq 3000$  کیلووات یا بیشتر - سفرهای نامحدود کاربرد دارد.

## ۳- تعاریف

### ۳-۱ مصوب (Approved)

به معنای مصوبات اداره استانداردهای دریانوردان مطابق با دستورالعمل های سازمان بنادر و دریانوردی می باشد

### ۳-۲ گواهی خدمت دریایی مورد تایید (Approved Seagoing Service/ Documentary Evidence)

به معنای تاییدیه خدمت دریایی دریانوردان جهت شرکت در دوره های آموزشی/آزمونهای دریانوردی و صدور گواهینامه های دریانوردی می باشد که می بایست علاوه بر ثبت در شناسنامه دریانوردی ، تاییدیه شرکت کشتیرانی / مالک کشتی و یا اتحادیه مالکان کشتیها به صورت فرم کامپیوتری (computer sheet)، نامه اداری شماره شده و یا فرم تعریف شده (به ضمیمه این دستورالعمل) قابل ارائه است.

### ۳-۳ گواهینامه شایستگی (Certificate of Competency)

به معنای گواهینامه صادره و یا شناسایی شده ای است که مطابق الزامات فصلهای ۲، ۳، ۴، و یا ۷ کنوانسیون برای فرماندهان، افسران و افسران مهندس الکترونیک صادر و یا تایید می شود و دارنده ی قانونی آن محق به خدمت در مقام و عمل به وظایف مربوطه در سطح مسئولیت مشخص شده در آن است.





### ۳-۴ دستگاه نظارت مرکز (Central Monitoring Office)

به معنای اداره یا بخشی که وظیفه صدور مجوز فعالیت آموزش دریانوردی و نظارت بر مراکز آموزشی را بر عهده دارد. دستگاه نظارت در ستاد سازمان، اداره استانداردهای دریانوردان می باشد. مدیر کل امور دریانوردان نیز جزء دستگاه نظارت مرکز بوده و می تواند صدور مجوز فعالیت آموزش دریانوردی و نظارت بر مراکز آموزش دریانوردان را تایید نماید.

### ۳-۵ افسر سر مهندس (Chief Engineer Officer)

به معنای افسر ارشد مهندسی است که مسئول رانش مکانیکی و عملیات و نگهداری تاسیسات الکتریکی و مکانیکی کشتی است.

### ۳-۶ دستورالعمل (Code of Practice)

به معنای مجموعه قوانین، مقررات ملی و الزامات مندرج در این دستورالعمل است که توسط اداره کل امور دریانوردان تدوین و به تصویب هیات عامل سازمان رسیده است.

### ۳-۷ شرکت کشتیرانی (Company)

به معنای مالک کشتی، هر شخصی مانند مدیر، یا اجاره کننده در بست کشتی است، که مسئولیت عملیات کشتی از طرف مالک کشتی بر وی فرض شده است، و با قبول چنین مسئولیتی، کلیه وظایف و مسئولیت‌های محول شده بر شرکت توسط این دستورالعملها را بر عهده گرفته است.

### ۳-۸ گواهی طی دوره

#### (Course Completion Certificate or Documentary Evidence)

به معنای گواهی است که مرکز آموزشی مورد تایید سازمان به فراگیر پس از گذراندن موفقیت آمیز دوره مربوطه ارائه می دهد.

### ۳-۹ افسر مهندس (Engineer Officer)

به معنای افسری است که مطابق با الزامات مقرر ۳/۱، ۳/۲ و ۳/۳ (III/3, III/2, III/1) کنوانسیون دارای صلاحیت است.





**۳-۱۰ فرمانده (Master)**

به معنای شخصی است که عهده دار فرماندهی کشتی می باشد.

**۳-۱۱ گواهینامه سلامت پزشکی (Medical Fitness Certificate)**

به معنای گواهینامه ای است که توسط پزشک معتمد سازمان جهت متقاضیانی که از نظر پزشکی از سلامت برخوردار باشند، صادر می گردد.

**۳-۱۲ مرکز صدور گواهینامه پزشکی (Medical Fitness Certificate Issuing Center)**

به معنای مرکزی است که صدور گواهینامه سلامت پزشکی توسط پزشک معتمد سازمان برای فرد متقاضی انجام می پذیرد.

**۳-۱۳ کشتی تجاری (Merchant Ship)**

به معنای هر نوع شناوری است (به استثنای شناورهای خدماتی، سکوهای متحرک فراساحلی، صیادی و یا نظامی) که در امر جابجایی کالاهای تجاری، مسافر و بار تسهیلات مربوط به کالاهای تجاری بکار گرفته می شود.

**۳-۱۴ ماه (Month)**

جهت محاسبه خدمت دریایی هر ماه متشکل از ۳۰ روز می باشد.

**۳-۱۵ افسر (Officer)**

به معنای عضوی از خدمه شناور به غیر از فرمانده است که بر اساس قوانین و مقررات ملی و یا بین المللی انتخاب شده باشد.

**۳-۱۶ سازمان (Ports & Maritime Organization of Iran (Islamic Republic))**

به معنای سازمان بنادر و دریانوردی جمهوری اسلامی ایران می باشد.





### ۳-۱۷ قدرت رانش موتور (Propulsion Power)

به معنای مجموع حداکثر قدرت موجود در موتورهای کشتی بر حسب کیلووات که در گواهینامه ثبت کشتی و یا دیگر مدارک مربوطه درج شده باشد.

### ۳-۱۸ خدمت دریایی (Seagoing Service)

به معنای مدت زمان دریانوردی بر روی کشتی است که می بایست مرتبط با صدور و یا تجدید گواهینامه های شایستگی و یا مهارت در یانوردان می باشد.

### ۳-۱۹ افسر مهندس دوم (Second Engineer Officer)

به معنای افسر مهندسی است که جانشین افسر سر مهندس است و مسئولیت رانش مکانیکی و عملیات و نگهداری تاسیسات الکتریکی و مکانیکی کشتی را در مواقع عدم توانایی سر مهندس بر عهده دارد.

### ۳-۲۰ کنوانسیون (STCW Convention)

به معنای کنوانسیون اصلاح شده بین المللی استانداردهای آموزشی، صدور گواهینامه و نگرهبانی دریانوردان (STCW-78 as amended) می باشد.

### ۳-۲۱ آئین نامه ی کنوانسیون (STCW Code)

به معنای آئین نامه ی آموزشی، صدور گواهینامه ها و نگرهبانی دریانوردان (STCW) که طی قطعنامه ی شماره ۲ کنفرانس ۱۹۹۵ تصویب که ممکن است توسط سازمان بین المللی دریانوردی بر اساس اصلاحیه های بعدی تغییر یابد.

### ۳-۲۲ سفرهای نامحدود (Unlimited Voyages)

به معنای سفرهای بین المللی که محدود به سفرهای نزدیک به ساحل نباشد.





#### ۴- مسئولیت ها

۴-۱- مسئولیت بازرنگری این دستورالعمل بر عهده دستگاه نظارت مرکز (اداره استانداردهای دریانوردان) می باشد.

۴-۲- مسئولیت تایید اصلاحیه ها به این دستورالعمل بر عهده اداره کل امور دریانوردان می باشد.

۴-۳- مسئولیت تصویب اصلاحیه ها به این دستورالعمل بر عهده معاون امور دریایی به نیابت از هیات عامل سازمان می باشد.

۴-۴- مسئولیت اجرای کامل دوره آموزشی بر اساس عناوین اعلام شده بر عهده مرکز آموزشی می باشد.

۴-۵- مسئولیت نظارت بر حسن اجرای این دستورالعمل در مراکز آموزشی دریانوردی بر عهده دستگاه نظارت مرکز (اداره استانداردهای دریانوردان) می باشد.

۴-۶- مسئولیت برگزاری آزمون بر اساس عناوین اعلام شده در بند ۱-۶-۵ بر عهده اداره امتحانات و اسناد دریانوردی در تهران و بنادر می باشد.







## ۵- روش اجرا

### ۵-۱- هدف از برگزاری دوره آموزشی

هدف از برگزاری دوره آموزشی ، آماده نمودن فراگیران برای کسب توانمندی های مندرج در ستون ۱ از جدول بخش ۱۱/۲ - الف آیین نامه کنوانسیون STCW می باشد.

### ۵-۲- طول دوره

۵-۲-۱- طول دوره حداقل ۱۰۲۶ ساعت است که شامل ۸۹۶ ساعت به صورت نظری (تئوری) ، ۵۸ ساعت عملی و ۷۲ ساعت تمرین (بدون احتساب مدت زمان آموزش کارورزی)

۵-۲-۲- حداکثر مدت زمان آموزش روزانه برای هر فراگیر ۸ ساعت می باشد.

### ۵-۳- تعداد شرکت کنندگان در دوره

۵-۳-۱- حداکثر فراگیران شرکت کننده در هر دوره ۲۰ نفر می باشد.

۵-۳-۲- در صورت افزایش حداقل فضا، تجهیزات و امکانات مرتبط کمک آموزشی بر اساس دستورالعمل صدور مجوز و نظارت بر اجرای دوره ها در مرکز آموزشی دریانوردی و پس از اخذ تاییدیه از دستگاه نظارت ذیربط، تعداد شرکت کنندگان دوره می تواند حداکثر تا ۳۰ نفر افزایش یابد.

### ۵-۴- شرایط ورود به دوره

۵-۴-۱- دارای گواهینامه سلامت پزشکی معتبر بر اساس دستورالعمل مصوب سازمان

۵-۴-۲- دارا بودن مدرک مهندس سوم بر روی کشتیهای با قدرت رانش ۷۵۰ کیلووات یا بیشتر - سفرهای نامحدود.

۵-۴-۳- انجام خدمات دریایی پس از اخذ گواهینامه دریانوردی مهندس سوم بر روی کشتیهای با قدرت رانش ۷۵۰ کیلووات یا بیشتر - سفرهای نامحدود بمدت حداقل ۱۸ ماه که از این مدت حداقل ۶ ماه بایستی در سمت مسئول نگهداری خدمت نموده باشد.





سازمان بنادر و دریانوردی

کد مدرک : P6-W78/1

شماره صفحه : ۱۰ از ۱۷

دستورالعمل اجرایی برگزاری دوره آموزشی و آزمونهای ساینک دریانوردی سمت افسر مهندس دوم بر روی کشتیهای با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر برای محدود  
The Code of Practice for Conducting Second Engineer Officer on Ships of KW≥3000  
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## ۵-۵ - دانش ، درک و مهارت مورد انتظار

- ۱-۵-۵-۵- کسب اطلاعات کافی در خصوص راه بری نیروی انسانی و ماشین آلات موتور خانه
- ۲-۵-۵-۵- کسب اطلاعات کافی در خصوص مدیریت تعمیر و نگهداری ماشین آلات موتورخانه
- ۳-۵-۵-۵- کسب توانایی بر عهده گیری مدیریت مستقل فنی کشتی در غیاب افسر سر مهندس
- ۴-۵-۵-۵- کسب مهارت در اتخاذ تدابیر لازم و عملی به جهت پیاده سازی قوانین ایمنی
- ۵-۵-۵-۵- کسب مهارت در اتخاذ تدابیر لازم به جهت حفاظت از محیط زیست
- ۶-۵-۵-۵- کسب توانایی در مدیریت و پیاده سازی دستورات مافوق و ایجاد ارتباط در محیط کاری و همچنین

آموزش نفرات تحت نظر

## ۵-۶ - عناوین دروس، ریز مواد درسی و آزمون

عناوین دروس و جدول نمایانگر حداقل تعداد سوالات، مدت، نوع، حدنصاب قبولی و مواد امتحانی آزمونهای شایستگی دریانوردی برای داوطلبین سمت " افسر مهندس دوم بر روی کشتیهای با قدرت رانش ۳۰۰۰ کیلو وات یا بیشتر سفرهای نامحدود به شرح ذیل می باشد.



سازمان بنادر و دریانوردی

کد مدرک : P6-W78/1

شماره صفحه : ۱۱ از ۱۷

دستورالعمل اجرایی برگزاری دوره آموزشی و آزمونهای شایستگی دریانوردی سمت افسر مهندس دوم بر روی کشتیهای با قدرت رانش ... کیلووات یا بیشتر برای مهندسان  
The Code of Practice for Conducting Second Engineer Officer (KW≥3000) Unlimited Voyage Training Course and Competency Assessments



۱-۶-۵ جدول نمایانگر حداقل تعداد سئوالات، مدت، نوع، حدنصاب قبولی و مواد امتحانی آزمونهای شایستگی درجه افسر مهندس دوم بر روی کشتیهای با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر - سفرهای نامحدود

ردیف	نام آزمون	تعداد سئوالات	مدت (ساعت)	نوع آزمون	حد نصاب قبولی (درصد)	برای هر آزمون مواد امتحانی مطابق با سر فصل ها و دروس بندهای ۲-۶-۵	ملاحظات
۱	دانش مهندسی دریایی (موتور)	۶	۳	کتبی	۶۰	4-1-1-1-i, 4-1-1-1-ii, 4-1-1-1-iii, 4-1-1-1-iv, 4-1-1-1-v, 4-1-1-1-vi, 4-1-1-1-vii, 4-1-1-1-viii, 4-1-1-1-ix, 4-1-1-2, 4-1-1-3, 4-1-1-4-i, 4-1-1-4-ii, 4-1-1-4-iii, 4-1-1-4-iv, 4-1-1-4-v, 4-1-1-4-vi, 4-1-1-4-vii, 4-1-1-4-viii, 4-1-1-4-ix, 4-1-1-4-x, 4-1-1-4-xi, 4-1-1-4-xii, 4-2-1-3-i, 4-2-1-4-i, 4-2-1-4-ii, 4-2-1-4-iii, 4-2-1-4-iv, 4-2-1-6-i, 4-2-1-6-ii, 4-2-1-6-iii, 4-2-1-6-iv, 4-2-1-6-v, 4-2-1-6-vi, 4-3-1-1, 4-3-1-2, 4-3-1-3, 4-3-1-4-ii, 4-3-1-5-ii, 4-3-1-5-iii	
۲	دانش مهندسی دریایی (عمومی)	۸	۳	کتبی	۶۰	4-1-1-1-x, 4-2-1-1, 4-2-1-2-i, 4-2-1-5, 4-2-1-7-i, 4-2-1-7-ii, 4-2-1-7-iii, 4-2-1-7-iv, 4-2-1-7-v, 4-2-1-7-vi, 4-2-1-7-vii, 4-2-1-7-viii, 4-2-1-7-ix, 4-2-1-7-x, 4-2-1-7-xi, 4-2-1-7-xii, 4-2-1-7-xiii, 4-3-1-4-i, 4-3-1-5-iv, 4-3-1-5-v, 4-3-1-5-vi, 4-3-1-5-vii, 4-4-1, 5-1-15, 6-1-1-1-i, 6-1-2-1, 6-1-2-1-i, 6-1-2-1-ii, 6-1-2-2, 6-1-2-3, 6-2-1, 6-2-1-1, 6-2-1-2, 6-2-1-3, 6-3-1-1, 12-4-2, 3-4-3, 3-5-1, 3-5-2, 3-5-3-1, 3-5-3-2, 3-5-3-3, 3-5-3-4, 3-5-4-1, 3-5-4-2, 3-5-4-3, 3-5-4-4, 3-5-4-5, 3-5-5-1, 3-5-5-2, 3-5-5-3, 3-5-5-4, 3-5-6	





	4-2-1-8-i, 4-2-1-8-ii, 3-1-1-i, 3-1-1-ii, 3-1-2-i, 3-1-2-ii, 3-1-2-iii, 3-1-3-i, 3-2-1-1, 3-2-1-2, 3-2-1-3, 3-2-1-4, 3-2-1-5, 3-2-1-6, 3-2-1-7, 3-2-1-7-i, 3-2-1-7-ii, 3-2-1-7-iii, 3-2-1-8, 3-3-1, 3-3-2, 3-3-3, 3-3-4, 3-3-5, 4-4-1-i	۵۵	کتبی	۲/۵	۶	آرشیفتکت دریایی، ایمنی کشتی و حفاظت از محیط زیست	۳
در زمان آزمون شفاهی شناسنامه دریانوردی می بایست ارائه گردد	4-3-1-1, 4-3-1-2, 4-3-1-3, 4-3-1-4-ii, 4-3-1-5-i, 6-1-1-1-i, 6-1-2-1, 6-1-2-1-i, 6-1-2-1-ii, 6-1-2-2, 6-1-2-3, 6-2-1, 6-2-1-1, 6-2-1-2, 6-2-1-3, 6-3-1, 6-3-1-1, 3-2-1-1, 3-2-1-2, 3-2-1-3, 3-2-1-4, 3-2-1-5, 3-2-1-6, 3-2-1-7, 3-2-1-7-i, 3-2-1-7-ii, 3-2-1-7-iii, 3-2-1-8, 3-3-2, 3-3-3, 3-3-4, 3-3-5, 3-4-2, 3-4-3, 3-5-1, 3-5-2, 3-5-3-1, 3-5-3-2, 3-5-3-3, 3-5-3-4, 3-5-4-1, 3-5-4-2, 3-5-4-3, 3-5-4-4, 3-5-4-5, 3-5-5-1, 3-5-5-2, 3-5-5-3, 3-5-5-4, 3-5-6	نمره ندارد	شفاهی	-	-	شفاهی / عملی / شبیه ساز	۴

❖ مهندسی کشتی با سیستم رانش توربین بخار مواد درسی 4-1-1-2-1-iii, 4-1-1-2-1-ii, 4-1-1-2-1-i را نیز شامل می گردد

❖ داوطلبان خدمت بر روی کشتی های با سیستم رانش توربین بخار از مواد درسی 4-1-1-1-i, 4-1-1-1-ii, 4-1-1-1-iii, 4-1-1-1-iv, 4-1-1-1-v, 4-1-1-1-vi, 4-1-1-1-vii, 4-1-1-1-viii معاف می باشند

❖ امتحان الکتروتکنولوژی دریایی به مرکز آموزش دریانوردی مورد تایید سازمان تویض اختیار شده است





۲-۶-۵ مواد درسی دوره افسر مهندس دوم بر روی کشتی های با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر - سفرهای نامحدود در بخش انگلیسی این دستورالعمل می باشد.

### ۷-۵- امکانات مورد نیاز جهت برگزاری دوره

جهت برگزاری دوره های آموزشی علاوه بر فضای آموزشی قید شده در "دستورالعمل نحوه صدور مجوز و نظارت بر مراکز آموزشی دریانوردی" مصوب سازمان، تجهیزات کمک آموزشی مشروحه زیر نیز مورد نیاز می باشد:

۱-۷-۵- سالن / کلاسها می بایست مجهز به سیستم تهویه و نور کافی و وسایل سمعی و بصری و امکانات مورد نیاز برای تدریس باشد.

۲-۷-۵- کتابخانه مجهز به کتب تخصصی مورد نیاز تدریس و اطلاعات جامع دیگر در خصوص دوره.

### ۳-۷-۵- آزمایشگاه و کارگاه مکانیک

Mechanical laboratory

- 1- Small scale refrigeration unit with sufficient instrumentation to determine the condition of the refrigeration at important stages.
- 2- Laboratory equipment to perform common tests and analysis on fuels and lubricating oils.
- 3- Testing machine for testing tensile, hardness, impact, fatigue, creeping and torsion.
- 4- Non-destructive test bench for dye penetrate, magnetic particle tests, radio graphic and ultrasonic crack detection.
- 5- Valves: Diaphragm-operated control valve with motor, correcting element and positions, miter valve, vee-ported valve, piston actuator, butterfly valve, wax-element control valve, solenoid valve.

Controllers: Working models to demonstrate the production of:

- a- Proportional control
- b- Integral action
- c- Derivative action





#### ۴-۷-۵- کارگاه و آزمایشگاه برق و الکترونیک

Electrical and electronic engineering laboratory/ workshop.

A.C and D.C electrical power supplies, ammeters and voltmeters with appropriate shunts, etc. to extend their range; instruments incorporating the Wheatstone bridge, potentiometers, multiunit indicators and recorders, thermocouples, ohm-meters, insulation and continuity testers, multimeter's, oscilloscopes, a selection of insulating materials, a selection of open-front and dead-front switchboards, reverse-current trips, preferential trips, instruments or trips, a selection of resistors, 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, hose proof, waterproof deck watertight and submersible motors, a selection of D.C motors, starters and a charging system, samples of equipment for which the safety levels are flameproof, explosion proof increased safety, intrinsically safe and pressurized.

#### ۵-۷-۵- کارگاه و آزمایشگاه ابزار دقیق

Instrumentation laboratory and workshop

- 1- Thermometers and pyrometers: Mercury in steel, vapor-pressure, gas-filled, bimetallic, resistance, thermistor-type, thermocouple.
- 2- Manometers: Wide-cistern, inclined-tube, mercury.
- 3- Pressure gauges: Bourdon tube, diaphragm, Schaffer, differential twin bellows, strain gauge, pressure gauge testing equipment.
- 4- Level-measuring devices: Float, probe element, displacement chamber, pneumaticator gauge.





- 5- Flow measurement: Rotometer.
- 6- General: mechanical tachometer, viscometer, a detector using a photoelectric cell, i.e.
  - a- For oil in water
  - b- For smoke density
  - c- For oil mist
  - d- For flame
- 7- Selection of fire detectors, explosive gas detector, oxygen analyzer, CO2 analyzer, relative humidity meter, sectioned pneumatic transducer with negative feedbacks, pneumatic receiver integrator.

### ۸-۵- شرایط مدرسین و مربیان دوره

مدرسین و مربیان دوره های آموزشی مندرج در این دستورالعمل می بایست علاوه بر گذراندن دوره مدرسین و ممتحنین دریانوردی (TFT) مورد تأیید سازمان دارای حداقل مدارک و تجارب مشروحه زیر باشند:

#### ۱-۸-۵- مدرسین

۱-۸-۵-۱- جهت ارایه مواد درسی مندرج در جداول مربوطه ردیف ۱، ۲، ۳ و ۴ ماده ۱-۶-۵

این دستورالعمل، گواهینامه شایستگی معتبر افسر سرمهندس بر روی کشتی های با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر- سفرهای نامحدود و یک سال خدمت دریایی در آن سمت.

۲-۸-۵-۱- جهت ارایه مواد درسی الکتروتکنولوژی دریایی این دستورالعمل دارندگان مدرک فوق

لیسانس مرتبط یا گواهینامه شایستگی معتبر افسر مهندس الکترونیک که حداقل ۳ سال بر روی کشتیهای با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر- سفرهای نامحدود خدمت نموده اند، می توانند مدرس بخشهای الکتروتکنولوژی دریایی باشند.

۳-۸-۵-۱- دارندگان مدرک فوق لیسانس در رشته های معماری و سازه کشتی ویا فرمانده بر روی

کشتی های با ظرفیت ناخالص ۳۰۰۰ یا بیشتر سفر های نامحدود با حداقل ۱۲ ماه خدمت دریایی در آن سمت می توانند مدرس بخشهای آرشیتکت کشتی باشند.





## ۲-۸-۵- مریان

۱-۲-۸-۵- گواهینامه شایستگی معتبر مهندس دوم بر روی کشتیهای با قدرت رانش ۳۰۰۰ کیلووات یا

بیشتر - سفرهای نامحدود و حداقل ۱۲ ماه خدمت دریایی در آن سمت یا.

۲-۲-۸-۵- لیسانس مرتبط (مهندسی کشتی، مهندسی کشتی سازی یا مهندسی مکانیک) با حداقل ۲

سال تجربه کاری .

۳-۲-۸-۵- برای ارایه دروس "برق عملی" دارندگان گواهینامه شایستگی افسر مهندس الکترونیک با

۱۲ ماه خدمت دریایی در آن سمت یا لیسانس برق با دو سال تجربه کاری مورد نیاز می باشد.

## ۹-۵- ارزیابی و صدور گواهینامه

۱-۹-۵- در صورت موفقیت فراگیران در ارزیابی های حین و یا پایان دوره، گواهی طی موفقیت آمیز دوره

مربوطه توسط مرکز آموزشی مورد تایید و مجری برگزاری دوره صادر می گردد.

۲-۹-۵- سپس فراگیران می توانند درخواست حضور در آزمون شایستگی و مهارت دریانوردی سازمان را بر

اساس مفاد بند ۱-۶-۵ این دستورالعمل ارائه نمایند؛ و

۳-۹-۵- نهایتا اداره امتحانات و اسناد دریانوردان سازمان برای آن دسته از شرکت کنندگان که آزمون مربوطه

را با موفقیت طی نموده باشند و حائز دیگر شرایط لازم باشند، گواهینامه مرتبط بر اساس دستورالعمل

صدور، تمدید و تجدید گواهینامه های شایستگی و مهارت دریانوردان صادر می نماید.

## ۱۰-۵- شرایط تمدید/ تجدید گواهینامه

گواهینامه های شایستگی و مهارت دریانوردی بر اساس مفاد دستورالعمل صدور، تمدید، و تجدید گواهینامه های

شایستگی و مهارت دریانوردن تمدید و یا تجدید می گردد.

## ۱۱-۵- روش تأیید دوره

بر اساس مفاد مندرج در دستورالعمل صدور مجوز و نظارت بر اجرای دورهها در مراکز آموزش دریانوردی.







سازمان دریانوردی

دستورالعمل اجرایی برگزاری دوره آموزشی و آزمونهای شایستگی دریانوردی سمت افسر منسب دوم بر روی کشتیهای با قدرت رانش ۳۰۰۰ کیلووات یا بیشتر - سزای نامحدود  
The Code of Practice for Conducting Second Engineer Officer (KW≥3000)  
Unlimited Voyage Training Course and Competency Assessments

کد محرک : P6-W78/1

شماره صفحه : ۱۷ از ۱۷

## ۶- سوابق

کلیه سوابقی که نشان دهنده رعایت موارد مندرج در این دستورالعمل باشد

## ۷- مراجع

۷-۱- کنوانسیون اصلاح شده STCW و آیین نامه مربوطه

۷-۲- مدل کورس سازمان بین المللی دریانوردی (IMO) شماره ۷/۰۲

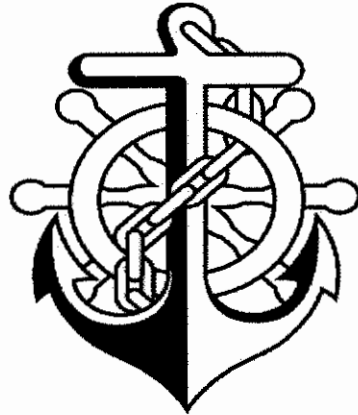
۷-۳- دستورالعمل صدور، تمدید و تجدید گواهینامه های شایستگی و مهارت دریانوردان

۷-۴- دستورالعمل صدور مجوز و نظارت بر اجرای دوره ها در مراکز آموزشی دریانوردی

## ۸- ضمیمه

ندارد





**PMO**

The Code of Practice for Conducting Second Engineer Officer on  
Ships of  $KW \geq 3000$  Engaged on Unlimited Voyage Training  
Course and Competency Assessments

P6-W79

Revision No.	Date of revision	Comment on revision	Draft provider	approving amendments authority	endorsing amendments authority
1	2014/07/28	STCW Convention, as amended	Head of Seafarers' Standards' Directorate	Director General of Seafarers' Affairs	PMO's Deputy for Maritime Affairs



No.	Title	Page No.
	Control (covering) page	1
	List of Contents	2
	Introduction	3
1-	Objectives	4
2-	Scope of application	4
3-	Definition	4
4-	Responsibilities	7
5-	Procedure	7
5-1	Course objective	7
5-2	Course duration	7
5-3	Number of trainees	8
5-4	Course entry requirements	8
5-5	Expected knowledge, understanding and proficiency	8
5-6	Course syllabi and competency assessment	9
5-7	Facilities and equipment required for conducting the course	60
5-8	Lecturer and instructor minimum qualifications	61
5-9	Assessment and Certification	62
5-10	Revalidation and renewal of certificates	62
5-11	Course approval	62
6-	Records	62
7-	References	62
8-	Appendices	62



## Introduction

Ports and Maritime organization (P.M.O) of the Islamic republic of Iran in performing its duty and in exercising its prerogative resulting from article 192 of the Islamic republic of Iran maritime code, 1964 and paragraph 10 of article 3 of P.M.O manifesto, 1970 enabling it to issue any document, certificate or license for ships, masters, officers and other ship personnel and also in accordance with the provisions of the international convention on standards of training, certification and watch keeping for seafarers (STCW), 1978, as amended adopted by the Islamic consultative assembly in 1996 and taking into account regulations III/2 of the mentioned Convention and section A-III/2 of the STCW Code, develops this "code of practice for conducting second engineer officer on ships of propulsion power  $KW \geq 3000$  engaged on unlimited voyages training course and competency assessment" which is applicable after endorsement by the of board of executives of Ports & Maritime Organization.

**NOTE:** The title of Ports and Shipping Organization changed to Ports and Maritime Organization dated 29.04.2008 through parliamentary act and approved by Islamic council assembly.





## 1 Objective

The objective of this code of practice is to specify the minimum requirements for conducting Second Engineer Officer on Ships of Propulsion power KW $\geq$ 3000 engaged on Unlimited Voyages training course and competency assessment.

## 2 Scope of application

This code of practice is applicable to all approved training centers that conduct Second Engineer Officer on Ships of Propulsion power KW $\geq$ 3000 engage on Unlimited Voyages training course.

## 3 Definition

### 3-1 Approved

Means approved by the Seafarer's Standards Directorate in accordance with the PMO's Codes of practices.

### 3-2 Approved Seagoing Service / Documentary Evidence

Means approved sea going service required to be presented for participating in a training course, maritime examination and issuance of certificate. These documentary evidence should be inserted in CDC and authenticated by company or ship owner or ship owner's associations and in addition be presentable in a form of computer sheet, official letter or other forms as defined in the annex to this code of practice.

### 3-3 Certificate of Competency (COC)

Means a certificate issued and endorsed for masters, officers and GMDSS radio operators in accordance with the provisions of chapters II, III, IV or VII of the STCW Convention and entitling the lawful holder thereof to serve in the capacity and perform the functions involved at the level of responsibility specified therein.

### 3-4 Central Monitoring Office

Central monitoring office which is responsible for approving and monitoring training courses is the Seafarer's standard directorate of the PMO.

### 3-5 Chief Engineer Officer

Means the senior engineer officer responsible for the mechanical propulsion and the operation and maintenance of the mechanical and electrical installations of the ship.





**3-6 Code of Practice**

Means all national rules, regulations and requirements specified in this document which have been drafted by the PMO's General Directorate of Maritime affairs and endorsed by the PMO's board of executive

**3-7 Company**

Means the owner of the ship or any other organization or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the ship owner and who, on assuming such responsibility, has agreed to take over all the duties and responsibilities imposed on the company by these Codes of practices.

**3-8 Course Completion Certificate or Documentary Evidence**

Means a certificate issued through the training center, after successfully completion of training program by the applicants

**3-9 Engineer officer**

Means an officer qualified in accordance with the provisions of regulation III/1, III/2 or III/3 of the Convention

**3-10 Master**

Means the person having command of a ship

**3-11 Medical Fitness Certificate**

Means a certificate issued by the PMO's recognized medical practitioner to the candidates who found to be medically fit.

**3-12 Medical fitness certificate Issuing Center**

Means a center in which candidates are to be tested medically as per requirement of relevant Code of Practice

**3-13 Merchant Ship**

Means any ship (other than servicing vessel, mobile offshore platform, fishing and naval ships) used for carriage of cargoes, passenger and/or provisions

**3-14 Month**

Means a calendar month or 30 days made up of periods of less than one month.

**3-15 Officer**

Means a member of the crew, other than the master, designated as such by national law or regulations or, in the absence of such designation, by collective agreement or custom.





### **3-16 PMO**

Means Ports & Maritime Organization (PMO) of the Islamic Republic of Iran

### **3-17 Propulsion Power**

Means the total maximum continuous rated output power, in kilowatts, of all the ship's main propulsion machinery which appears on the ship's certificate of registry or other official document.

### **3-18 Seagoing service**

Means service on board a ship relevant to the issue or revalidation of a certificate or other qualification.

### **3-19 Second Engineer Officer**

Means the engineer officer next in rank to the chief engineer officer and upon whom the responsibility for the mechanical propulsion and the operation and maintenance of the mechanical and electrical installations of the ship will fall in the event of the incapacity of the chief engineer officer.

### **3-20 STCW Convention**

Means international convention on standards of training, certification and watch keeping for Seafarers, 1978, as amended.

### **3-21 STCW Code**

Means the seafarers' training, certification and watchkeeping (STCW ) code as adopted by the 1995 conference resolution 2, as it may be amended by the international maritime organization.

### **3-22 Unlimited Voyages**

Means voyages not limited to the near coastal voyages.





#### 4- Responsibilities

- 4-1 Central monitoring office is responsible for revising this code of practice.
- 4-2 General Director of Seafarers' Affairs is responsible for approving amendments to this code of practice.
- 4-3 Deputy of maritime affairs is responsible to endorse amendments to this code of practice on behalf of PMO's board of executive.
- 4-4 Training centers are to conduct training course in accordance with this Code of practice.
- 4-5 Central monitoring office is responsible for supervising the implementation of this code of practice in training centers.
- 4-6 Seafarers' Examinations and Documents Directorate is responsible to conduct the competency assessment mentioned in paragraph 5-6-1 of this code.

#### 5- Procedure

##### 5-1 course objective

The objective of this course is to prepare trainees to achieve competencies required to perform as Second Engineer Officer on ships of Propulsion power KW $\geq$ 3000 engaged on Unlimited Voyages.

##### 5-2 course duration÷

5-2-1 A minimum of 1026 hours which includes 896 theoretical, 58 hours exercise and 72 hours practical for each trainee.

5-2-2 Maximum daily contact hours for each trainee is 8.







**5-3 number of trainees:**

5-3-1 the maximum number of trainees in each course is 20.

5-3-2 the number of trainees may be increased to 30 when the relevant facilities, teaching aids and class-room space are increased as per criteria set out in the code of practice for approving and monitoring training courses.

**5-4 Course entry requirement:**

The course trainees should, at least;

5-4-1 hold valid medical fitness certificate issued by a medical practitioner recognized by the PMO;

5-4-2 hold certificate of competency as third engineer officer for ships of KW $\geq$ 750 engaged on unlimited voyages;

5-4-3 have, in total 18 months seagoing service as officer in charge of engineering watch on ships of kW  $\geq$ 750, engaged on unlimited voyages.

**5-5 Expected Knowledge, Understanding and Proficiency:**

5-5-1 Knowledge of how machineries work in engine room as well as leading working personnel;

5-5-2 Proficiency in maintaining machineries in engine room and deck;

5-5-3 Ability to manage engine department personnel independently;

5-5-4 Proficiency in practicing safeties;

5-5-5 Proficiency in practicing and protecting environmental safeties;

5-5-6 Ability to manage and practice superior instructions as well as educating personnel under command in working environmental.





**5-6 course syllabus and competency assessment:**

5-6-1 Competency assessment details;

No	Title	Number of Question	Time (hours)	Type	Pass mark	Subjects as per syllabus mentioned in 5-6-2	Remarks (if any)
1	Motor	6	3	written	60	4-1-1-1-i, 4-1-1-1-ii, 4-1-1-1-iii, 4-1-1-1-iv, 4-1-1-1-v, 4-1-1-1-vi, 4-1-1-1-vii, 4-1-1-1-viii, 4-1-1-1-ix, 4-1-1-2, 4-1-1-3, 4-1-1-4-i, 4-1-1-4-ii, 4-1-1-4-iii, 4-1-1-4-iv, 4-1-1-4-v, 4-1-1-4-vi, 4-1-1-4-vii, 4-1-1-4-viii, 4-1-1-4-ix, 4-1-1-4-x, 4-1-1-4-xi, 4-1-1-4-xii, 4-2-1-3-i, 4-2-1-4-i, 4-2-1-4-ii, 4-2-1-4-iii, 4-2-1-4-iv, 4-2-1-6-i, 4-2-1-6-ii, 4-2-1-6-iii, 4-2-1-6-iv, 4-2-1-6-v, 4-2-1-6-vi, 4-3-1-1, 4-3-1-2, 4-3-1-3, 4-3-1-4-ii, 4-3-1-5-ii, 4-3-1-5-iii	
2	General	8	3	written	60	4-1-1-1-x, 4-2-1-1, 4-2-1-2-i, 4-2-1-5, 4-2-1-7-i, 4-2-1-7-ii, 4-2-1-7-iii, 4-2-1-7-iv, 4-2-1-7-v, 4-2-1-7-vi, 4-2-1-7-vii, 4-2-1-7-viii, 4-2-1-7-ix, 4-2-1-7-x, 4-2-1-7-xi, 4-2-1-7-xii, 4-2-1-7-xiii, 4-3-1-4-i, 4-3-1-5-iv, 4-3-1-5-v, 4-3-1-5-vi, 4-3-1-5-vii, 4-4-1, 5-1-15, 6-1-1-1-i, 6-1-2-1, 6-1-2-1-i, 6-1-2-1-ii, 6-1-2-2, 6-1-2-3, 6-2-1, 6-2-1-1, 6-2-1-2, 6-2-1-3, 6-3-1-1, 12-4-2, 3-4-3, 3-5-1, 3-5-2, 3-5-3-1, 3-5-3-2, 3-5-3-3, 3-5-3-4, 3-5-4-1, 3-5-4-2, 3-5-4-3, 3-5-4-4, 3-5-4-5, 3-5-5-1, 3-5-5-2, 3-5-5-3, 3-5-5-4, 3-5-6	
3	Naval architecture	6	2.5	written	55	4-2-1-8-i, 4-2-1-8-ii, 3-1-1-i, 3-1-1-ii, 3-1-2-i, 3-1-2-ii, 3-1-2-iii, 3-1-3-i, 3-2-1-1, 3-2-1-2, 3-2-1-3, 3-2-1-4, 3-2-1-5, 3-2-1-6, 3-2-1-7, 3-2-1-7-i, 3-2-1-7-ii, 3-2-1-7-iii, 3-2-1-8, 3-3-1, 3-3-2, 3-3-3, 3-3-4, 3-3-5, 4-4-1-i	
4	Oral	unlimited	maximum 3 hours	oral	No mark	4-3-1-1, 4-3-1-2, 4-3-1-3, 4-3-1-4-ii, 4-3-1-5-i, 6-1-1-1-i, 6-1-2-1, 6-1-2-1-i, 6-1-2-1-ii, 6-1-2-2, 6-1-2-3, 6-2-1, 6-2-1-1, 6-2-1-2, 6-2-1-3, 6-3-1, 6-3-1-1, 3-2-1-1, 3-2-1-2, 3-2-1-3, 3-2-1-4, 3-2-1-5, 3-2-1-6, 3-2-1-7, 3-2-1-7-i, 3-2-1-7-ii, 3-2-1-7-iii, 3-2-1-8, 3-3-2, 3-3-3, 3-3-4, 3-3-5, 3-4-2, 3-4-3, 3-5-1, 3-5-2, 3-5-3-1, 3-5-3-2, 3-5-3-3, 3-5-3-4, 3-5-4-1, 3-5-4-2, 3-5-4-3, 3-5-4-4, 3-5-4-5, 3-5-5-1, 3-5-5-2, 3-5-5-3, 3-5-5-4, 3-5-6	At the time of oral examination seaman book must be presented





## 5-6-2 Course minimum syllabus

### FUNCTION 4 : MARINE ENGINEERING AT THE MANAGEMENT LEVEL

(427hours Theoretical ,16hours Practical)

*Competence 4-1: Manage the operation of propulsion plant machinery (192hrs.T)*

*4-1-1-Design features and operative mechanism of the following machinery and associated auxiliaries: (192hrs.T)*

*4-1-1-1-Marine diesel engine (110hrs.T)*

*4-1-1-1-i-Engine components (28hrs.T)*

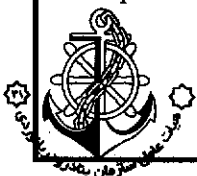
**Knowledge of:** Engine bed plate; Bedplate connection to the tank top; Engine frame and column; Main strength member in different engines; Holding down arrangements; Tie bolts (Single/Twin, Vertical/Horizontal); Geometry of combustion chamber; Cylinder cover and mountings; Excess pressure release method; Cylinder liners; Cylinder liner calibration and wear; Cylinder liner lubrication; Piston and piston assembly; Piston rings; Exhaust valves and cooling arrangements; Crankshaft ; Crankshaft manufacture, alignment and slippage; Engine bearings including cross head arrangement, arrangement of main bearing caps; Cylinder block and scavenging trunk; A-frames and columns; Diaphragm and stuffing box; Main bearing; Bottom end bearing; Connecting rod; Guides and guide shoes; Timing chain and gear; Telescopic pipes and swinging arms; Camshaft bearing arrangements.

*4-1-1-1-ii-Engine lubrication (4hrs.T)*

**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.

*4-1-1-1-iii-Fuel injection (10hrs.T)*

**Knowledge of:** Principle operation of fuel pumps in diesel engine (Port and valve controlled); Fuel pump parts; Fuel cut off devices; Suction and puncture valve; Non return valve; Umbrella sealing; Fuel pump timing and adjustments; Variable injection timing (Theory, function and adjustment); Modern VIT systems; Fuel quality setting (FQS); Latest fuel common rail features; Hydraulically operated fuel valve (Function, maintenance and pressure setting); Fuel valve with return line; Importance of atomization, penetration and turbulence; Pilot injection; High pressure pipes; Double skin pipe; Fuel limit; Identify common service faults, symptoms, and causes of combustion problems.





#### **4-1-1-1-iv-Scavenging and supercharging (8hrs.T)**

**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 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; Purpose of relief devices fitted to scavenge trunks.

#### **4-1-1-1-v-Starting and reversing (12hrs.T)**

**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 with respect to fuel pump; Exhaust valve and distributor; Reversing procedure of different main engines; Different design of distributors; Slow turning; Emergency maneuvering and crash astern procedure; First and second start concept; Fuel limit; Starting and reversing system malfunctions; Fault tracing and detection.

#### **4-1-1-1-vi-Cooling systems (4hrs.T)**

**Knowledge of:** Cooling systems of piston (Oil and water), cylinder, exhaust valve, turbocharger, fuel valve and safeties; Need for treatment; Types of additives.

#### **4-1-1-1-vii-Diesel engine control (12hrs.T)**

**Knowledge of:** Engine governor; Principle of operation; Speed droop; Proportional action governors; Proportional and reset action governors; Isochronous governor; Governor maintenance; Electric governor; Governor adjustment (Speed setting, speed droop and load limit); Action when governor is out of service; Governor fitted to diesel alternator; Load sharing procedure; 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; Cause of crankcase explosion and how avoided; Early warning of a potential explosion; Procedure to follow if oil mist in crankcase; Oil mist detection; Scavenge fire; 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.





#### **4-1-1-1-viii-Compressed air (8hrs.T)**

**Knowledge of:** Sketches 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 compressor; Swept volume and effective swept volume; Volumetric efficiency and need for high volumetric efficiency; Free air delivery; Need for using intercoolers; Different types of compressor; Reciprocating and rotary compressors (Operation, parts, lubrication, unloading mechanism, safeties, automatic water drain); Inter and after cooler; Malfunction of suction and delivery valves; Start/stop control; Using the characteristic equation to convert free air delivery to actual delivery conditions and vice versa; Evaluating the effects of common operational faults of single and multi-stage air compressors, including: (Leaking valves, leaking piston rings, blocked filters, blocked coolers); Effects of high levels of oil or water in compressed air; Effects of operating air compressors with synthetic lubricating oils compared to operating with mineral lubricating oils; 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 and survey; Reservoir common faults.

#### **4-1-1-1-ix-Multi-engine propulsion arrangements (4hrs.T)**

**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.

#### **4-1-1-1-x- Propeller Shaft and associated ancillaries (20hrs.T)**

**Knowledge of:** Shaft alignment in ships; offset; Initial boring process of bulkheads by various methods; Installation of stern tube; Fitting of tail shaft and propeller; Intermediate 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; Shaft bearings (Plain bearings, tilting pad bearings and roller bearings); 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.





#### **4-1-1-2-Marine steam turbine (44hrs.T)**

**Knowledge of:** Steam turbine construction, lubrication; Impulse and reaction turbines; H.P and L.P turbines; Materials of blades and other components; Bearings; Thrust bearings; Turbine glands and gland steam systems; Sequential nozzle operation; Vacuum pumps; Air ejectors; Extraction pumps; Gland condensers; Vibration; Procedures for warming through turbine installations; Warming up procedure from cold; Shut down procedures; Preparing the turbine for sea; Standby period components and materials used; Turbine safety devices (Over speed and excessive axial movement trip mechanism; Low vacuum trip; Loss of lubricating oil pressure trip).

#### **4-1-1-2-1-Steam propulsion plant machinery (40hrs.T)**

##### **4-1-1-2-1-i-Marine steam turbines and associated auxiliaries (20hrs.T)**

**Knowledge of:** Convergent and convergent/divergent nozzles and Nozzle boxes; Impulse and reaction turbines; Pressure and velocity compounding; Pressure/velocity diagrams; Optimum blade speeds; Hybrid blades; Materials of blades and other components; Turbine construction; Erosion shields; Bearings, thrust bearings; Turbine glands and gland steam systems; Astern turbines; Turbine casings; Diaphragms; Reheat turbines; Support and expansion of turbines; Describes with the aid of sketches the operative mechanism of steam turbines: (Alarms and trips; Warming through; Normal and emergency operation; Shut down procedures; Turbine performance; Sequential nozzle operation; Resonance; Critical speed; Vibration; Emergency control systems; Rotor straightening); Describes with the aid of sketches/computer aided drawing, material selection and design features of steam turbine gear box: (Single and double reduction gear; Double helical involutes gear teeth; Single and double locked gear trains; Epicyclical gearing; Flexible couplings; Nodal drive; Method of manufacturing of spur gears).

##### **4-1-1-2-1-ii-Propulsive characteristics of steam turbine (10hrs.T)**

**Knowledge of:** Propeller curve; Propeller design point; Fouled hull, sea margin and heavy propeller; Continuous service rating; Limits for continuous operation; Limits for overload operation; Evaluate plant performance and analysis.

##### **4-1-1-2-1-iii-The efficient operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery (10hrs.T)**

**Knowledge of:** Performance data of individual turbines and cycle components during sea trial; Periodic acquisition of above mentioned data and comparison for location of deterioration; Enthalpy drop test in superheated section of steam turbine; Quantification of stage efficiency losses: Leakage; Friction; Aerodynamic; Changes in flow passage areas).





#### **4-1-1-3-Marine gas turbine (6hrs.T)**

**Knowledge of:** Analysis the flow of air and gas through a simple marine gas turbine; Identifying the materials and construction of a gas turbine compressor, combustion system, and turbine for single and two shaft design; Discussing the design features related to maintenance requirements associated with optimum performance of a marine gas turbine plant; Describing with the aid of sketches the operative mechanism of a marine gas turbine (Lubrication system; Fuel system; Starting system; Monitoring and control system; Other ancillary equipment).

#### **4-1-1-4-Marine steam boiler (32hrs.T)**

##### **4-1-1-4-i-Types of boiler (4hrs.T)**

**Knowledge of:** 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.

##### **4-1-1-4-ii-Boiler Construction (2hrs.T)**

**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; Boiler fittings and drum internals; Water circulation; Gas circulation; Operating parameters; Support and expansion; Soot blower; Economizers.

##### **4-1-1-4-iii-Combustion of fuel in Boilers (2hrs.T)**

**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.

##### **4-1-1-4-iv-Boiler Mountings (4hrs.T)**

**Knowledge of:** High lift safety valve; Full lift safety valve; Full bore safety valve; Main stop valve; Feed check valve; Feed water regulator; Water level indicator (Direct and remote); Low water level alarms and cut out; Blow down valves; Scum valve; Drain valve; Air vents; Super heater / economizer circulating valve; Chemical dosing valve; Salinometer valve; Soot blower master steam valve; Pressure gauge connection; Man hole and hand hole doors.

##### **4-1-1-4-v-Waste heat utilization (4hrs.T)**

**Knowledge of:** Normal minimum difference between the temperature of exhaust gas and water or steam being heated; Steam pressure produced by waste heat systems; Design and operational factors that contribute to fires in waste heat units; Generation of soot and hydrogen fires; Possible





consequences of such fires; Cleaning and inspection criteria; Symptoms of a fire; Actions to be undertaken upon fire detection in order to contain/extinguish the fire; Risks of isolating a waste heat unit.

#### **4-1-1-4-vi-Boiler Operation (4hrs.T)**

**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.

#### **4-1-1-4-vii-Corrosion in boilers (2hrs.T)**

**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 before being supplied to a feed system; How sea water and oil could enter into a boiler water.

#### **4-1-1-4-viii-Water treatment (2hrs.T)**

**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 from boiler water; Precautions for storing and handling hydrazine; Effect of pH value of boiler water; Purpose of antifoams; Avoiding the caustic embrittlement.

#### **4-1-1-4-ix-Steam and condensation lines (1hr.T)**

**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; Functions of steam trap.

#### **4-1-1-4-x-Water testing (1hr.T)**

**Knowledge of:** Function of a salinometer; 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.

#### **4-1-1-4-xi-Boiler control and safety devices (4hrs.T)**

**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 such as (Flame failure; High pressures alarms and cut out; Low fuel pressure alarm and cut out; High level alarm); Emergency stop; Principles of a remote water level (Igema type remote water level indicator).

#### **4-1-1-4-xii-Marine High Pressure Boilers (2hrs.T)**

**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.

**Competence 4-2: Plan and schedule operations (143hrs.T, 16hrs.P)**

#### **4-2-1-Theoretical knowledge (143hrs.T, 16hrs.P)**

##### **4-2-1-1-Thermodynamic and heat transmission (24hrs.T)**

**Knowledge of:** Thermodynamics Fundamentals: Reversible and irreversible processes; First law applied to non-flow and flow processes; Throttling, nozzles and mixing of streams; Perfect gas: (Specific heat, internal energy; Adiabatic, polytropic, isobaric and isothermal compression/expansion; Daltons Law of partial pressures); Second law: (Heat engine; Thermal efficiency; Isentropic process); Gas cycles: (Constant pressure and constant volume air standard cycles); Properties of vapors: (Saturation, dryness fraction and superheat; T-s, p-h, p-v, h-s diagrams); Steam cycles (Rankine cycle; Thermal efficiency; Cycle on T-s diagram); Combustion: (Air-fuel ratio; Excess air; Volumetric analysis of combustion products; Calorific value); Heat transfer: (Conduction, radiation and convection; Composite walls; Insulation); Refrigeration and air conditioning: (Enthalpy and entropy; Refrigeration; Cycle on p-h diagram; Coefficient of performance; Refrigerant mass flow.

**Proficiency in:** Compressor calculations; Air Conditioning; Comfort conditions; Psychrometric charts; Wet and dry bulb temperatures; Humidity; Dew point; Dehumidifying and humidifying processes).

##### **4-2-1-2-Mechanics and hydromechanics (24hrs.T)**

###### **4-2-1-2-i-Engine Trial Data (24hrs.T)**

**Knowledge of:** Dynamometers; Brake power; Indicated power; Friction power; Torque; Brake mean effective pressure; Calculation of brake power using the equation  $\text{brake power} = 2\pi NT$ .

**Proficiency in:** 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); 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; Torque and peak pressure versus crank angle; 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; Economy speed; 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).

**4-2-1-3-Propulsive characteristics of diesel engines, steam and gas turbines, including speed, output and fuel consumption (10hrs.T)**

**4-2-1-3-i-Engine Performance (10hrs.T)**

**Knowledge of:** Brake thermal efficiency; Fuel consumption and specific fuel consumption of marine diesel engine versus steam turbines; Normal working power of main propulsion and electrical generation engines; Brake power; Mechanical efficiency; Specific fuel consumption; Compression ratio of two stroke(Long and short stroke engines) and four stroke engines; Calculating indicated powers; Indicator diagrams and irregularities; Light spring diagrams; Out of phase diagrams; Power balance; Engine layout and load diagrams; Propeller curve; Propeller design point; Fouled hull; Sea margin and heavy propeller; Continuous service rating; Engine margin; Constant ship speed lines; Limits for continuous operation; Limits for overload operation; maximum continuous rating (MCR) and normal continuous rating (NCR).

**4-2-1-4-Heat cycle, thermal efficiency and heat balance of the following: (10hrs.T)**

**4-2-1-4-i-Marine diesel engine (4hrs.T)**

**Knowledge of:** Heat cycle of marine diesel engine; Thermal efficiency; How thermal efficiency can be increased; Heat balance for analysis of cooling water loss; Heat in the exhaust and possible recovery of waste heat; Dual cycle; Thermal efficiency of dual cycle; Heat balance of marine diesel engine.

**4-2-1-4-ii-Marine steam turbine (2hrs.T)**

**Knowledge of:** Heat cycle of marine steam turbine; Thermal efficiency; How thermal efficiency can be increased; Heat balance of marine steam turbine.

**4-2-1-4-iii-Marine gas turbine (2hrs.T)**

**Knowledge of:** Brayton cycle; Thermal efficiency of Brayton cycle; Heat balance of marine gas turbine plant.





#### **4-2-1-4-iv-Marine steam boiler (2hrs.T)**

**Knowledge of:** Heat cycle of Marine steam boiler; Thermal efficiency; How thermal efficiency can be increased; Heat balance of marine steam boiler; Use of economizer and its effect on thermal efficiency of whole plant; Rankine cycle; Thermal efficiency of Rankine cycle; Heat balance of a marine steam plant.

#### **4-2-1-5-Refrigeration and refrigeration cycle (12hrs.T)**

**Knowledge of:** Practical refrigerating cycle on a pressure-enthalpy diagram, indicating compression, cooling (Condensation), throttling and evaporation; Methods employed to transfer heat in the evaporator and condenser and how the throttling is achieved (Considering both large scale and domestic refrigeration plants); A more effective refrigeration cycle on a pressure-enthalpy diagram with dry compression and under-cooling and advantages achieved; 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; Trouble shooting; 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.

**Proficiency in:** Using enthalpy tables to calculate the condition of refrigerant at stage points in the cycle and the coefficient of performance; the principles of vapor absorption refrigerator.

#### **4-2-1-6-Physical and chemical properties of fuel and lubricants (18hrs.T, 8hrs.P)**

##### **4-2-1-6-i-Production of oils from crude oil (2hrs.T)**

**Knowledge of:** Production of oils from crude oil; Types of crude oil and chemical structure of hydrocarbons; Simple distillation process; Bio fuel.

##### **4-2-1-6-ii-Main characteristics of fuel oil (2hrs.T)**

**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, calculated carbon aromaticity index (CCAI); Poor quality fuel; Common tests normally carried out on fuels on board and laboratory; Compatibility of fuels; Lack of compatibility and its effect on fuel system.

##### **4-2-1-6-iii-Combustion (2hrs.T)**

**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; Method of dealing with combustion by products.

#### **4-2-1-6-iv-Fuel system (4hrs.T)**

**Knowledge of:** Fuel system from service tank to injector; Blending system; Homogenizer; Automatic control of fuel viscosity; Correct bunkering strategy (Including correct sampling method, MARPOL sample, bunker delivery note and associated regulation); Precautions taken during bunkering to avoid pollution; Bunker dispute; Common tricks and short lifting techniques some suppliers follow; Effect of temperature on density; Temperature correction on fuel density.

#### **4-2-1-6-v-Oil purification (4hrs.T)**

**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  $1010 \text{ kg/m}^3$ ); Operation of a self cleaning purifier; Effect of temperature on density of fuel versus water; Modern centrifuges.

#### **4-2-1-6-vi-Production of lubricating oil (4hrs.T, 8hrs.P)**

**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 and Hydrodynamics lubrication; Factors influencing hydrodynamic lubrication; Lubricating oil sampling; Onboard and laboratory lubricating oil testing; Oxidation of oil; Its effect and remedy; Microbial degradation of lubricating oil, symptoms, means of prevention and remedy.

**Proficiency in:** Performing appropriate test on fuel oil and lubricating oil on board.

#### **4-2-1-7-Technology of materials (45hrs.T, 8hrs.P)**

##### **4-2-1-7-i-Metallurgy of steel and cast iron (2hrs.T)**

**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 to steel.

##### **4-2-1-7-ii-Testing and properties of materials (4hrs.T, 8hrs.P)**

**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 (optical aids, dye-penetrant, magnetic crack detection); Nondestructive 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.

**4-2-1-7-iii-Heat treatment of metals (4hrs.T)**

**Knowledge of:** Hardening and tempering; Critical temperature range; Annealing and normalizing; Black heart process; Work hardening; Nitriding; Flame hardening; Induction hardening; Spheroidising anneal.

**4-2-1-7-iv-Alloying elements in irons and steels (2hrs.T)**

**Knowledge of:** The principle reason for adding various elements (Cobalt; Nickel; Chromium; Molybdenum; Vanadium; Tungsten; Copper; Manganese; Silicon; Titanium) and their marine application.

**4-2-1-7-v-Non-ferrous metals (2hrs.T)**

**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.

**4-2-1-7-vi-Non-metallic materials (1hr.T)**

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

**4-2-1-7-vii-Welding (4hrs.T)**

**Knowledge of:** Principle feature of the argon arc welding process; AC and DC welding machines; Automatic welding processes; Electro-slag; tungsten inert gas (TIG) and metal inert gas (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.

**4-2-1-7-viii-Vibration in ships (10hrs.T)**

**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 existing vessels.





**4-2-1-7-ix-Direct stress and strain (4hrs.T)**

**Knowledge of:** Stress and strain; Direct stress, strain, hooks law; Young's modulus of elasticity; Factor of safety; Strain energy; Resilience; Impact and suddenly applied force.

**Proficiency in:** Solving simple numerical examples related to above objectives.

**4-2-1-7-x-Stress in pressure vessels (2hrs.T)**

**Knowledge of:** Stress in pressure vessels; Hook stress and axial stress in a thin walled cylindrical pressure vessel; Joint efficiency.

**Proficiency in:** Solving simple numerical examples related to above objectives.

**4-2-1-7-xi-Bending of beams (4hrs.T)**

**Knowledge of:** Condition of equilibrium; Concentrated and distributed load; Shearing force and bending moment diagrams.

**Proficiency in:** Solving simple numerical examples related to above objectives.

**4-2-1-7-xii-Stresses in beams (2hrs.T)**

**Knowledge of:** Neutral axis; Fundamental bending equation; Modulus of section; Combined bending and direct stress.

**Proficiency in:** Solving simple numerical examples related to above objectives.

**4-2-1-7-xiii-Torsion (4hrs.T)**

**Knowledge of:** Fundamental torsion equation; Relationships between torque, stress and power; Torsional resilience; Maximum and mean torque; Coupling bolts.

**Proficiency in:** Solving simple numerical examples related to above objectives.

**4-2-1-8-Naval architecture and ship construction, including damage control**

**4-2-1-8-i-Naval architecture and ship construction**

Refer to function 4

**4-2-1-8-ii-Damage control**

Refer to function 4

**Competence 4-3: Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery (72hrs.T)**

**4-3-1-Practical knowledge (72hrs.T)**

**4-3-1-1-Start up and shut down main propulsion and auxiliary machinery, including associated systems (2hrs.T)**

**Knowledge and proficiency in:** Preparation of main machinery (warm up) and associated auxiliaries for starting such as Fuels, lubricants, cooling water, air; Checking pressures,





temperatures and other parameters during the start-up and warm-up period to be in accordance with technical specifications and work plans; Running gear tests; Surveillance of main propulsion plant and auxiliary systems to maintain safe operating conditions; Fault detection during running and actions taken; Methods of preparing for shut down, and supervising cooling down of the engine; Root cause analysis of faults.

#### **4-3-1-2-Operating limits of propulsion plant (2hrs.T)**

**Knowledge and proficiency in:** Following maker's instruction to avoid operation over hazardous limits such as over speed, Over load, Over stress, Vibration and critical speed; Methods of measuring the load capacity of the engine in accordance with technical specifications; Speed increase procedure to avoid thermal and mechanical over stress; Methods of checking performance against bridge orders Refer to section, 1-2-1-3.

#### **4-3-1-3-The efficient operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery (8hrs.T)**

**Knowledge and proficiency in:** Combustion performance monitoring of main machinery during operation; Vibration monitoring; Indicator and draw diagrams (Compression pressure, maximum pressure and faults; Area of indicator diagram; Calculating indicated and effective engine power; Calculating turbocharger efficiency; Estimating effective engine power without indicator diagrams by fuel index and turbocharger speed); Detecting of fault from indicator diagrams; Engine condition monitoring and evaluation system (On line system with automatic sampling of engine parameters supplemented by cylinder pressure measurement; Engine diagnosis system and computer controlled surveillance).

#### **4-3-1-4-Functions and mechanism of automatic control for main engine (24hrs.T)**

##### **4-3-1-4-i-Control fundamentals and systems (20hrs.T)**

**Knowledge of:** Open and closed control loops; Process control; Essential components in process control loops; Sensors and transmitters (Resistance temperature devices; Thermocouples, flow and pressure measurement; Level measurement; Ambient temperature compensation; Viscosity measurement; Torque measurement; Force balance transmitters; Oil and water interface and oil in water monitoring; Pneumatic flapper and nozzle system plus off-set and permanent off-set; Pneumatic 20-100 kPa, analogue 4 to 20 mA signals, pneumatic pilot relays; Control air supply; Operational amplifiers; Electrical supply); Controllers and basic control theory (Disturbances and time delays and means to reduce them; Two step, proportional, integral, and derivative control actions); Final control elements (Diaphragm operated control valves; Flow and lift characteristics of





control valves; Control valve actuators and positioners , "fail-safe", "fail-set" strategies; Wax element valves; Electronically operated valves ); Control loop analysis (Temperature control systems; Level control systems; Pressure control systems; Split range and cascade control; Single, two and three element control); Control theory (Changing set points; Basic control system design; First order and second order systems; Transfer functions; Control system stability; Natural frequency and control systems; Time lag and time constant; System response); Tuning (System response; Control loop tuning); Signal transmission systems (Digital communication bus and fibre optic signal transmission systems); Final control elements (Control valve trim; Selecting control valves and their actuators; Valve sizing); Electronic PID controllers (Single loop digital controllers; Manual and automatic tuning of electronic controllers); Monitoring and control systems (Boiler water level control; Diesel engine cooling control; Main engine control for FP and CP propellers; Alarm and monitoring systems); General requirements of automatic control equipment and safety devices (Monitoring system; Safety system; System independence; Local control; Failure mode and effect analysis; Power supply); Remote control-diesel propulsion (Control-electronic, electro-pneumatic, electro-hydraulic or pneumatic; Malfunctions-alarm, engine slow down, engine stop); UMS systems (Concept of Unattended Machinery Spaces (UMS); Requirements of UMS, bridge control; Testing procedure for UMS).

#### **4-3-1-4-ii-Main engine control (4hrs.T)**

**Knowledge and proficiency in:** Main engine control diagrams; Experience in automatic and remote control of main engine; How change over from remote to local maneuvering is done; Speed increase; Speed reduction; Crash maneuvering; Safety features including shut down and slow down; Reset of safeties.

#### **4-3-1-5-Functions and mechanism of automatic control for auxiliary machinery including but not limited to: (36hrs.T)**

##### **4-3-1-5-i-Generator distribution systems (2hrs.T)**

**Knowledge and proficiency in:** Instrumentation and safety in main switchboard construction and generator and distribution system ; Function of short circuit protection; Fuses; Main circuit breakers; The generator air circuit breaker; Overload relay; Under voltage relay; Reverse power protection; Fault tracing in distribution circuits; Auxiliary diesel generator alarm and shut down; Automatic starting of propulsion auxiliaries; Electrical equipment for tankers and hazardous areas and safety systems.







#### **4-3-1-5-ii-Steam boilers (4hrs.T)**

**Knowledge of:** Function of automatic control of auxiliary boiler; Automatic combustion monitoring; Monitoring safety of boiler; Correct operation; Avoiding excess pressure; Water level control; Alarms and safety features operation; Tests adjustments, safety activation and action taken after the alarm; Feed water high salinity; High water level; Boiler pressure high and low; Superheater outlet temperature high; Fuel pump low outlet pressure; Heavy fuel temperature high and low (or high and low viscosity); Uptake high gas temperature; Control system power failure; Automation steam and air pressure low; Automatic shutdown of boiler: (Low water level; Supply air pressure failure; Ignition or flame failure).

#### **4-3-1-5-iii-Oil purifier (2hrs.T)**

**Knowledge of:** Function of automatic control of Oil purifier; Operation monitoring; Correct operation; Automatic de-sludging; Alarms and safety features incorporated; Automatic action if feed condition i.e. temperature and pressure over limits; Vibration; Correct operation and monitoring to avoid and minimize damage to purifiers; Common faults.

#### **4-3-1-5-iv-Refrigeration system (4hrs.T)**

**Knowledge of:** Automation, monitoring and alarms in refrigeration system; Automatic start and stop of compressor at normal running condition; Automatic shut down and alarm in case of high pressure in discharge line; Manual reset for restarting of compressor; Low lubrication oil pressure alarm and shut down; Control of defrosting units; Compressor capacity control (unloaders); Humidity control for air conditioning system.

#### **4-3-1-5-v-Pumping and piping systems (2hrs.T)**

**Knowledge of:** Automatic start of standby pumps; Automatic start and stop of hydrophore pumps; Automatic water level control of boiler by feed pumps; Automatic cargo stripping system onboard tankers; Automatic heeling system.

#### **4-3-1-5-vi-Steering gear system (10hrs.T)**

**Knowledge of:** Electro-hydraulic and electrical telemotor system; Steering gear control system; Auto pilot; 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.

#### **4-3-1-5-vii-Cargo-handling equipment and deck machinery (12hrs.T)**

**Knowledge of:** Deck machineries and 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 concept as the main source of powering for major deck machineries; Hydraulic system components; Hydraulic system valves and their function; Basic hydraulic operation and control systems; Shipboard applications of different hydraulic systems; General guidelines on hydraulic systems maintenance; Speed and load control; Hydraulic cylinders extraction and 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 and mechanical safeties (Limit switches, relays, stoppers, automatic shut downs at abnormal operating conditions and etc.).

**Competence 4-4: Manage fuel, lubrication and ballast operations (20hrs.T)**

**4-4-1-Operation and maintenance of machinery, including pumps and piping Systems (20hrs.T)**

**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, the main causes of corrosion in sea water systems and the regions most affected; Domestic water supply; Ejectors; pumping systems including ship side valves, sewage and sludge; Ballast; Bilge; Fire main; International shore connection; Central cooling system; Central priming system; Illustrate the operation of self priming systems as used on ballast, cargo pumping & bilge pumping arrangements; Explains the purpose and procedure for using bilge injection; Compare corrosion and marine growth prevention systems used for pumps and pumping systems, including impressed current, sacrificial anodes, chemical injection, special coatings, chlorination, and special materials; Identifying problems which affect performance, and identify common faults and evaluate methods of assessment.





## FUNCTION 5 : ELECTRICAL, ELECTRONIC AND CONTROL ENGINEERING AT THE MANAGEMENT LEVEL

(164hours Theoretical, 30hours Practical, 48hours Exercise)

*Competence 5-1: Manage operation of electrical and electronic control equipment (108hrs.T, 18hrs.P, 48hrs.E)*

*5-1-1-Theoretical knowledge (108hrs.T, 18hrs.P, 48hrs.E)*

*5-1-1-1-Marine electro technology, electronics, power electronics, automatic control engineering and safety devices (26hrs.T, 10hrs.P)*

*5-1-1-1-i- General Requirements and Application of Ohm's and Kirchhoff's Laws (2hrs.T, 2hrs.P)*

**Knowledge of:** Electrical equipment designed for use on ships; As far as possible, all materials should be non-flammable; meaning of the term ' flame- retardant'; Angles of heel and trim at which machinery should be capable of operating; Effect of temperature changes on Electromagnetic devices and Generator voltage; The need for axis of a rotating machines not be placed athwart ships unless so designed; The need to periodically check the security of all electrical connections; The general requirements regarding the provision of electrical power and lighting for normal operation and for an emergency; Ohm's and Kirchhoff's laws; Power required by electrical and mechanical loads, taking efficiency into account; Applications of the Wheatstone bridge: How resistances are measured using the bridge; How the range of a Wheatstone bridge is extended and how temperatures are determined; The principles of a potentiometer; The Use of a Wheatstone bridge to measure resistances, a potentiometer to measure e.m.f.; The principles of multipoint indicators, recorders, thermocouples.

**Proficiency in:** Maxwell's circulating current and super-position theorems to solve network problems; Sketches Wheatstone bridge circuit.

*5-1-1-1-ii-Electromagnetism (4hrs.T, 2hrs.P)*

**Knowledge of:** Magnetism fundamentals and its relationship to electromagnetism; Magnetic fringing; How magnetic leakage occurs; The effects of magnetic fringing and magnetic leakage; The effect of a nonmagnetic core; Hysteresis loss; Lists the various losses which take place in electric machines and transformers; How eddy-current loss occurs and design features used to minimize such losses; Losses other than hysteresis and eddy-current; Necessities for air gap in magnetic circuits and its relative permeability; Comparing electrical and magnetic circuits; Series,





parallel and complex magnetic circuits; Comparing magnetic field produced around current carrying conductors e.g. straight, single and multi-turn loops, coils and solenoids; Application of magnetism in ship control and automation.

**Proficiency in:** Sketching graphs showing the relationship between flux density and ampere-turns per meter if using the same coil with the following core materials Air, cast iron, cast steel and mild steel; Showing diagrammatically the effect on the flux density of applying an alternating magnetizing force to an iron core; Sketching hysteresis loops for hard steel, cast steel and wrought iron.

#### 5-1-1-1-iii-A.C. Circuit Theory, Power Factor and its improvement (6hrs.T)

**Knowledge of:** Relationship between impedance, voltage and current; Comparison between an A.C. circuit and in a D.C. circuit of: A simple resistance; The same resistance wound in form of a coil; An iron core inserted into the same coiled resistance; Impedance triangle; power factor; Faraday's law; Lenz's law; Static and dynamic inductions; The effect of changing current and its associated magnetic flux on the induced e.m.f. in a coil; Power produced by shipboard installations; Power formula; Self-inductance (L); Henry(H); Induced e.m.f. formula; Inductive reactance ( $X_L$ ); Instantaneous voltage and current formulas in an A.C. circuit; Average power formula in different circuits; Circuit transient response for active loads; Application of circuit transient response in ships control and instrumentation, e.g., sensors; relationship between induced e.m.f., current and the supply voltage; The effect of different values of inductance and resistance on power consumption; Apparent power and lagging power factor; Type of ship loads; The principles of construction of a capacitor; Mesh Current and node voltage network analysis for A.C. circuits; Resonance concepts and its specifications plus its applications in circuits, including communication networks; Resonant frequency and quality factors, wave bands and noise reduction; Action of a capacitor in a D.C. and A.C. circuits; Farad; Capacitive reactance ( $X_c$ ) and its formula; Ratings of electrical equipment; Active and reactive power components; How resonance can occur in parallel circuits; Typical power factors for different loads; Power in the sinusoidal steady state, average power; Complex power and methods of obtaining them including: Rectangular form; Polar form; Conjugate form; The relationship between power factor and line current; The disadvantages of running with a low power factor; The effect of placing an appropriately sized capacitor in parallel with an inductive load on: The line current; The line power loss; The motor current; The motor power.

**Proficiency in:** Calculating impedance's and power factors; Sketching graphs showing the variation of current, applied voltage and back e.m.f over one cycle when an A.C. is applied to: A





choke having inductance; A circuit with only pure resistance; Solving simple problems concerning power, current, resistance, impedance, reactance and power factor and verifies the solutions, using laboratory equipment; Sketching the current, voltage and power waveforms to illustrate the phase relationship in a circuit with pure resistance, pure inductance; Sketching a phasor diagram to show current and voltage components in a circuit with resistance and inductance; Given diagrams of the waveforms, identifies the current and voltage waves; Solving problems to find power (true and apparent) and power factor in purely resistive, purely inductive and resistive - inductive series circuits; Sketches related curves; Drawing phasor and circuit diagrams as an aid to determine impedance, reactance, resistances, power factors, currents and voltages across: Inductors; Resistors; Capacitors; When connected in series; Combining V-I phasor diagrams with impedance, voltage and current phasor diagrams and their corrections; The use of apparent power in practice; Uses the application of phasor summation to solve simple problems in parallel circuits; Demonstrating, how power factors can be improved; Drawing vector diagrams showing the similarity between: Active current component and KW power; Reactive current component and KVAR; Line current and KVA; Solving problems on power - factor improvement to find total KVA, power and power factor, using phasor diagrams (Current and KVA) and the tabular method; Methods of obtaining resultant powers and power factor in a multi- load network either single or three phase systems.

#### 5-1-1-iv-Cells and Batteries (2hrs.T)

**Knowledge of:** Basic laws of electro-lyses, electrolyte and electrodes; The difference between primary and secondary cells; The construction of an alkaline battery, referring to the materials used for different parts; Care to be taken with cell containers and covers; Applications of both types of batteries; The type of lead- acid battery normally used for marine work; The construction of a flat- plate battery, referring to the materials used for different parts; The principal difference between a flat- plate battery and a tubular - plate battery; The advantages and disadvantages of alkaline batteries with lead - acid batteries; How and why cells are connected together in series, in parallel and in series- parallel configuration to form a battery; IEEE requirements for batteries and control gear installation; The emergency and stand- by duties provided by batteries; How lead- acid and alkaline batteries are maintained in a state of readiness for emergency/ stand- by purposes; Applications where batteries are used for normal operation and how continual supply is maintained; How the capacity of a battery is identified; The capacity and variation of voltage for different rates of discharge for lead - acid and alkaline batteries of both normal and low - resistance types; The range of voltage commonly used for the shipboard applications; The requirement for the capacity of





emergency batteries for the following: Passenger ships; Passenger ships where the main emergency power is from a generator; Cargo ships of 5,000 GRT and upwards; Cargo ships of less than 5,000 GRT; The charge- discharge method; The system where automatic switching connects the battery to the load; The provision for trickle charging and re- charging; The need for warning devices when batteries are being charged; Where batteries should be located; The care necessary when both lead-acid and alkaline batteries are installed in a ship; Why battery spaces need to be ventilated; The safety precautions necessary in battery compartments; Correct procedure for making up an electrolyte for lead- acid battery; The importance of specific gravity measurement for a lead-acid cells and necessary care when taking hydrometer readings; Proper operation, handling and maintenance of different types of batteries; How battery repairs are normally performed; Action to be taken if dilute sulphuric acid is splashed: On the skin; in the eye; Action to be taken if alkaline electrolyte is splashed: On the skin and in the eye.

**Proficiency in:** Calculating the secondary type cells efficiency in the two following cases: Ampere-hour efficiency; Watt- hour efficiency; Examining and reports on the condition of battery casings, terminals, etc.; Carry out the topping - up process for lead - acid batteries.

#### **5-1-1-1-v-Electronics (12hrs.T, 6hrs.P)**

##### **1-Properties of Crystals**

**Knowledge of:** A crystalline structure; Semiconductors; The effect of temperature on semiconductors resistance; The fact that, under certain imposed conditions, semiconductors can behave as conductors or insulators and their absolute zero temperature ( $0^{\circ} \text{K}$  or  $-273^{\circ} \text{C}$ ) behavior; How and when semiconductor crystal is termed 'intrinsic conduction'; The term 'hole'; Two common materials used as semiconductor crystals (Silicon and germanium); Comparison of silicon and germanium; the term 'doping'; The effect of arsenic, phosphorus and boron on silicon crystal; Differences between 'n type' and 'p - type' crystals; Principle construction of a 'diode'; The fact that if an e.m.f. is applied to a diode, the diode could be a perfect insulation or a conductor depending upon how it is connected; 'forward biased' and 'reverse biased'; 'avalanche', 'breakdown' or 'zener' voltage; Different application of diodes in electrical power supply.

**Proficiency in:** Sketching curves of voltage and current for a diode at forward and reverse biased; Demonstrates objectives above.

##### **2-Passive Components**

**Knowledge of:** The term 'passive'; Examples of 'passive' components as: Resistors; Thermistors; Inductors; The concept of oscillation; A silicon temperature sensor compared to a thermistor.





### 3-Active Components

**Knowledge of:** The term 'active'; Examples of active components as: Diodes; Rectifiers; Zener diodes; Light-emitting diodes (LEDs); Transistors; Junction transistors; Uni-junction transistors; Field-effect transistors (FETs); thyristors; Heat sinks.

### 4-Diodes

**Knowledge of:** The fact that diodes are suitable crystals (usually silicon) which have a 'junction' of p-and n-type material, that, at forward biased, a diode acts as a conductor; And when reverse biased, acts as an insulator.

### 5-Rectifiers and Rectification

**Knowledge of:** Principle operation of a diode; Principle construction, operation and application of a zener diode; Principle operation of a LED; The components of LED circuits and their purposes; Application of LEDs; Principle construction and operation of a rectifier; The effect of over current and over voltage on rectifiers; Comparison between the different types of rectifiers; The purposes of different components in a rectifier circuit; Methods of testing rectifier's diodes while in circuit and while out.

**Proficiency in:** Sketching curves of voltage and current for a zener diode, light-emitting diode (LED).

### 6-Transistors

**Knowledge of:** The general form of a transistor; Junction or bipolar transistors, and different regions; Principle construction of monolithic integrated circuit; The forward transfer ratio ( $h_{fe}$ ); Effect of voltage feedback on amplifier gain; Input-output impedances and impedance matching; Equivalent circuits and hybrid parameters.

**Proficiency in:** Sketching a typical circuit diagram for an npn transistor connected in the common-emitter mode; Demonstrating objectives above in the laboratory.

### 7-Thyristors (SCR)

**Knowledge of:** A thyristor construction; Principle construction of 'triode'; The fact that it is essentially an 'on/off' or switching device, that a thyristor is a large-current small-voltage device, with a very low resistance (only a fraction of an ohm) in its forward, or 'conducting' state; That Thyristors are widely used as switches, speed controllers or current controllers; How a 'triac' is constructed.

### 8-Heat Sinks

**Knowledge of:** How safe working temperature of a semiconductor is achieved and controlled.





### 9-Integrated Circuits (ICs)

**Knowledge of:** An electronic circuit constructed from a number of components, such as diodes, transistors, resistors, capacitors, etc.; 'Hybrid' integrated circuits; 'Monolithic ' integrated circuits; Application of integrated circuits classified as 'digital ' or 'analogue'; Application of digital Ics and analogue Ics.

### 10-P.L.C.

**Knowledge of:** Programmable logic controllers (PLC) function; Comparison of relays and PLC control circuits; Ship- board application of PLC.

**5-1-1-2-Design features and system configurations of automatic control equipment and safety devices for the following: (34hrs.T, 4hrs.P)**

#### 5-1-1-2-1-Main engine

Refer to section 9-3-1-4.

#### 5-1-1-2-2-Generator and distribution system (34hrs.T, 4hrs.P)

##### 5-1-1-2-2-i-Insulation and Temperature Rating (4hrs.T, 2hrs.P)

**Knowledge of:** Grouping insulating materials into classes according to their nature and acceptable working temperature; The importance of using the correct insulating materials; Comparing the expected life of marine electrical installations with similar installations ashore; Describing the effect of stress, vibration, moisture, dirt and age on insulation materials; Explaining the effect of changing ambient temperatures on the temperature rise of a continuously rated machine; the recognized current overload in a continuous maximum rated machine is 50% for 15 seconds; Checking insulation values of equipment.

##### 5-1-1-2-2-ii-Distribution (4hrs.T)

**Knowledge of:** Describing the D.C. distribution cable systems (including dual voltage); The A.C. distribution systems and voltages used on ships; the preference for a 60 Hz system; Medium-voltage systems and that insulated neutrals are preferred to earthed neutrals; Comparing between types of earth fault indicators fitted on main switch board (lamp and pointer type) from all point of views.

**Proficiency in:** Sketching diagrammatically the alternator and motor connections in a three- wire system; Sketching diagrammatically a distribution system with an earthed neutral; Demonstrating how earth faults are detected and located.







**5-1-1-2-2-iii-Polyphase Supplies; A.C. Generators; Automatic Voltage Regulation and A.C. Switchgear (Main Circuit Breaker); Generators Protection; Synchronizing and Load Sharing (10hrs.T, 2hrs.P)**

**Knowledge of:** The principle of the circuits in a three- phase alternator, the phase difference and the usual color coding; Arrangements of connections in a star and delta connected alternator; Voltage and current phasor diagrams for objective above, using conventional notation; Methods of using star or delta bank of capacitor in 3Ph systems for finding overall power factor; The principles of construction of a synchronous A.C. generator; The purpose of the return wire in a four - wire system; The effect of the following loads on power factor: Filament lighting; Heating; Induction motors; Fluorescent lighting; Transformers; Partly loaded motors; Cage - type motors; Practical reasons why in modern generators armature winding and field windings are interchanged; Cylindrical and salient pole rotors and their applications; The load/voltage curve of an A.C. generator; The effect of starting a large induction motor on the current and voltage of an A.C. generator and on other electrical equipment; Types of load on board ship which can cause excessive voltage dip; The effect of automatic voltage regulators; The advantage of using self-excited compound generators; All safety rules and regulations, minimum required values and setting for marine generators in various classification societies; The main criteria affecting the parallel operation of A.C. generators; The requirements for satisfactory power sharing between generators; The effect of unbalanced loading in the three phases of a generator; Difference between: "functional" and "error- operated" Voltage regulating systems; The function of an excitation system; The basic principles of self - excited and separately excited A.C. generators; Care necessary when replacing diodes in a rotating rectifier; The essential parts of an automatic voltage regulator (A.V.R.) their function; the principle of a voltage - comparison circuit; The principle of converting the voltage- comparison signal into a form suitable for control of the excitation; The purpose of an excitation control element; which features control the load sharing when generators are running in parallel; Acceptable deviation of load sharing and voltage droop; Why an excitation system should be capable of carrying a substantial short- circuit current; A.V.R. performance, trouble- shootings, rules, regulations, settings, care and maintenance; Additional fittings on an A.C. switchboard compared to a D.C. switchboard; The main criteria governing the operation of a circuit breaker; The function of a circuit breaker; The purpose of short- time - fault current rating; Circuit breakers used on board compared to those used ashore; The methods of closing circuit breakers and maintenance of circuit breakers; Performs the safety precautions necessary when a circuit breaker is removed;





The purpose of interlocks and their possible misuse; The use of earthing of circuit breakers; Possible causes of overheating; The sequence of events if an overload trips out a generator circuit breaker; Range of a generator load, where preferential trips and alarms are set to operate; Minimum requirements necessary for main switch-board control and instrumentation devices for single and parallel operations; The backup protections considered for generator protection including: Over load current relay; Instantaneous over current protection; Restricted earth fault protection; Unrestricted earth fault relay; Under and over voltage protection; Reverse power relay; Preferential trip; possible internal generator faults and appropriate action; How loss of excitation is detected and handled; How loss of power can occur and its effect in a generator; The necessary instrumentation for generators working in parallel and their purposes; How the following are determined: Power factor, voltage, load, frequency, when a generator is running alone or in parallel; The controls necessary at the main switchboard for each generator; Complete procedure, when generators running in parallel; "Lamps bright", "lamps dark" and "sequence lamps" operation; The purpose of a check synchronizer; The system of automatic selection of diesel generator sets; Using generator load test characteristics speed/ active power and voltage/ reactive power to explain: flat, isochronous and drooped sharing of load; All requirements regarding droop; Automatic and manual load sharing processes; Effects of loss of excitation, loss of fuel and overall power factor altering on a good and proper load sharing; The protection necessary and the information required at a shore supply connection box; The earthing requirement when taking a three- phase shore supply with an earthed neutral; Emergency stop controls; The emergency control necessary for ventilating fans, and emergency control necessary for fuel and cargo oil pumps.

**Proficiency in:** Sketching a graph showing the voltage variation over one cycle; Sketching a three-wire and a four - wire system connected to a star supply, showing typical line to load connections; Solving problems to demonstrate the existence of unbalanced current and to calculate its phase angle in the neutral of a four - wire system; Solving problems to determine power, KVA' power factor and current in star and delta loads; Improving the power produced relation with winding (Star or Delta); Sketching diagrammatically simple field windings and their neutral- point connection for a three- phase alternator with a rotating field; The voltage variation over one cycle from a three-phase supply; Sketching the alternator and motor connections in a three - wire system, and why the power factor governs the physical size of a generator; Sketching the relationship between voltage and time when a load is suddenly applied, for different excitation systems; Drawing simple diagrams of the excitation systems in common use; Demonstrating in detail the safety precautions





necessary before commencing work on switchgear; Describing the purpose of examining insulators; Demonstrating the inspection and maintenance of circuit breakers; Demonstrating the routing testing of circuit breakers; The procedure for safe isolation before allowing work on equipment; Carrying out routine checking on trips, etc. Detecting and corrects fault symptoms; Sketching the arrangement of connections an A.C. shore supply;

#### **5-1-1-2-2-iv-D.C. Generators and D.C. Switchgear (6hrs.T)**

**Knowledge of:** The purpose of commutating poles; How to remedy a reversal of polarity; The differences in operational techniques of open-front and dead-front switchboards; Construction, operation and maintenance of main switchboards, showing : Ammeter; Voltmeter; Circuit breaker; Low voltage release; Over current trip; Reverse current trip; Armature; Series field and Shunt field and Shunt field rheostat; Principle operation of all protective devices including: Reverse current; Preferential trip; Short circuit; Fuses; How continuation of supply to essential services is ensured; What is meant by discrimination in protective devices; The principles of construction of bus bars; How bus bars are cooled and the effect of overheating; Checking for the correct operation of protective devices.

**Proficiency in:** Sketching a diagrammatic arrangement of the field coils and the armature of a compound generator; Graph showing the relationship between current and voltage; Performing the procedure for isolating machinery prior to inspection, maintenance etc.

#### **5-1-1-2-2-v-Cables (6hrs.T)**

**Knowledge of:** The materials used in cables and applications for multi - stranded and single - wire cables; The types of PVC insulating compounds used in ship's cables; How insulating compounds are affected by: Variation in temperature, oxidation, fire, oil, seawater, acids, solvents; The purpose of sheathing electric cables; What is meant by flexible cords and cables; The factors which determine the rise in temperature, and hence the current rating, of cables; Current ratings obtained from tables approved by administrations; The care necessary with the layout and paths of cable runs in machinery spaces; The cables volt drop and the permitted level of it on board; The maximum ambient air temperature of cable permitted operation with maximum conductor temperature for all types of cable in standard tables and charts; Trunking with reference to: Ventilation and drainage, condensation, fire, earthing, electrical continuity, expansion and utilization of available trunk cross- section; The principles of passing cables through bulkheads and decks; The need to bond and earth the sheathing of cables; The problems of passing high currents





through single- core metal- sheathed cable; Comparing continuous A.C. current ratings of single core cable with different insulating materials; Cables care and maintenance.

**Proficiency in:** Attempts practically for calculating current carrying capacity of ship cable for continuous operation or calculating the cable cross sectional areas on tables given in various classification societies.

**5-1-1-2-2-vi-Lightings and lamps: (4hrs.T)**

**Knowledge and proficiency in:** Summarizing the general requirements for the areas requiring emergency lighting; Lamps for emergency lighting; The expected life of a general-service lamp; Principles construction of the following lamps: Incandescent, gas discharge, fluorescent, neon; High and low pressure mercury fluorescent and sodium vapor lamps; The navigation lights circuit, rules and regulations and surveying; The Stero-boscopic effect relating to fluorescent lamps and the methods of minimizing it; Emergency lighting on board a ship, care and maintenance.

**5-1-1-2-3-Steam boiler**

Refer to 9-3-1-5-2.

**5-1-1-3-Design features and system configurations of operational control equipment for electrical motors (30hrs.T, 4hrs.P)**

**5-1-1-3-i-D.C.Motors, A.C. (Induction) Motors, Motor Control & Protection (12hrs.T, 2hrs.P)**

**D.c. motors:**

**Knowledge of:** The usual speed regulation obtained with shunt and compounded motors and describing typical applications; How a wider range of speed regulation is obtained; The applications of series-wound motors; The situations where ward- Leonard systems might be used; Armature reaction, brush shifting and methods of decreasing it; The different methods of D.C. motor starting; D.C. motors losses and efficiency; D.C. motors application on deck machinery; Braking D.C. motors: frictional, dynamic action and plugging types; Modern methods of D.C. motors speed control.

**Proficiency in:** Sketching the various methods of field control.

**A.C.motors:**

**Knowledge and proficiency in:** Drip proof, watertight, hose proof, deck watertight, submersible motors; How totally enclosed motors are ventilated and cooled; Proving that the rotating magnetic field produced in induction motors is of constant value; The three main types of A.C. motors; The concept of slip; How speed of synchronous and induction motors controlled; Sketching a graph of





starting current and torque against the speed of rotation for a single- cage motor; Why starters are sometimes necessary for cage motors; How starting torque reduces; Advantages of a double cage construction; Situations where slip - ring motors might be used; Principle of starting and speed control; Effect of varying the supply frequency on: Speed, temperature, torque, power output; The effect of varying the supply voltage on: Starting torque, starting time, ability to start, speed and current; Max. starting and running torques; Supply voltage reduction on running and starting torques; Demonstrating methods of calculating starting currents and torques in direct on line, star-delta and auto- transformer methods; All losses occurring in induction motors; Typical problems, their causes and remedies; Effect of accumulation of dirt in a motor; The process of maintaining a motor , including: Initial cleaning, use of cleaning fluid, re- varnishing, adjustment of brushes; The attention necessary for roller or ball bearings; The common causes of trouble with commutators; What is meant by single phasing; Possible causes and the effect of running a three- phase motor with one phase open – circuited; Symptoms of single phasing; Purpose of protection; Overload - protection devices in use on board ship; Diagrammatic arrangement of a direct on- line starter for a cage motor; How protection against short circuit is provided; The principle of operation of magnetic overload relays, Their advantage over thermal types; The need for separate temperature- sensing devices; Comparing use of thermistors, thermocouples and thermostats for motors; Process of replacing a fuse in a three- phase supply; Principle of star - delta starting and the reasons for its use; Effect of running an induction motor on reduced voltage; Effect of prolonged and repeated starting periods on the heating of the windings; Principle of an autotransformer starter and its limitations in frequent starting; Comparing three starting methods from different point of views: usage, run- up time, starting torque and current, voltage dip obtained, etc.; Magnetic brake, its types, application, and simple diagram; ingress protection codes by their standard chart and application; Differential protection relay and its usage; How back protection is carried out for induction motors; Principles and applications of synchros; Function of an induction regulator and its principles; Basic movement of contact breakers and why it is so; Performing maintenance on copper - and silver - faced contact breakers, including: cleaning, checking condition of contact surfaces, adjusting contact pressure, lubrication, magnet faces pivot joints and bearings; Detecting and rectification of faults implanted in motors, starters and controllers; function of a high- rupturing - capacity (HRC) fuse; What is meant by the current rating and the minimum fusing current of a fuse; Problems which can arise with re-wireable fuses; Situations where miniature circuit breakers (MCB s) are used, their maximum capacity and how both overload and short circuits are handled; States how miniature





circuit breakers must be calibrated; Range of capacity of molded - case circuit breakers (MCCBs); Criteria which influence the selection of fuses for, motor circuit protection; Factors influencing the selection of, and selects fuses to protect, transformers; general order in which protective devices are fitted in series.

#### **5-1-1-3-ii-Transformers as Static A.C. Machines (6hrs.T, 2hrs.P)**

**Knowledge and proficiency in:** Principle of operation of a simple single-phase transformer; Typical applications of transformers; Sketching combinations of star /delta connections used in three- phase transformers; Advantages of a delta/ star transformer with an earthed neutral on the low - voltage side; How essential supplies can be ensured with a star/ delta transformer; Why three single - phase transformers are sometimes used in place of one three- phase transformer; Potential hazards if liquid - cooled transformers are used; Stating the methods of calculating 3Ph- power triangle for transformers; Why delta- delta 3Ph- transformer is the best suited for marine use; Magnetic amplifiers, static and rotary types.

#### **5-1-1-3-iii-Deck Machinery (8hrs.T)**

**Knowledge and proficiency in:** Machinery used for lowering loads are fitted with a fail - safe brake system; Principles of coil - operated brake suitable for winches and other deck machinery; How speed of lowering is controlled on the cable lifter of a windlass; How excessive forces on the cable are avoided when lifting the anchor; The need for the various speeds of a windlass; How dynamic braking is applied to the slewing movement; The principle of the swinging- derrick cargo-handling system; Factors influence drum speed; Given a basic circuit for a potentiometer control; Indicating the different speed connections when: lifting, lowering, in the off position with dynamic braking; The purpose of a load discriminator, reverse - delay relay, voltage lock- out, contactor lock - out, torque - limit relay, time- delay relay; field control and voltage control methods on speed control; Application of the ward - Leonard system to the control of deck machinery; The function of booster control, a reducer, Warming winches and capstans; the purpose and setting of a torque - limit relay in the control; System of a warping winch or capstan, including the provision for emergency heavy pulls; Speed variation necessary when handling slack ropes; A.C. systems used for winch controls; Possible effect on the generators if direct on - line cage motors are used for winches; Principle of a three- speed cage winch motor; how the cage motor has been applied to windlass operation; Control arrangement of a capstan drive using a two - speed cage motor; Principle of a slip- ring motor drive to a warping winch, including: Reversing, overload, torque limiting, speed control, fail - safe braking; Electrical steering system on board, including: Manual





and Automatic steering of a vessel; Electronic methods of speed control; The PWM frequency converter and its power components; Development of Ward- Leonard system in various fields, such as position control and velocity or rate control; All safety, care and maintenance aspects of deck-machinery.

#### **5-1-1-3-iv-Insulation Testing (4hrs.T)**

**Knowledge of:** Principles of measuring and recording insulation resistance; Common causes of reduction in insulation resistance; The reason for the difference in insulation resistance of intermittently and continuously running machines; Information to be entered on a record of insulation resistance; Satisfactory and minimum values of insulation resistance, explaining the conditions under which readings should be taken; The drying out procedure for machines which have been accidentally exposed to, or immersed in, seawater, referring to: Ventilation, maximum temperature, heat source, internal heating, recording insulation resistance and temperature, variation of insulation resistance during the drying time, acceptable insulation resistance; Tests and records resistance values of insulated cables in various conditions and temperatures; The advantages, disadvantages and differences between two models of insulation resistance testers: handle type and push button type; Insulation classes together with ambient and hot spot temperatures with methods of measuring them.

#### **5-1-1-4-Design features of high-voltage installations (6hrs.T)**

**Knowledge and proficiency in:** Economical necessities for large ships and their standards common at 3.3, 6.6 and even 11 Kv; Reduction of size of conductors and current value; Distribution system types on such H.V ships; Systems working at 3.3 KV are normally designed to operate with an earthed neutral via a resistor; Normal limit allowed for an earth- fault current; Sketches arrangement of earthing with resistors for a 3.3 KV system; A mixed system of earthing; Electric propulsion system; Synchro-convertors and cyclo-convertors; Functional, operational and safety requirements for a marine high-voltage system; Assigning qualified personnel to carry out maintenance and repair of high-voltage switchgear of various types; High voltage system advantages; Advantages of an insulated system; High voltage circuit breakers; Cable; Fuses; Remedial action necessary during faults in a high-voltage system; Switching strategy for isolating components of a high-voltage system; Selection of suitable apparatus for isolation and testing of high-voltage equipment; Switching and isolation procedure on a marine high-voltage system, complete with safety documentation; Performance of insulation resistance and polarization index on high-voltage equipment.





**5-1-1-5-Features of hydraulic and pneumatic control equipment (12hrs.T, 48hrs.E)**

**1-Hydraulic Control Equipments (6hrs.T, 24hrs.E)**

**Knowledge and proficiency in:** System components; Hydraulic circuits; Hydraulic system fitting and maintenance; Describing with the aid of computer aided drawing or workshop facilities the operation of conventional electro-hydraulic marine type crane incorporated with P.L.C.; Describing the function of each component in the system; Fault finding and possible remedies.

**2-Pneumatic Control Equipment (6hrs.T, 24hrs.E)**

**Knowledge and proficiency in:** Pneumatic circuits; Pneumatic system fitting and maintenance components and troubleshooting; Describing with the aid of computer aided drawing or workshop facilities the principle operation of electro-pneumatic control systems of Main engine, auxiliary engine and etc.

**Competence 5-2: Manage trouble-shooting, restoration of electrical and electronic control equipment to operating condition (56hrs.T, 12hrs.P)**

**5-2-1-Practical knowledge (56hrs.T, 12hrs.P)**

**5-2-1-1-Troubleshooting of electrical and electronic control equipment (26hrs.T, 4hrs.P)**

**5-2-1-1-i-Graphical Symbols, Regulations, Regulating Organizations and Units and Conversions (2hrs.T)**

**Knowledge and proficiency in:** Common graphical symbols and their meaning; Simple electrical control circuits with first level fault finding; SI, base units, multiples and submultiples; Other units and plus conversion factors.

**5-2-1-1-ii-Electric Shock and Electrical Interference (4hrs.T, 2hrs.P)**

**Knowledge and proficiency in:** Different effects of D.C. and A.C. on victims of electric shock; Conditions which increase and decrease the risk of electric shock; How to reduce the possibility of injury through electric shock from portable electrical appliances; The factors that govern the severity of electric shock; Let go current limits average values for men, women and children together with relative discomfort based on frequency values; Dangers arising from electric shock of: Micro - wave radiation, capacitors, static electricity and portable equipments with prevention of danger; Signal interference and shielding resulted in low level signal of many sources e.g. fluorescent lamps, switching power supplies, motors, radio transmitters or even faulted grounding (ground-loop interference); Types of equipment susceptible to interference; Common sources of interference; All equipment should meet requirements for radio interference suppression; Typical examples of ship's cables susceptible to interference and the necessary precautions; Main points of







maintenance of equipment and cabling to preserve compatibility; Capacitive interference and its minimizing.

#### **5-2-1-1-iii-Ships Electrical Survey Requirements (4hrs.T)**

**Knowledge and proficiency in:** The importance of relevance electrical surveying; Items which are electrically under surveying with their time intervals; All the guide-notes of surveying for: Generators, circuit breakers and switch boards, protection relays, cables, insulation resistance, motors and starters, emergency power supply equipments, steering gear, navigation lights, unattended machinery spaces (UMS) ships, tankers and their hazardous areas.

#### **5-2-1-1-iv-Tankers (6hrs.T)**

**Knowledge and proficiency in:** Electrical installation must meet the requirements of administrations and classification societies; The limited exceptions when earth returns may be permitted; How generators, switchboards and batteries are separated from cargo tanks; The protection necessary for cables which may be exposed to cargo oil, vapor or gas; The separation of cables associated with intrinsically safe circuits; The dangerous or hazardous spaces of a tanker; Protection necessary if it is essential to install electrical equipment in a dangerous space; Requirement for lighting in a pump- room; Recommendations for tankers carrying cargoes with a closed - cup flash point in excess of 60° C; Protection necessary if it is essential to install electrical equipment in a gas - dangerous space; Basic principle and periodic examination, maintenance and care of the following protective equipment: Flameproof, increased safety, intrinsically safe, pressurized, non- sparking, powder filled, oil immersed and special protection; The need to isolate and insulate electrical equipment before every maintenance commencing; Selection of type of protection according to hazardous areas; Requirements for portable electrical equipment; The occurrence of stray electrical energy; Imbalance of lead and return wires of a circuit with respect to earth; What is meant by earthing and bonding; What are certification bodies, certification bodies overseas and equipment identification tags.

#### **5-2-1-1-v-Test Equipment (2hrs.P)**

**Knowledge and proficiency in:** Practical use of meggers, multimeters and CRO; Care and precautions for carrying out open, short and insulation measurement test.

#### **5-2-1-1-vi-Logical six step troubleshooting procedure (2hrs.T)**

**Knowledge and proficiency in:** Symptom identification; Symptom analysis; Probable faulty function; Localizing of faulty function; Localizing trouble to circuit; Failure analysis.





**5-2-1-1-vii-Calibrate & Adjust Transmitters & Controllers (4hrs.T, 2hrs.P)**

**Knowledge and proficiency in:** Differential pressure transmitter calibration; Electronic temperature transmitter calibration; The operation of a PID controller; Tuning a PID controller; Governors and controllable pitch propeller control; Tests, faults, and remedies.

**5-2-1-1-viii-Control System Fault Finding (2hrs.T)**

**Knowledge and proficiency in:** Fault finding methods; Governor faults; Evaluation and rectification of common control systems; Testing alarm and monitoring systems; Electric power supply for control systems.

**5-2-1-2-Function test of electrical, electronic control equipment and safety Devices (2hrs.T, 2hrs.P)**

**Knowledge and proficiency in:** Function test of Over Current Relay (OCR), Relays and magnetic contactors, Timers, Fuses, MCCB, ACB, Diodes, Silicon Controlled Rectifier (SCR), Temperature, Pressure and Level transmitters, Overspeed Protection Devices, Flame Scanners and Fire Detecting System.

**5-2-1-3-Troubleshooting of monitoring systems (8hrs.T, 2hrs.P)**

**5-2-1-3-i-General requirements (4hrs.T)**

**Knowledge and proficiency in:** Sequential monitoring; Computer data storage; Data logging and VDU displays; Assessment of operating condition and automatic adjustment; Machinery condition monitoring; Alarm system, with automatic reset; Manual reset; Lock in means; Time delay; Event recorder and first in flooding alarm.

**5-2-1-3-ii-Test and calibrations of sensors and transducers of monitoring system (4hrs.T, 2hrs.P)**

**Knowledge and proficiency in:** Testing and calibration of pressure sensor and transducer, temperature sensor and transducer, flow sensor and transducer, level sensor and transducer, tachometer sensor and transducer, viscometer sensor and transducer.

**5-2-1-4-Software version control (20hrs.T, 4hrs.P)**

**5-2-1-4-i-General requirements including: (4hrs.T)**

**Knowledge of:** Typical safety systems; Machinery auto start-up; Reduction of power; Shut downs; Level detections; Safe programmed policies and calibration or pre-settings; All With on board testing and maintenance following rules and regulations.





**5-2-1-4-ii-Programmable logic controllers (PLC) (6hrs.T, 2hrs.P)**

**Knowledge and proficiency in:** Basic of PLC operation; Comparison between hard-wired and programmable control operation; Advantages of PLCs; Binary number conversion; Digital logic gates and its practical application; Inputs and output modules and configuration of PLCs; Understanding of ladder logic and PLCs programming; Human machine interace (HMI) and alteration of parameters in the programmer; Basic software version and control of access; Maintenance of Electronic Control Equipment and PLC Controlled processes; Checking the programmer validity and faultfinding and restoration of process with the help of PLCs.

**5-2-1-4-iii-Microcontrollers (2hrs.T)**

**Knowledge and proficiency in:** Introduction to microcontroller; Basics of microcontroller; Analog to digital convertor; Digital interfaces; Serial peripheral interface; Communication with PC; Code integration.

**5-2-1-4-iv-Digital Techniques (8hrs.T, 2hrs.P)**

**Knowledge and proficiency in:** Basic Logic gates and derived Logic gates, Boolean algebra; Principles and operation of digital integrated circuits (TTL and CMOS), adders, flip flops, registers, counters, multiplexers, encoders and decoders; Memories, RAM, ROM, PROM, EPROM, UV PROM; Microprocessors, principles of operation, input/output functions, application in marine control systems, programs, alteration of values; Single integrated circuit containing a processor core, memory, and programmable input/output peripherals; Program memory in the form of NOR flash or OTP ROM is also often included on chip and RAM; Microcontrollers- designed for embedded applications and real time response to events; Typical input and output devices- switches, relays, solenoids, LEDs, radio frequency devices, and sensors for data such as temperature, humidity, light level etc.; Description and use of General Purpose Input/ Output pins (GPIO); Analog-to-digital convertor (ADC); Digital-to-analog convertor (DAC).





## FUNCTION 6: MAINTENANCE AND REPAIR AT THE MANAGEMENT LEVEL

(41hours Theoretical, 12hours Practical, 24hours Exercise)

### *Competence 6-1: Manage safe and effective maintenance and repair procedures*

(27hrs.T, 24hrs.E)

#### **6-1-1-Theoretical knowledge (6hrs.T)**

##### **6-1-1-1-Marine engineering practice (6hrs.T)**

##### **6-1-1-1-i-Preparation for maintenance (6hrs.T)**

**Knowledge of:** Permit to work; enclosed spaces entry procedure; 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; Planning the maintenance strategy according to classification society rules, regulations and survey schedule; Considering renewal of class and statutory certificates when planning maintenance schedule and job procedures; Planned maintenance system (PMS); Updating of maintenance schedule, spare parts inventory and records.

##### **6-1-2-Practical knowledge (21hrs.T, 24hrs.E)**

##### **6-1-2-1-Manage safe and effective maintenance and repair procedures (9hrs.T, 24hrs.E)**

**Knowledge of :** Maintenance policy and type of maintenance including the Objective of planned maintenance system; Planned maintenance, condition monitoring, and breakdown maintenance as applied to a plant.

##### **6-1-2-1-i-Planned maintenance (24hrs.E)**

**Knowledge and proficiency in:** Practical knowledge of planned maintenance system; (Instruction manual consideration, history of machinery, appropriate tool, spare parts availability, legal and safety considerations); Dismantling and inspection strategy; Assembly and testing.

##### **6-1-2-1-ii-Condition monitoring / predictive maintenance (8hrs.T)**

**Knowledge of:** Information obtained from actual working condition; Various methods or measuring instrument reflecting working condition (Oil analysis, vibration analysis, acoustic emission, pressure, temperature); Predictive maintenance based on condition monitoring; Comparison between planned maintenance and predictive maintenance.

**Knowledge and proficiency in:** Dry docking, in-water survey and lay up; Dry dock repair file;





Preparation of dry dock repair specification; Initial and final dry dock inspection; Supporting the vessel in dry dock; Preparation for dry docking and undocking; Survey work and maintenance during dry dock; Typical arrangements for the supply of electrical power, fresh water and sanitation facilities while the vessel is in dry dock; Special arrangements during dry dock for the prevention of fires and explosions; The management of oil and water tanks during dry dock; Testing of tanks by hydrostatic and pneumatic means; preparations, inspections, records, planning, maintenance and events which occur with dry docking and in-water hull surveys; Lay ups(cold or hot), plan aspects of dry docking, in water hull cleaning, and vessel layup and reactivation; emergency preparedness.

**6-1-2-2-Planning maintenance, including statutory and class verification**

**(6hrs.T)**

**Knowledge of:** Planning for the maintenance work and planned maintenance program to be performed in a safe and proper manner, knowing the priorities and class concerns under following considerations: Instruction manual, history of machinery, appropriate tools, spare parts availability, legal and safety aspects.

**Proficiency in:** Dismantling as per manufacturer instruction manual, inspection /calibrations as appropriate (Cleaning prior to inspection); Information to be recorded in the maintenance record book / engine log book.

**6-1-2-3-Planning repairs (6hrs.T)**

**Knowledge of:** Preparation of the general list of routine, periodical and case repairs and monitoring their proper execution and reporting system for the result; Knowing the priorities and class concerns under the following considerations: Instruction manual, history of machinery, appropriate tool, spare parts availability, legal and safety aspects; Assembly and testing of the Individual parts are as per instruction manual; Performance test data comparison and recording upon starting and running up as per the instruction manual, and historical values.

**Competence 6-2: Detect and identify the cause of machinery malfunctions and correct faults (2hrs.T, 12hrs.P)**

**6-2-1-Practical knowledge (2hrs.T, 12hrs.P)**

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





**6-2-1-1-Detection of machinery malfunction, location of faults and action to prevent damage (4hrs.P)**

**Knowledge and proficiency in:** Initial action taken when fault is first identified, considering vessel's safety and environment protection; Bridge is notified of potential problems in good time; Senior engineers are advised and advice sought in all cases of doubt; Priorities and scheduled work are re-assessed in light of identified fault; Errors are acknowledged, reported, recorded and corrective action taken.

**6-2-1-2-Inspection and adjustment of equipment (2hrs.T, 2hrs.P)**

**Knowledge and proficiency in:** Daily, weekly, monthly and other routine inspections as per manufacturers instruction manuals; Inspection of equipment as per class and statutory requirements; Adjustment of equipment as per manufacturer's instruction manual; Special tools for adjustment of equipment.

**6-2-1-3-Non-destructive examination (6hrs.P)**

**Knowledge and proficiency in:** Different types of non-destructive examination including, Use of optical aids, Dye penetrate test (Use of cleaner, penetrant and developer), Magnetic particle Testing, Radiography (Use of radiography in welding), Portable Hardness test.

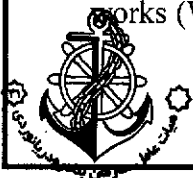
**Competence 6-3: Ensure safe working practices (12hrs.T)**

**6-3-1-Practical knowledge (12hrs.T)**

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

**6-3-1-1-Safe working practices (12hrs.T)**

**Knowledge and proficiency in:** Code of safe working practice, safety and health of the ship's staff, risk assessment (Elements of risk assessment; Identify hazards; Identify risk controls; Estimate risks; Determine tolerability of risks; Prepare risk control action plan); Safety officials (Safety officer; Safety committee; Safety inspector; Investigation for accidents and dangerous occurrences); Personal protective equipment; Work equipment (Maintenance; inspection; training; electrical equipment); Safety induction (Emergency procedures and fire precautions; Accidents and medical emergencies; Health and hygiene; Good housekeeping; Environmental responsibilities; Occupational health and safety); Fire precaution (Smoking; Electrical fittings; Spontaneous combustion; Precautions in machinery spaces); Emergency procedures (Action in the event of fire; Muster and drills); Safe handling (Lighting; Guarding of openings; Watertight doors); Safety at works (Working aloft; Portable ladders; Lagging of steam and exhaust pipes; Unmanned machinery





spaces; Refrigeration machinery); Entering enclosed or confined spaces (Identifying hazards such as Oxygen deficiency; Toxicity of oil and other substances; Flammability; Other hazards); Breathing apparatus and resuscitation equipment; Preparing the space for entry; Testing atmosphere of the space; Procedures and arrangement before entry; Procedures and arrangements during entry; Procedures on completion); Permit to work (Work in unmanned machinery spaces; Entry into enclosed or confined spaces; Hot work; Working aloft; Electrical system for other than electrical officer); Manual handling (Musculo-skeletal injuries due to an unsatisfactory working method; Appropriate steps to reduce risk of injury); Use of work equipment (Use of tools and equipment; Abrasive wheels; High pressure hydraulic and pneumatic equipments; Ropes); Lifting equipment (Safe working load (SWL); Register for lifting appliances, markings and certificates; Regular maintenance; Examination, inspection and testing; operational Safety measures); Maintenance of machinery (Precautions before maintenance; Warning notices not to start machines; Securing heavy parts during maintenance); Hot work (Pre-use equipment test; precautions against fire and explosion; Precautions during use of electric arc welding; Compressed gas cylinders; Gas welding and cutting); Painting (Preparation, precautions and storage); Hazardous substances (Carcinogens and mutagens; Asbestos dust; use of chemical agents); Noise and vibrations.





**FUNCTION 3 : CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR  
PERSONS ON BOARD AT THE MANAGEMENT LEVEL  
(264hours Theoretical)**

***Competence 3-1: Control trim, stability and stress (124hrs.T)***

***3-1-1-Understanding of fundamental principles of ship construction and the theories and factors affecting trim and stability and measures necessary to preserve trim and stability (40hrs.T)***

***3-1-1-i-Form coefficients; Areas and volumes of ship shapes; Floatation; TPC and displacement (20hrs.T)***

**Knowledge and proficiency in:** Terms; Coefficient of fineness of waterplane area; Block coefficient; Midship coefficient; Prismatic coefficient; 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; Archimedes principle; Force of buoyancy, center of buoyancy; Tones per centimeter immersion (TPC); Effect of different densities of water on TPC; TPC's values at different draughts; Change of mean draught; Hydrostatic information on a ship's stability information; Reserve buoyancy; Effect of a change of density on draught; Fresh water allowance; Diagram of a load line identifying the various draught markings; Solving problems related to above objectives.

***3-1-1-ii-Centre of gravity, movement of the centre of gravity; Transverse statical stability (20hrs.T)***

**Knowledge and proficiency in:** 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; 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 is 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 affecting the vessel list; Purpose and principle of inclining experiment and precautions before taking; Solving problems related to above objectives.







**3-1-2-Knowledge of the effect on trim and stability of a ship in the event of damage to, and consequent flooding of, a compartment and countermeasures to be taken (80hrs.T)**

**3-1-2-i-Effect of liquids on stability; moments of statical stability (14hrs.T)**

**Knowledge and proficiency in:** 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; KG solid and KG fluid; Effect of bilging on transverse stability; Permeability and stowage factor; Purpose of non watertight longitudinal subdivision of tanks; 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; Solving problems related to above objectives.

**3-1-2-ii-Trim; Dry-docking and grounding (16hrs.T)**

**Knowledge and proficiency in:** Trim; Center of flotation; Longitudinal metacentre; Longitudinal centre of buoyancy and metacentre; MCTIcm; 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; 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 water in 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 the correct condition for dry docking; Types of dock; Action to be taken after vessel is grounded; Solving problems related to above objectives.

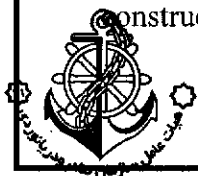
**3-1-2-iii-Ship's hydrodynamics (50hrs.T)**

**1- Ship motion (4hrs.T)**

**Knowledge and proficiency in:** 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 determine periods of rolling, pitching and heaving; Large rolling, purposes and principle operations of fin and tank stabilizers; Natural roll period.

**2- Rudders (12hrs.T)**

**Knowledge and proficiency in:** Angle of heel when turning; Factors governing 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 and their clearances; Rudder construction and repair; Rudder protection against corrosion; Solving problems related to above





objectives.

### **3-Resistance, powering and fuel consumption (20hrs.T)**

**Knowledge and proficiency in:** Residuary and frictional resistance; Ship resistance estimation; Boundary layer and fluids flow; Relationship between frictional resistance and ship speed, the wetted surface area, surface roughness and length of the vessel; Freud's law; Types of wave when a ship moves; Reasons for fitting bulbous bow; Fuel consumption at varying speeds; Estimation of the potential fuel consumption and variations in it when running at different conditions; Solving problems related to above objectives.

### **4-Propulsion and propellers (14hrs.T)**

**Knowledge and proficiency in:** Measuring turbine and diesel engine delivered power, thrust power, effective power; Relationship between different powers; 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; Cavitations; Effect of cavitations 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; Solving problems related to above objectives.

### **3-1-3-Knowledge of IMO recommendations concerning ship stability (4hrs.T)**

#### **3-1-3-i- Damage control (4hrs.T)**

**Knowledge of:** International Code of Intact Stability 2008 (2008 IS code); Damage control plan; AA max.; Preparation for emergency action; Ship's system and equipment for emergency action; Procedure to follow when hull is breached (Localized flooding, usage of portable pumps); Temporary repair and its limitations; Possible repairs to hull damage.

**Competence 3-2: Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea, security and protection of the marine environment (50hrs.T)**

**3-2-1-Knowledge of relevant international maritime law embodied in international agreements and conventions, Regard shall be paid especially to the following subjects: (50hrs.T)**

**3-2-1-1-Certificates and other documents required to be carried on board ships by international conventions, how they may be obtained and the period of their legal validity (4hrs.T)**

**Knowledge of:** Statutory certificates; 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 registry; International tonnage certificate; International load line certificate; Passenger ship safety certificate; Cargo ship safety construction certificate; Cargo ship safety equipment certificate; Cargo ship safety radio certificate; International oil pollution prevention certificate; Document of authorization for grain loading; ISM related certificates; Any other appropriate certificates depends on ships type as applied by SOLAS; How each certificate may be obtained and the period of their validity.

***3-2-1-2-Responsibilities under the relevant requirements of the International Convention on Load Lines, 1966, as amended (4hrs.T)***

**Knowledge of:** Free board, free board deck, free board categories, free board correction; Load line markings; Requirements for free board assignment, maintenance of conditions of assignment, Provisions for determining the freeboard of ships by subdivision and damage stability calculations; The potential hazards present in different zones and different seasons; The safety measures concerning doors; Freeing ports; Hatchways and other items; The main purpose of these measures is to ensure the watertight integrity of ships' hulls below the freeboard deck; Type A ship; Type B ship; Requirement for type B ship with reduced freeboard; Requirements for initial and periodical inspections and endorsements on the international load line (ILL) certificate; load line Fittings and appliances that are inspected.

***3-2-1-3-Responsibilities under the relevant requirements of the International Convention for the Safety of Life at Sea, 1974, as amended (8hrs.T)***

**Knowledge of:** Following SOLAS chapters: Chapter I: 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; Chapter II-1: Construction – structure, subdivision and stability, machinery and electrical installations; Chapter II-2: Construction – fire protection, fire detection and fire extinction; Chapter III: Life saving appliances and arrangements; Chapter IV: Radio communications; Chapter V: Safety of navigation; Procedure for testing of 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 gear and the holding of emergency drills; Chapter VI: Carriage of cargoes; Chapter VII: Carriage of dangerous goods; Regulations for the carriage of dangerous goods; Chapter IX: Management for the safe





operation of ships; International safety management (ISM) code Aims and objectives; Advantages and disadvantages of ISM and (SMS) Safety management systems; certification and audit; Chapter XI-2: Special measures to enhance maritime safety security; The international ship and port facility security code (ISPS Code) Aims and objectives; Compliance to the code; Implementation of the code; Role of ship's security officer; Levels of security; Addressing major security concerns and potential threats; Minimum safe manning requirements; 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.

### **3-2-1-4-Responsibilities under the International Convention for the Prevention of Pollution from Ships, as amended (10hrs.T)**

**Knowledge of:** MARPOL 73/78, violation of the convention and its 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; Record of construction and equipment as supplement to the IOPP certificate; Requirements for initial and periodical surveys; Requirements for periodical inspections and endorsements on the IOPP certificate; 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); Ships surveyed and certified in accordance with Noxious Liquid Substances in Bulk; International bulk chemical code (IBC Code) or bulk chemical code (BCH Code); Duration of validity of certificate; ANNEX III (Provisions for the carriage of harmful substances in packaged form); Regulations regarding packaging, labeling, stowage and reporting incidents of harmful substances in packaged form; IMDG Code; ANNEX IV (Provisions regarding the discharge of sewage into the sea); International sewage pollution prevention certificate; Duration of validity of certificate; ANNEX V (Garbage handling and disposal regulations);





Garbage management plan; Garbage record book; Garbage disposal restrictions ANNEX VI (Air pollution regulations and possible reduction methods); Exhaust emissions; Cargo vapour emissions; Ozone depleting substances; International air pollution prevention certificate; Periodical and intermediate surveys; Duration and validity of certificate; Regulation 13 regarding NO<sub>x</sub>; NO<sub>x</sub> technical code; Regulation 14 regarding Sox; Emission control areas; Regulation 18 – bunker delivery note and fuel oil sample.

**3-2-1-5-Maritime declaration of health and the requirements of the International Health Regulations (4hrs.T)**

**Knowledge of:** The International Health Regulations (IHR), as an international legal instrument; The Member States of world Health Organization (WHO); International community responds to acute public health risks that have the potential to cross borders and threaten people worldwide; Entry into force; Require countries to report certain disease outbreaks and public health events to WHO; Building on the unique experience of WHO in global disease surveillance, alert and response; The rights and obligations of countries to report public health events, And establish a number of procedures that WHO must follow in its work to uphold global public health security.

**3-2-1-6-Responsibilities under international instruments affecting the safety of the ships, passengers, crew or cargo (4hrs.T)**

**Knowledge of:** 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), as amended by the 2010 conference (STCW 2010); General obligations under the convention; Purpose of the convention; Application of the convention; Mandatory minimum requirements for the certification of masters, officers, and ratings forming part of a navigational watch or an engineering watch; Mandatory minimum requirements for the training and qualification of Masters, Officers and Ratings of oil, chemical and gas tankers; Requirements for continued proficiency and updating of Masters, deck and engineer officers; Basic principles in keeping engineering watches; responsibilities of Company and officers under the convention.

ILO's Maritime Labour Convention 2006 (MLC 2006); Minimum requirements for seafarers to work on a ship; Conditions of employment; Accommodation, recreational facilities, food and catering; Health protection, medical care, welfare and social security protection; Compliance and enforcement; Maritime labour certificate and a declaration of maritime labour compliance issued by flag state under MLC 2006.





**3-2-1-7-Methods and aids to prevent pollution of the environment by ships (4hrs.T)**

**Knowledge of:** Sources of Marine pollution: such as Oil; Noxious liquid substances carried in bulk; Harmful substances carried by sea in packaged form; Sewage; Garbage; Ballast water; Anti-fouling paints; Noise; Emissions and combustion by products, gases and vapours; Bilge and ballast water discharge; Precautions to be taken when bunkering fuel oil and lubricating oil; Principle operation of following equipment:

**3-2-1-7-i-Oily water separator (4hrs.T)**

**Knowledge of:** Function and Principle of operation of an oily water separator; General construction and material of components; Maintenance and care required; How the mode and type of pump used affects oily water mixture; How the temperature, relative density and size of oil particles affect the separation process; The principles of the operation of a two stage and three stage automatic oily water separator; Function of a coalesce; How the automatic valve is controlled and operated; The safeguards in an oily water separator system; The automatic cleaning of an oily water separator; Recording to be made and historical values to be analyzed.

**3-2-1-7-ii-Sewage treatment plant (4hrs.T)**

**Knowledge of:** Principles of operation of a biological sewage treatment plant; Discharge tests of aerobic sewage plant (Suspended solid, biochemical oxygen demand, coliform count); How the sludge from a biological treatment plant is disposed of; Why biological treatment should be kept working continuously; Principles of operation of zero discharge system; Sewage retention system; Vacuum type sewage system; recording to be made and historical values to be analyzed.

**3-2-1-7-iii-Incinerator plant (2hrs.T)**

**Knowledge of:** Function and Principle of operation of an incinerator; General construction and sections in the plant; Maintenance and care required; Waste materials that can be incinerated; How liquid and solid waste are prepared for combustion in an incinerator; Recording to be made and historical values to be analyzed.

**3-2-1-8-Knowledge of national legislation for implementing international agreements and conventions (2hrs.T)**

**Knowledge of:** Maritime law; Matters of safety, protection of the marine environment and conditions of employment covered by statutory law; International conventions; Adoption of international conventions and agreements; Main originators of maritime international conventions; National maritime legislations for implementing international conventions and agreements.





**Competence 3-3: Maintain safety and security of the vessel, crew and passengers and the operational condition of life-saving, firefighting and other safety systems (8hrs.T)**

**3-3-1-A thorough knowledge of life-saving appliance regulations (International Convention for the Safety of Life at Sea) (2hrs.T)**

**Knowledge of:** Chapter III of SOLAS regarding life-saving appliances and arrangements.

**3-3-2-Organization of fire and abandon ship drills (2hrs.T)**

**Knowledge and understanding of:** Importance of fire and abandon ship drills; Each member of the crew shall participate in at least one abandon ship drill and one fire drill every month; Limitations of these drills when 25% of the crew have not participated in abandon ship and fire drills on board that particular ship in the previous month; Abandon ship and fire drills should be organized and managed in such a manner that fulfill requirements of SOLAS convention; Fire drills should be planned in such a way that due consideration is given to regular practice in the various emergencies that may occur depending on the type of ship and its cargo; The equipment used during drills shall immediately be brought back to its fully operational condition, and any fault and defects discovered during the drills shall be remedied as soon as possible; The drills shall be organized, as far as practicable, as if there were an actual emergency.

**3-3-3-Maintenance of operational condition of life-saving, fire- fighting and other safety systems (2hrs.T)**

**Knowledge and proficiency in:** Skill that is required to maintain the operational condition of life saving, firefighting and other safety systems, including the coordination of the monitoring of systems and their components to ensure that they function in the event of fire and other shipboard emergencies on board vessel which includes: Monitoring of operational condition of lifesaving, fire detection, firefighting and other safety systems on board a vessel; Coordinate the checking and replacement of consumable materials and items in lifesaving, fire detection, firefighting and other safety systems; Maintain documentation on the condition of lifesaving, fire detection, firefighting and other safety systems on board a vessel.

**3-3-4-Actions to be taken to protect and safeguard all persons on board in emergencies (1hr.T)**

**Knowledge and proficiency in:** Actions to protect and safeguard all persons on board in emergencies; Rescue of persons from a vessel in distress or from a wreck; Man overboard procedures.





**3-3-5-Actions to limit damage and save the ship following fire, explosion, collision or grounding (1hr.T)**

**Knowledge and proficiency in:** Contingency plans for response to emergencies; Means of limiting damage and salvaging the ship following a fire or explosion; Procedures for abandoning ship.

**Competence 3-4: Develop emergency and damage control plans and handle emergency situations (40hrs.T)**

**3-4-1-Ship construction, including damage control (30hrs.T)**

**3-4-1-i- Ship structures & stresses (30hrs.T)**

**Knowledge of:** 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; Cargo load master; Bending moment; Location of maximum bending moment; Relation between stress and depth 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 panning and pounding; Materials for ship construction; Marine steel for ship construction; Connection of steel to steel by welding; Aluminum alloys for ship construction; Problems of connections between aluminum and steel; Different types of keel construction in general; Duct keel and its advantages; Construction of double bottom tanks for longitudinally and transversely framed vessel in different regions; 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; Purpose of the different types of bulk head; Minimum number and location of watertight bulk heads; Construction of watertight bulkheads; Testing of bulkheads; Access through watertight bulkheads; Operation of water tight doors; Penetration of pipes, electrical cables and air trunking through the bulkheads; Non water tight bulkhead; Routine procedures, testing and maintenance of watertight doors; Panning, pounding and 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 for a rudder stock ; Necessary care for a rudder in dry dock; Supports for propeller shafts of twin screw ship; 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 dry-dock and access); Protective coating used for the different tanks; Protection of tanks by fitted anodes; Limitations on the application of anodes; Segregation of tanks in a tanker; Purpose of cofferdam in tankers; Role of inert gas system; Ventilation of cargo tanks; Carriage of liquefied gas and petroleum and required conditions; Construction of LNG & LPG carriers; Boil off; Checking on board fittings for survey; In water survey; Special survey.

#### **3-4-2-Methods and aids for fire prevention, detection and extinction (8hrs.T)**

**Knowledge of:** Basic principles of the regulations on fire protection; Properties of "A" 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 equipments 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; Special requirements for ships carrying dangerous goods; Different types of detectors (Heat, smoke and flame); Different types of portable fire extinguishers; Fixed installation (CO<sub>2</sub>, foam, dry powder and sprinkler); Fire main and its components rule requirements.

#### **3-4-3-Functions and use of life-saving appliances (2hrs.T)**

**Knowledge of:** Function and use of lifeboats (Ordinary davit type, free fall); Rescue boats; Life rafts; Buoys; Line throwing apparatus and other Life Saving Appliances (L.S.A) including Emergency Escape Breathing Devices (EEBD); Survival at sea; Abandon ship; Accepted safety practices and standards; Perform abandon ship drills and the operation of survival crafts and launching appliances, arrangements and their requirements, including radio life-saving appliances, satellite EPIRBs, SARTs, immersion suits and thermal protective Aids.

#### **Competence 3-5: Use leadership and managerial skills (42hrs.T)**

##### **3-5-1- Knowledge of shipboard personnel management and training (6hrs.T)**

**Knowledge of:** Organizing the staff for emergency duties and the use of safety equipment; Organization of repairs and surveys; Training of staff for both normal and emergency duties, supervision of staff in the absence of ideal safe working conditions; Management; Functions, characteristics and skills of engineers, supervisor and managers; Crew management; Staff appraisal;





Training needs analysis; Planning and organization of training programmes; Training methods; Debriefing after training exercises; Evaluation of training programmes; Maintenance techniques; Machinery maintenance, surveys planning and organization; An insight into Reliability Centered Maintenance.

**3-5-2- A knowledge of international maritime conventions and recommendations, and related national legislation (2hrs.T)**

**Knowledge of:** Of Islamic Republic of Iran national legislations for implementing international agreement and conventions.

**3-5-3- Ability to apply task and workload management, including: (8hrs.T)**

**3-5-3-1-Planning and coordination (2hrs.T)**

**Knowledge of:** Main elements and objectives of maintenance planning; Minimum requirements for a maintenance planning; Planning based on maintenance books and planning on board; Planning in preparation for emergency action.

**3-5-3-2-Personnel assignment (2hrs.T)**

**Knowledge of:** Methods of evaluating personnel abilities, assignment of different maintenance jobs to carry out by competent personnel, preparation for maintenance.

**3-5-3-3-Time and resource constraints (2hrs.T)**

**Knowledge and proficiency in:** Fuel consumption; Off hire; Port time class survey; Engine efficiency; Machinery break down; Hull corrosion and cracking; Marine growth; Class survey; Lack of spare parts and service facilities; Maintenance in terms of possible reduction in off hire , repair work and fuel consumption and/or increase in speed.

**3-5-3-4-Prioritization (2hrs.T)**

**Knowledge of:** Maintenance jobs, according to their importance or urgency, and in relation to the maintenance budget and return on investment.

**3-5-4-Knowledge and ability to apply effective resource management: (12hrs.T)**

**3-5-4-1-Allocation, assignment, and prioritization of resources (2hrs.T)**

**Knowledge of:** Resources allocated and assigned as needed in correct priority to perform necessary tasks; Type and scale of the tasks; Actions conforming to the emergency procedures and contingency plans for the ship, in order of priority, the levels and time scales of solving problems and informing personnel on board, are relevant to the nature of the emergency and reflect the urgency of the problem.

**3-5-4-2-Effective communication on board and ashore (2hrs.T)**





**Knowledge of:** English language to enable the officers to use makers' manuals and to perform engineering duties; Communicating clearly and to understand others; Transmitting information relating to machinery components by means of simple drawings with supplementary notes and specifications; Verbal and non-verbal communication; Report writing; Presentation; Group discussion; Meetings.

**3-5-4-3-*Decisions reflect consideration of team experience (2hrs.T)***

**Knowledge of:** Current and predicted engine room and associated systems condition, and of external environment; Team working; Group dynamics; Approaches to team building. Committees.

**3-5-4-4-*Assertiveness and leadership, including motivation (2hrs.T)***

**Knowledge of:** Assessment of personnel competence, capabilities and operational requirements with effective leadership behaviors in order to tackle the jobs.

**3-5-4-5-*Obtaining and maintaining situation awareness (4hrs.T)***

**Knowledge and proficiency in:** Operation of the propulsion plant under control during any situation; Response to bridge manoeuvres at any time; Switchboard parameters at a normal value and to keep electrical power available for ship and bow-thruster; Different pumping systems; To inform the bridge or a superior officer of any abnormal situation; The main and auxiliary machinery for maneuvering operations; Manage boiler operation during maneuvering; Determine order of priority among problems encountered; Resolve problems in an orderly manner; Write appropriate entries in a log book and notice unusual readings; Write appropriate entries in the Oil Record Book; Manually bring the electrical power system back to working order after a power failure; Bring the propulsion system back on line after a power failure; Transfer controls from bridge to engine room.

**3-5-5-*Knowledge and ability to apply decision-making techniques: (10hrs.T)***

**3-5-5-1-*Situation and risk assessment (4hrs.T)***

**Knowledge of:** Potential risk on board; Risk assessment procedure; Objective and scope of assessment; Implementation of risk reduction measure and preventive actions for the risk factors; The potential risk in safety and health activities for the ship and crew; The change of working condition operational circumstances and personal resource.

**3-5-5-2-*Identify and generate options (2hrs.T)***

**Knowledge of:** Preparation and plan of risk assessment; Method of risk assessment; Risk level; Countermeasures for the risk assessment; Risk control affairs on shipboard; Identification of new risk; Monitoring and improvement.





**3-5-5-3-Select course of action (2hrs.T)**

**Knowledge of:** Preparation, implementation and general management of risk assessment plan; Setting up and distribution of standards for the risk assessment and its level; Training ship' personnel for the technique of the risk assessment and risk control.

**3-5-5-4-Evaluation of outcome effectiveness (2hrs.T)**

**Knowledge of:** Review of the effectiveness of risk assessment; Periodical evaluation of implementation of the risk assessment and risk control; Updating safety and health information related to tasks.

**3-5-6-Development, implementation, and oversight of standard operating Procedures (4hrs.T)**

**knowledge of:** Project planning and controlling processes, GANTT charts, Critical Path Method, Program Evaluation and Review Techniques; Application of Fault Tree Analysis and similar Reliability Engineering; Techniques to solve practical shipboard problems.





### **5-7 facilities and equipment required for conducting the course:**

Apart from those facilities, equipments and or requirements mentioned in Code of practice for approval and monitoring of maritime training courses followings have to be provided:

**5-7-1-** Classroom with air conditioning facilities, sufficient lighting and other facilities, suitable for delivering theoretical subjects

**5-7-2-** library with related technical books and references .

#### **5-7-3- Mechanical laboratory**

- 1- Small scale refrigeration unit with sufficient instrumentation to determine the condition of the refrigeration at important stages.
- 2- Laboratory equipment to perform common tests and analysis on fuels and lubricating oils.
- 3- Testing machine for testing tensile, hardness, impact, fatigue, creeping and torsion.
- 4- Non-destructive test bench for dye penetrate, magnetic particle tests, radio graphic and ultrasonic crack detection.
- 5- Valves: Diaphragm-operated control valve with motor, correcting element and positions, miter valve, vee-ported valve, piston actuator, butterfly valve, wax-element control valve, solenoid valve.

Controllers: Working models to demonstrate the production of:

- a- Proportional control
- b- Integral action
- c- Derivative action

#### **5-7-4- Electrical and electronic engineering laboratory/ workshop.**

A.C and D.C electrical power supplies, ammeters and voltmeters with appropriate shunts, etc. to extend their range; instruments incorporating the Wheatstone bridge, potentiometers, multiunit indicators and recorders, thermocouples, ohm-meters, insulation and continuity testers, multimeters, oscilloscopes, a selection of insulating materials, a selection of open-front and dead-front switchboards, reverse-current trips, preferential trips, instruments or trips, a selection of resistors, 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, hose proof, waterproof deck watertight and submersible motors, a selection of D.C motors, starters and a charging system, samples of equipment for which the safety levels are flameproof, explosion proof increased safety, intrinsically safe and pressurized.

#### 5-7-5- Instrumentation laboratory and workshop

- 1- Thermometers and pyrometers: Mercury in steel, vapor-pressure, gas-filled, bimetallic, resistance, thermistor-type, thermocouple.
- 2- Manometers: Wide-cistern, inclined-tube, mercury.
- 3- Pressure gauges: Bourdon tube, diaphragm, Schaffer, differential twin bellows, strain gauge, pressure gauge testing equipment.
- 4- Level-measuring devices: Float, probe element, displacement chamber, pneumaticator gauge.
- 5- Flow measurement: Rotometer.
- 6- General: mechanical tachometer, viscometer, a detector using a photoelectric cell, i.e.
  - a- For oil in water
  - b- For smoke density
  - c- For oil mist
  - d- For flame
- 7- Selection of fire detectors, explosive gas detector, oxygen analyzer, CO<sub>2</sub> analyzer, relative humidity meter, sectioned pneumatic transducer with negative feedbacks, pneumatic receiver integrator.

#### 5-8 Lecturers and instructors minimum qualifications

Lecturers and instructors shall have completed a course in instructional techniques (TFT) in one of the training centers approved by the PMO, and;

5-8-1 for lecturing in theoretical subjects should;

5-8-1-1 For lecturing theoretical subjects mentioned in this code of practice as mentioned in chart 5-6-1 column 1, 2, 3 and 4 lecturers must possess valid chief engineer certificate of competency for ships of  $KW \geq 3000$  engaged on unlimited voyages as well as having one year of seagoing service in that rank.

5-8-1-2 For lecturing electro-technology subjects as mentioned in this code of practice lecturers must possess at least relevant Master of Science degree or have electro technology valid certificate of competency with three years of seagoing service experiences on ships of  $KW \geq 3000$  engaged on unlimited voyages.

5-8-1-3 holders of Master of Science degree in ship architecture and shipbuilding or Master certificate of competency for ships of  $GT \geq 3000$  engaged on unlimited voyages can be assigned in teaching ship stability and ship construction subjects.

5-8-2 for delivering practical training should;





5-8-2-1 have minimum second engineer valid certificate of competency for ships of KW $\geq$ 3000 engaged on unlimited voyages as well as having one year of seagoing service in that rank.

5-8-2-2 Possess minimum Bachelor of Science in mechanical or ship building engineering with minimum two years of working experiences.

5-8-2-3 For electro-technology practical subjects possess electro-technology certificate of competency and 12 month of seagoing service experience or have minimum relevant Bachelor Science degree and two years of working experiences.

### **5-9 Assessment and Certification**

5-9-1 upon successful completion of the examination which is carried out during and at the end of the course, the trainee will be awarded relevant course completion certificate issued by the approved training center

5-9-2 then after trainee applies for the PMO competency assessments specified in above paragraph 5-6-1; and

5-9-3 finally, Seafarers' Examinations and Documents Directorate of the PMO will issue a CoC for those candidates who have passed above mentioned PMO competency assessment and fulfill other relevant certification requirements set out in paragraph 5-4 of the "code of practice for issuing, revalidating and renewing certificates of competency and certificates of proficiency for seafarers".

### **5-10 revalidation/renewal of certificates**

CoPs and CoCs will be revalidated and renewed in accordance with provisions of the Code of practice for issuing, revalidation and renewal for certificate of competency and certificates of proficiency for seafarers.

### **5-11 course approval**

It will be carried out as per code of practice for approval and monitoring of maritime training courses.

## **6- Records**

All records which present the implementation of the content of this code of practice.

## **7- References**

7-1 STCW Convention and STCW Code;

7-2 IMO model course;

7-3 Code of practice for approval and monitoring of maritime training courses;

7-4 Code of practice for issuing revalidating and renewing certificates of competency and certificates of proficiency for seafarers.

## **Appendixes**

