REGULATIONS,
COURSE STRUCTURE & SYLLABUS

for

B.Tech Degree in Marine Engineering

(With effect from 2019 Admissions)

Kunjali Marakkar School of Marine Engineering

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
COCHIN – 682 022

REGULATIONS FOR B.Tech DEGREE PROGRAMMES UNDER FACULTY OF ENGINEERING

The following regulations are made applicable to B.Tech programme in Marine Engineering in the University under Faculty of Engineering with effect from the academic year 2019-20.

1. B.Tech Programme

The duration of the B.Tech course in Marine Engineering shall be eight semesters spanning over four academic years. Each semester shall consist of 18 weeks except 7^{th} semester. 7^{th} semester consist of 26 weeks.

1.1 Structure of the B. Tech. programme

1.1.1 The programme of instruction will consist of the following:

i) General (common) core courses comprising basic sciences, mathematics and basic engineering
ii) Engineering core courses introducing the student to the foundations of engineering in the Marine Engineering;
iii) Elective courses enabling the student to opt and undergo a set of courses of interest to him/ her;
iv) Professional practice including project, seminar, and industrial training and
v) Humanities courses on Communication Skills and Environmental Studies.

1.1.2. The B. Tech. Marine Engineering programme will have a curriculum and syllabus for the course approved by the Academic Council.

1.1.3. The B.Tech programme in Marine Engineering offered by the University shall follow the credit system.

1.1.4. The curriculum of any branch of the B. Tech. Marine Engineering shall have a minimum total of 172 credits.

1.2 Course Registration

It is mandatory for the students to register for the courses in each semester.

Before registration, the students should
a) Clear all dues including any fees to be paid and should not have any disciplinary issues pending.
b) Meet the requirements regarding the minimum number of credits for promotion stipulated in clause 1.9.

The dates for registration will be announced by the School in the academic calendar. Late registration will be allowed up to 7 working days from the commencement of the semester with late registration fee.

1.3 Mode of Evaluation

1.3.1. The performance of the students in theory courses will be evaluated based on continuous assessment and semester end examination. In the case of practical courses, the evaluation will be based on continuous assessment and semester end assessment which will be carried out internally.
1.3.2. For theory courses, there will be 40% weightage for internal assessment and 60% weightage for semester end examination. For practical courses, continuous assessment and semester end assessment will carry 50% weightage each.

1.3.3.In theory courses, the assessment pattern will be as follows:

Continuous assessment:

1. I Periodical Test – Maximum marks: 12.5
2. II Periodical Test – Maximum marks: 12.5
3. Assignments - Maximum marks: 10
4. Attendance – Maximum marks: 5

The Semester End Examination shall be of 3 hours duration.
At the end of the semester, semester examination will be conducted in all the theory courses offered in the semester and it will be of three hours duration unless otherwise specified. The Controller of Examinations will make necessary arrangements for setting the question papers and valuation of answer books for the semester end examination of theory courses.

Each question will carry 15 marks and the student can attend 5 questions for 75 marks. ***The maximum mark that can be awarded for a Semester End Examination (SEE) will be only 60, even though the questions are for 75 marks.***

1.3.4. For each practical course, the assessment pattern will be as follows:

50% marks is earmarked for Continuous Evaluation, and 50% marks for Semester End Examination. The Semester End Examination to be conducted by a minimum of two examiners, one not below the rank of an Associate Professor. A candidate shall secure a minimum of 50% marks in the aggregate and 40% minimum in the Semester End Examination for a pass.

1. Continuous assessment : 25 marks

For continuous assessment, the marks may be awarded on the basis of the performance of the student in the laboratory sessions. The break-up of marks for continuous assessment of laboratory courses shall be:
a) Practical records/Outputs: 10 marks
b) Lab work: 10 marks
c) Attendance: 5 marks

2. Semester end assessment:25 marks

The semester end assessment will consist of an examination and a viva voce.
The semester end assessment for the laboratory courses shall be conducted internally by the department with at least two faculty members as examiners. One of the examiners for conducting the semester end laboratory examination shall be at the level of Associate Professor or above in the regular cadre.

1.3.5.In the case of project work, the project guide concerned shall make the continuous assessment. A committee consisting of the Project Coordinator (nominated by the Head of the Department / Division), project guide, and at least one senior faculty member at the level of Associate Professor or above will carry out the final review.

The weightages for the reviews shall be as follows:
Continuous assessment: 40 percent
Project Report : 20 percent
Final review: 40 percent

1.3.6. The Viva-voce examination at the end of VIII Semester will be conducted by a panel of three examiners consisting of the Head of the Department or his/her nominee and one senior faculty at the level of Associate Professor or above of the Department and one external expert.

1.3.7. A candidate shall not be allowed to improve the continuous assessment marks in theory / laboratory courses. A candidate who desires to improve his/her marks in the semester end examination in theory courses shall be permitted to do so in the next available chance. This facility will be available only once for a theory course.

1.4 Course completion and earning of credits.

Students registered for a course have to attend the course regularly and meet the attendance rules of the university and appear for all the internal evaluation procedures for the completion of the course. However, earning of credits is only on completion of the semester examination and on getting a pass grade. Students, who have completed a course, but could not write the semester examination for valid reasons, are permitted to write the semester examination at the next opportunity and earn the credits without undergoing the course again.

1.5 Eligibility to appear for the Semester End Examination

1.5.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester.
Ideally every student is expected to attend all classes and earn 100% attendance. However, in order to allow provision for certain unavoidable reasons such as medical / personal grounds / participation in sports, the student is expected to earn a minimum of 75% attendance. Therefore, he/she shall secure not less than 75% of overall attendance in that semester taking into account the total number of days in all courses attended by the candidate as against the total number of days in all courses offered during that particular semester.

1.5.2 The Head of the School shall have the power to condone shortage of attendance up to 5 percent (between less than 75% and 70%) in a particular semester due to medical reasons (hospitalization / accident / specific illness) duly verified and recommended by the Course in Charge and on production of medical certificate from a registered medical practitioner endorsed by the University Medical Officer and on payment of the required fee. However such condonation for shortage of attendance shall be given only twice during the entire duration of the B.Tech programme.

1.5.3 The Vice Chancellor shall have the power to condone shortage of attendance up to 10 percent (between less than 70% and 65%) in a particular semester due to medical reasons (hospitalization / accident / specific illness) duly verified and recommended by the Head of the School and on production of Medical certificate from a registered medical practitioner endorsed by the University Medical Officer and on payment of the required fee. However such condonation for shortage of attendance shall be given only twice during the entire duration of the B.Tech programme.

1.5.4 Candidates who secure less than 65%overall attendance will not be permitted to write the Semester End Examinations and are not permitted to go to next /subsequent semester. They are required to repeat the incomplete semester in the next academic year.

1.6 Eligibility to write the Supplementary examination

Supplementary examinations for a particular semester will be conducted along with the regular examination of the next semester.

Failed candidates and those who could not write the semester examination due to health reasons or other contingencies that are approved by the Head of the School can register for the supplementary examination. Those who wish to improve their performance in the semester end examinations can also register for the same, subject to the provisions of clause 1.3.7. Grades awarded in the supplementary examination will be taken as semester grades in these subjects and will be based on the semester examination grading pattern in that subject. In the case of candidates appearing for improvement of marks, the higher mark obtained will be considered for the purpose of grading.

1.7. Revaluation

A candidate can apply for revaluation of his/her semester end examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee along with prescribed application to the Controller of Examinations through the Head of School. The Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the School. Revaluation is not permitted for practical courses, seminar and project work.

1.8. Pass requirements

A candidate has to obtain a minimum of 50 percent marks for continuous assessment and semester end examination put together with a minimum of 40 percent marks in the semester end examination for a pass in theory and laboratory courses.

1.9 Promotion to Higher Semesters

Promotion to the V^{th} semester and VII^{th} semester shall be subject to the following conditions:

Promotion to	**Minimum number of credits to be earned**
V Semester	30 out of 60 credits of Semesters I, II, &III
VII Semester	55 out of 106 credits of Semesters I to V

A student will be given one regular chance and one supplementary chance for the semester end examination of I^{st} and II^{nd} semesters for considering the promotion to V^{th} semester and one regular

chance and one supplementary chance for semester end examinations of IIIrd and IVth semesters for considering the promotion to the VIIth semester.

1.10Grading

1.10.1. Grades shall be awarded to the students in each course based on the total marks obtained in continuous assessment and the semester end examination and as per the provisions of clause 1.3.1.
The grading pattern shall be as follows:

Marks obtained (Percentage)	Grade	Grade points
90 to 100	S	10
80-90	A	9
70-80	B	8
60-70	C	7
50-60	D	6
Less than 50	F	0

Note:- Where X-Y range denotes 'X' inclusive and 'Y' exclusive.

1.10.2. A student is considered to have credited a course or earned credits in respect of a course if he/she secures a grade other than F for that course.

1.10.3. Grade Point Average.

The academic performance of a student in a semester is indicated by the Semester Grade Point Average (SGPA).

$$SGPA = \frac{G_1C_1 + G_2C_2 + G_3C_3 + \text{----------} + GnCn}{C_1 + C_2 + C_3 + \text{----------} + Cn}$$

Where 'G' refers to the grade point and 'C' refers to the credit value of corresponding course undergone by the student.

1.10.4. Grade Card
The Grade Card issued at the end of the semester to each student by the Controller of Examinations, will contain the following:
a) The code, title, number of credits of each course registered in the semester,
b) The letter grade obtained,
c) The total number of credits earned by the student upto the end of that semester and
d) SGPA & CGPA.

1.10.5.Classification

The classification based on CGPA is as follows:

CGPA 8 and above : First Class with distinction
CGPA 6.5 and above, but less than 8 : First Class
CGPA 6 and above, but less than 6.5 : Second Class.

1.10.6. Conversion of CGPA to Percentage marks

The following formula shall be used to convert the SGPA/CGPA obtained by a student to percentage marks.

Percentage marks = (SGPA/CGPA – 0.5) 10

1.11 Faculty Advisor

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department of the student will attach a certain number of students to a teacher of the Department who shall function as Faculty Advisor for those students throughout their period of study. Such Faculty Advisor shall advise the students and monitor the courses taken by the students, check the attendance and progress of the students attached to him / her and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress / performance of the students concerned.

1.12 Class Committee

A class committee consists of teachers of the class concerned, student representatives and a chairperson who does not handle any subject for the class. It is like the 'Quality Circle' more commonly used in industries), with the overall goal of improving the teaching-learning process. The functions of the class committee include:

• Solving problems experienced by students in the classroom and in the laboratories in consultation with the Course in Charge/ Director.
• Clarifying the Regulations of the degree programme and the details of rules therein.
• Informing the student representatives the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
• Informing the student representatives the details of Regulations regarding weightage used for each assessment.
• Discussing in the class committee meeting the breakup of marks for each experiment / exercise / module of work, in case of practical course (laboratory / drawing / project work / seminar, etc.) and informing the students.
• Analysing the performance of the students of the class after each test and finding ways and means of improving the performance of the students.
• Identifying the students who are low achievers or weak in their subjects if any, and requesting the teachers concerned to provide some additional help or guidance or coaching to such students.

The class committee is normally constituted by the Head of the Department. The class committee shall be constituted within a week from the date of commencement of a semester. At least 3 student-representatives from the respective class (usually 3 boys and 1 girl) shall be included in the class committee. The student representatives shall be nominated on the basis of their academic performance since the First Semester of the B.Tech programme. In the case of First and Second semesters, the rank obtained in the Common Admission Test (CAT) shall be the criterion for nominating the student representatives. The Chairperson of the class committee may invite the Faculty Advisor(s), Course in Charge and the Head of the Department to the meeting of the class committee. The chairperson of the class committee is required to prepare the minutes of every meeting, submit the same to the Head of the Division within two days of the meeting and arrange to circulate the same among students concerned and teachers. If there are some points in the minutes requiring action by the University the same shall be brought to the attention of the Director and the Registrar.

The first meeting of the class committee shall be held within fifteen days from the date of commencement of the semester. The nature and weightage of internal assessments shall be discussed in the first meeting, within the framework of the Regulations and the same shall be communicated to the students. Two or three subsequent meetings in a semester may be held at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process.

1.13 Discipline

Every student is required to observe discipline and decorous behavior both inside and outside the campus and refrain from any activity which may tarnish the image of the university. Any act of indiscipline, misbehavior including unfair practice in examinations will be referred to the authorities of the University that will make a detailed enquiry on the matter and decide on the course of action to be taken.

1.14 Amendment to Regulations

Notwithstanding all that has been stated above, the University has the right to modify any of the above regulations from time to time.

B.TECH DEGREE COURSE

Scheme of Examinations (2019 admissions)

SEMESTER I

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-208-0101	Mathematics – I	4	1	0	3	40	60	100
19-208-0102	Engineering Physics	4	0	0	3	40	60	100
19-208-0103	Engineering Chemistry	4	0	0	3	40	60	100
19-208-0104	Engineering Mechanics	4	1	0	3	40	60	100
19-208-0105	Basic Electrical Engineering	4	0	0	3	40	60	100
19-208-0106	Environmental studies and Technical Communication	4	1	0	3	40	60	100
19-208-0107	Electrical Engineering Workshop	0	0	3	1	25	25	50
19-208-0108	Language Lab	0	0	2	1	25	25	50
19-208-0109	NSS/Nature Conservation Activity	0	0	1	0	-	-	-
	TOTAL	**24**	**3**	**6**	**20**			

CA – Continuous Assessment**, SEE –**Semester End Examination

SEMESTER II

Code No.	Subject	L Hrs/Wk	T Hrs/ Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-208-0201	Mathematics – II	4	1		3	40	60	100
19-208-0202	Applied Thermodynamics	4	1		3	40	60	100
19-208-0203	Engineering Graphics	3	1		3	40	60	100
19-208-0204	Basic Electronics and measurements	4	0		3	40	60	100
19-208-0205	Computer Programming	4	0		3	40	60	100
19-208-0206	Mechanics of solids	4	1		3	40	60	100
19-208-0207	Mechanical Engineering Workshop			3	1	25	25	50
19-208-0208	Computer Programming Laboratory			3	1	25	25	50
	TOTAL	**23**	**4**	**6**	**20**			

B.TECH DEGREE COURSE IN MARINE ENGINEERING

Scheme of Examinations (2019 admissions)

SEMESTER III

Code No.	Subject	L Hrs/Wk	T Hrs/ Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-208-0301	Mathematics – III	4	1	0	3	40	60	100
19-208-0302	Electrical Technology	4	1	0	3	40	60	100
19-208-0303	Production Technology	3	1	0	3	40	60	100
19-208-0304	Marine Electronics	3	1	0	3	40	60	100
19-208-0305	Fluid Mechanics	4	1	0	3	40	60	100
19-208-0306	Machine Drawing	3	1	0	3	40	60	100
19-208-0307	Strength of Materials Lab	0	0	3	1	25	25	50
19-208-0308	Workshop Practices	0	0	3	1	25	25	50
	TOTAL	**21**	**6**	**6**	**20**			

CA – Continuous Assessment**, SEE** –Semester End Examination

SEMESTER IV

Code No.	Subject	L Hrs/Wk	T Hrs/ Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-208-0401	Mechanics of Machinery	3	1	0	3	40	60	100
19-208-0402	Thermal Engineering & Heat Transfer	3	1	0	3	40	60	100
19-208-0403	Metallurgy & Materials Science	4	0	0	3	40	60	100
19-208-0404	Marine Auxiliary Machinery – I	4		0	3	40	60	100
19-208-0405	Hydraulic Machinery	3	1	0	3	40	60	100
19-208-0406	Seamanship and Navigation	3	0	0	3	40	60	100
19-208-0407	Ship Technology	4	0		3	40	60	100
19-208-0408	Electrical Machines Lab	0	0	3	1	25	25	50
19-208-0409	Boiler Chemistry & Heat Engines Lab	0	0	3	1	25	25	50
	TOTAL	**24**	**3**	**6**	**23**			

SEMESTER V

Code No.	Subject	L Hrs/Wk	T Hrs/ Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-208-0501	Dynamics of Machinery	3	1	0	3	40	60	100
19-208-0502	Marine Boiler and Steam Engineering	3	1	0	3	40	60	100
19-208-0503	Marine Economics and Commercial Geography	3	1	0	3	40	60	100
19-208-0504	Marine Auxiliary Machinery – II	3	1	0	3	40	60	100
19-208-0505	Marine Internal Combustian Engine – I	3	1	0	3	40	60	100
19-208-0506	Marine Engineering Drawing	2	1	3	3	40	60	100
19-208-0507	Naval Architecture – I	3	1	0	3	40	60	100
19-208-0508	Fluid Mechanics & Hydraulic Machinery Lab	0	0	3	1	25	25	50
19-208-0509	Electronics Lab	0	0	3	1	25	25	50
	TOTAL	**20**	**7**	**9**	**23**			

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SEMESTER VI

Code No.	Subject	L Hrs/Wk	T Hrs/ Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-208-0601	Management Science	3	1	0	3	40	60	100
19-208-0602	Marine Electrical Technology	3	1	0	3	40	60	100
19-208-0603	Ship fire Prevention and Control	3	1	0	3	40	60	100
19-208-0604	Marine Refigeration and Air Conditioning	3	1	0	3	40	60	100
19-208-0605	Marine Internal Combustion Engines – II	3	1	0	3	40	60	100
19-208-0606	Machine Design	3	1	0	3	40	60	100
19-208-0607	Naval Architecture – I	3	1	0	3	40	60	100
19-208-0608	Fire Control Engineering Lab	0	0	3	1	25	25	50
19-208-0609	Mechanical Lab	0	0	3	1	25	25	50
	TOTAL	**21**	**7**	**6**	**23**			

SEMESTER VII

Code No.	Subject	L Hrs/Wk	T Hrs/ Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-208-0701	Ship in Campus – I	0	0	3	1	50	-	50
19-208-0702	Ship in Campus – II	0	0	8	4	50	-	50
19-208-0703	Ship in Campus – III	0	0	4	2	50	-	50
19-208-0704	Ship in Campus – IV	0	0	6	3	50	-	50
19-208-0705	Ship in Campus – V	0	0	11	5	50	-	50
19-208-0706	Ship in Campus – VI	0	0	7	4	50	-	50
19-208-0707	Ship in Campus – VII	0	0	3	1	50	-	50
	TOTAL	**0**	**0**	**42**	**20**			

SEMESTER VIII

Code No.	Subject	L Hrs/Wk	T Hrs/ Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-208-0801	Safe Watch Keeping and Engine Resource Management	4		0	3	40	60	100
19-208-0802	Ship Operation and Management	4		0	3	40	60	100
19-208-0803	Maritime Statutory Regulations	4			3	40	60	100
19-208-08**	Elective – I	3	1	0	3	40	60	100
19-208-08**	Elective- II	3	1	0	3	40	60	100
19-208-0812	Simulation and Control Lab			3	1	25	25	50
19-208-0813	Seminar	3			2	50	-	50
19-208-0814	Project			10	4	200	-	200
19-208-0815	Viva-voce			0	1		50	50
		21	**2**	**13**	**23**			

19-205-0804 to 0807: **ELECTIVE – I**

19-208-0804: Marine Machinery System Design
19-208-0805: Marine Control Engg. & Automation
19-208-0806: Double Hull Tank Vessels
19-208-0807: Cryogenic Engineering

19-208-0808 to 0811: **ELECTIVE – II**

19-208-0808: Fluid Circuits and Controls
19-208-0809: Hydraulic and Pneumatic Drives
19-208-0810: Renewable Energy Sources & Applications
19-208-0811: Tribology

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19-208-0101 ENGINEERING MATHEMATICS I (90 hrs)

Course Outcome:
On completion of this course the student will be able to:

1. Apply parabola, ellipse and hyperbola in engineering disciplines.
2. Use differential calculus and integral calculus for solving engineering problems.
3. Estimate the maxima and minima of multi variable functions.
4. Find area as double integrals and volume as triple integrals in engineering applications.
5. Apply vector methods in solving engineering problems.

Module I

Co-ordinate geometry of two dimensions : Standard equations of parabola, ellipse and hyperbola, their parametric representations, equations of tangents and normals to these curves, simple properties of these curves, asymptotes of a hyperbola, rectangular hyperbola. (18 hours)

Module II

Differential calculus: Continuity and differentiability of functions of one variable, Rolle's theorem, Mean value theorem, Cauchy's theorem, Taylor's theorem, Taylor's series, Maclaurin's series, Indeterminate forms, curvature, maxima and minima, Asymptotes (8 hours)

Integral Calculus: Reduction formula for $\sin^n x$, $\cos^n x$, $\sin^m x.\cos^n x$ applications of definite integrals in the evaluation of length arcs, areas, area of surface of revolution and volumes. (10 hours)

Module III

Successive Differentiation: Higher order derivatives, n^{th} order derivatives, n^{th} order derivatives of rational functions and partial fraction, Leibniz formula for the n^{th} derivative of the product of two functions, n^{th} order derivative of the product of powers of sines and cosines. (8hours).

Partial Differentiation : Partial differentiation, chain rule, Homogenous functions, Euler's theorem on homogenous function of two variables ,total derivatives, Jacobians-Maxima, minima of functions of two variables. Lagrange multipliers, Exact differentials, errors and approximations. (10hours)

Module IV

Multiple Integrals : Evaluation of double and triple integrals, volumes and surface areas of solids using multiple integrals. (9 hours)

Vector Algebra: Scalar and vector triple product, Linear dependence of vectors, orthogonal triad, Reciprocal system. (9 hours)

Module V

Vector differential calculus : Scalar and Vector point functions, their derivatives, curves, gradient, divergence and curl, their physical meanings, conservative force fields, scalar potential. (10 hours)

Vector Integration

Line and surface Integrals, Greens theorem, Divergence theorem and Stokes theorem(without proofs)and their applications (8 hours)

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers,2005.
2. Erwin Kreyszing, Advanced Engineering Mathematics, John Wiley &Sons,2010.
3. S.S. Shastri, Engg. Mathematics Vol. I & II, Prentice Hall, 2004.
4. S.B. Balachandra Rao & C.K. Shantha Differential Calculus, Wiley Eastern.
5. G.B. Thomas, Calculus and Analytical Geometry, Addison Wesley,2010.
6. Shantinarayana, Engg. Mathematics Vol. I & II, S. Chand & Co.
7. S. Narayanan, Manickavachagom Pillai & Dr. G. Ramanaiah, Advanced Mathematics for Engg.,S. Viswanathan publishers, Chennai, 2002.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0102 ENGINEERING PHYSICS (72 hrs)

Course Outcomes

On completion of this course the student will be able to:

1. Understand interference of light and its applications and applications of X- rays
2. Grasp the basics of diffraction and their applications.
3. Understand many modern devices and technologies based on lasers and sound recording.
4. Have a fundamental knowledge of fiber optics and their applications.
5. Have an understanding of different marine equipment the characteristics and applications and superconducting materials

Module I

Interference of light: Interference of thin films, colours of thin films – Newton's rings (reflected system) – determination of wave length and refractive index. Air wedge-diameter of thin wire-Testing of plainness of surfaces. (12hrs)

Production of X-rays-continuous and characteristic X-rays-Mossleey's law-Diffraction of X-rays-Bragg's X-ray spectrometer-Compton effect-expression fro change in wavelength. –(6hrs)

Module II

Diffraction: Fresenel and Fraunhofar diffraction-Zone place-place diffraction grating-Measurement of wave length-Dispersive of power of grating. Resolving power-Raleigh's criterion-Resolving power of telescope and grating. **(**8hrs)

Double refraction: Positive and negative crystals-Nicol prism-Huygen's theory of double refraction. Quarter wave and half wave plates. Production and analysis of place polarized and circularly polarized light using crystal plates. Optical activity-Fresnel's theory-specific rotation-Half shade polarimeter . (8hrs)

Module III

Coherence and lasors: Spatial and temporal coherence-coherence length-spontaneous omission-stimulated emission-population inversion-CW & Pulsed Laser, typical laser systems like Helium-Neon, Nd, YAG, Ruby, Semi-conductor lasers. Applications of lasers-Principle of holography-reflection and transmission type-Recording and reconstruction-application of holography-white light holograms. (8hrs)

Electronic waves-Production, properties and application.
Recording and reproduction of sound-Magnetic tape recording sound recording on cine films.
(6hrs)

Module IV

Fiber optics and its applications: General ideas of optical fiber-NA of fiber-step index and graded index of fibers-multimode and single mode fibers-applications of optical fiber-fiber optic communication-optical fiber sensors-general ideas of intergraded optics. (10hrs)

Module V

Marine Physics: Gyroscope, gyroscopic effect, gyro compass, SONAR, repeaters, Echo sounder, Ultra sound waves-Production, properties and use of ultra sound to measure the depth, flaw detection.
Dielectrics : Types and applications. (10hrs)

Superconductivity: Transition temperature-Meissner effect-Isotope effect-Type I and type II-super conductors-B.C.S. theory (qualitative study)-High temperature super conductivity (General idea)-Josephson effect-SQUIDS. -4hrs

References:

1. Mani Naidu, S. (2010). *A text book of engineering physics*. Pearson, New Delhi.
2. Vasudeva, A.S. (2013). *Modern engineering physics*. S. Chand & Co, New Delhi
3. Prabir K. Vasu and Hrishikesh Dhasmana. (2010). *Engineering physics*. Ane books Pvt. Ltd, New Delhi.
4. Pillai, S.O and Sakami. (2008). *Applied physics*. (second edition). New Age International (P) Ltd., New delhi..
5. Raghuvanshi, G.S. (2008). *Engineering physics*. Prentice Hall of India, New Delhi.
6. Santosh Kumar, M.C. (2012). *Engineering physics*. Nalpat Publishers, Ernakulam.
7. Premlet, B. (2013). *Advanced engineering physics*. Phasor Books, Kollam.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0103 ENGINEERING CHEMISTRY (72 hrs)

Course Outcomes

On completion of this course the student will be able to:

1. Understand the treatment of water to remove hardness
2. Get exposure to the important aspects of solid state chemistry and spectroscopy.
3. Understand and apply the concepts in electrochemistry and corrosion science
4. Get exposure on the important types of fuels used in marine applications.
5. Gain sound understanding on the requirements and properties of a few important engineering materials

Module I

Water and its treatment : Hard and soft water-Degree of hardness of Water and its determination-hot lime – soda process-ion exchange method –calculation of soda requirements-desalination of sea water (electro dialysis & reverse osmosis) – water for domestic use – boiler feed waters – defects of using hard water in boilers and the treatments given-Bio chemical Oxygen Demand (BOD)- Chemical Oxygen Demand (COD) – Pollution – chemical characteristics – Sewage Treatment – Air pollution- causes and control (14hrs)

Module II

Electrochemistry & Solid State: - Electro chemical cells – EMF and its measurement (Poggendroff) – Weston cadmium cell – Nernst's equation – standard hydrogen Electrode- calomel Electrode – Edisson cell – Nickel – Cadmium cell, Metal – Air Batteries, Nickel – Metal Hydride Batteries, Lithium Batteries – PH Measurements- and Potentiometric titrations. (10hrs)

Solid State: ionic, covalent, Molecular and metallic solids-crystal defects in stochiometric solids and non-stoichiometric compounds- semi conductors-organic and high temperature – Super Conductors-Liquid Crystals – L.C.D. – Nano materials – Fullerens. (8hrs)

Module III

Corrosion: Thermodynamics and kinetics of corrosion, Dry (Chemical) and Wet (Electro chemical)-electro chemical theory of corrosion (Evolution hydrogen and absorption of oxygen) – Factors influencing corrosion – Prevention of Corrosion – Electroplating- Hot dipping- Cathodic protection – paints- varnishes-Japans- Enamels (gloss finisher) – Lacquers., Special paints. (8hrs)

Module IV

Fuels: Solid, Liquid and Gaseous fuels - Calorific Value of fuels and its determination – Different types of coal – importance of proximate analysis – Refining of petroleum – composition and uses of fractions – Diesel oil and petrochemicals, synthetic petrol – coal gas – Producer gas – LPG – LNG – water gas – Nuclear fission – Nuclear fusion – Fuel cells – Solar cells. (12hrs)

Module V

High Polymers : Classification of High Polymers-production of high polymers-general methods-Some important plastics, their production, properties and uses-Polyethylene PVC, Polystyrene, Teflon, Acrylis, Nylon, Polyesters, Phenol Formaldehyde Resins, Urea Formaldehyde Resins and silicones-compounding and moulding of high polymers. (10hrs)

Plastics and Rubber: Thermoplastics and thermosetting plastics. Natural rubber, production and properties, Compounding and Vulcanization of Rubber, Synthetic Rubbers – Buna Rubbers, Butyle Rubbers, Neoprene Thiokols, Polyurethane and a Silicons Rubbers. (10hrs)

References:

1. Peter Atkins and Julio de Paula. (2005). *Elements of physical chemistry*. Oxford University Press, New Delhi.
2. John E. McMurry and Robert C. Fay. (2008). *Chemistry*. (fifth edition). Pearson, New Delhi.
3. Palanna, O.G. (2009). *Engineering chemistry*. Tata McGraw Hill Education Pvt. Ltd., New Delhi.
4. Goyal, R.N. and Harmendra Goel. (2011). *Textbook of engineering chemistry*. (second edition). Ane Books Pvt. Ltd., New Delhi.
5. Gopalan, R. Venkappayya, D. and Sulochana Nagarajan. (2005). *Textbook of engineering chemistry*. (second edition). Vikas Publishing House Pvt. Ltd., New Delhi.
6. Shashi Chawla. (2003). *A text book of engineering chemistry*. Dhanpat Rai & Co, New Delhi.
7. Kochubaby Manjooran. (2012). *Modern Engineering Chemistry*. Kannantheri Publication, Kochi.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0104 ENGINEERING MECHANICS (90 hrs)

Course Outcomes:

On completion of this course a student will be able to:

1. Understand the basic principles of statics and learn general and conventional procedure to solve problems involving equilibrium of forces.
2. Ascertain the physical and mathematical meaning of quantities, like centroid, moment of inertia and their applications in engineering, assimilate the principle of virtual work as a powerful tool in analysis of structures in equilibrium and analyze structures carrying two-force and multi-force members.
3. Refresh and reinforce the basics of rectilinear translation and conceive the idea of the D'Alembert's principle as an ideal method to solve kinetic problems.
4. Refresh and reinforce the basics of curvilinear translation and rotation of rigid bodies and familiarize their applications in engineering.
5. Understand the rotational mechanics and apply them in solving engineering problems.

Module I

Introduction to Mechanics: Definition of mechanics, classification of mechanics – rigid body and deformable body mechanics, division of rigid body mechanics – statics and dynamics, Applications of mechanics in engineering practice.

Forces and Force systems: Force and its characteristics, Principles of statics – concept of resultant and equilibrant, Composition and resolution of forces, force systems.

Coplanar Concurrent force system: Equilibrium – two forces, three and more than three forces, concept of moment of a force, equations of equilibrium, Friction and its effects on bodies, Solutions of problems involving equilibrium of coplanar concurrent forces.

Coplanar Parallel force System: Two parallel forces, General case of parallel forces in a plane, Centre of parallel forces, Centre of gravity, Centre of mass, Centroids of curves, areas and volumes – regular and composite, Pappus's theorems, Equilibrium of distributed forces in a plane, Applications of the concept of centroid in engineering practice.

Module II

Moment of Inertia: Concept of moment of inertia and second moment of area, Mass moment of inertia of regular and composite solids, Second moment of area of regular and composite surfaces, Polar moment of inertia / second moment of area, Product of inertia, Principal moments of inertia and principal axes, Applications of the concepts in engineering practice.

Coplanar non-concurrent force system: Resultant of a general case of force system in a plane, Equilibrium equations, Applications in engineering practice.

Analysis of Plane trusses and frames: Concept of load carrying mechanism in trusses and frames – internal (axial) forces, two force and multi force members, Analysis of plane trusses by Method of joints and Method of sections, Analysis of Plane frames by Method of members, Applications of trusses and frames in structures.

Principle of virtual work: Concept of virtual work and the principle of virtual work, Applications in engineering, Equilibrium of ideal systems, Stable and unstable equilibrium.

Module III

Introduction to Dynamics: Definitions, Units, Divisions – Kinematics, Kinetics.

Rectilinear translation: Kinematics of rectilinear motion – displacement, velocity, acceleration, Kinetics – Differential equation of rectilinear motion, Motion of a particle due to a constant force, Motion of a particle due to a force proportional to displacement – Simple harmonic motion. The D'Alembert's principle in rectilinear translation and its applications, Momentum and impulse, Work and energy, Ideal systems, Conservation of energy, Collision of two bodies – direct central impact.

Module IV

Curvilinear translation: Kinematics of curvilinear translation – components of displacement, velocity and acceleration, normal and tangential acceleration, Kinetics – Differential equations of motion, Motion of a projectile – projection on horizontal and inclined surfaces, D'Alembert's principle in curvilinear motion and its applications, Moment of momentum, Work and energy in curvilinear motion.

Module V

Rotation of a rigid body: Kinematics of rotation – angular displacement, velocity and acceleration, rpm, Relations of kinematic parameters of linear and angular motions, Kinetics –Equation of motion of a rigid body rotating about a fixed axis, Rotation under the action of a constant moment, Rotation proportional to angular displacement – Compound pendulum, D'Alemberts principle in rotation, Resultant inertia force in rotation, Principle of angular momentum in rotation, Energy equation for rotating bodies.

References

1. Timoshenko and Young. (1956). *Engineering mechanics*. McGraw Hill Book Company, Singapore.
2. Beer, F. P. and Johnston, E. R. (2004). *Mechanics for engineers (Vol. 1: Statics and Vol.2: Dynamics*). Tata McGraw Hill, New Delhi.
3. Merriam, H. L. and Kraige, L. G. (2003). *Engineering mechanics (Vol. 1: Statics and Vol.2: Dynamics)*. John Wiley and Sons, Somerset, N.J.
4. Rajasekaran,S. and Sankarasubramanian,.G. (2010). *Fundamentals of engineering mechanics*. (third edition). Vikas Publishing House Pvt. Ltd., New Delhi.
5. Hibbeller, R.C. *Engineering mechanics. Vol. 1: Statics, Vol. 2: Dynamics*. (twelfth edition). Pearson Education Asia Pvt. Ltd., New Delhi.
6. Biju, N. (2014). *Engineering mechanics*. Educational Publishers & Distributors, Ernakulam.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

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19-208-0105 BASIC ELECTRICAL ENGINEERING (72 Hrs)

Course Outcomes

On completion of this course the student will be able to:

1. Acquire knowledge of electrical circuit analysis
2. Review the basic concepts of magnetic circuits, electromagnetism & electrostatics.
3. Understand AC generation, representation & analysis of AC circuits.
4. Grasp the methods of Electrical power generation and concept of three phase system.
5. To understand Electrical power transmission, distribution, house wiring.

Module I

Basic Principles of Electric Circuits(Review):- Resistance, Current, Voltage and Power- Series and Parallel circuits; Ohm's law, Kirchoff's laws (4hrs)

Network Theorems:- Network analysis by Maxwell's circulation currents(Mesh analysis), Thevenin's theorem, Norton's Theorem, Super - position theorem, Maximum power transfer theorem; Simple illustrative problem on network theorems. (10hrs)

Module II

Electrostatics(Review) :- Coulomb's law, Electric field strength and Electric flux density, capacitance (4hrs)

Magnetism(Review) :- Magnetic field; field strength; Intensity, Flux density; Ampere turns & its calculations; Magnetic Hysteresis (6hrs)

Electromagnetic Induction: - Faradays law, Lenz's law, self and mutual induction, Energy stored in a magnetic field. (4hrs)

Module III

AC Fundamentals: - Generation of alternating voltage and current; equations of sinusoidal voltage and current, wave form, cycle frequency, time period, amplitude, phase difference, r.m.s. and average values, power factor, peak factor, form factor, phasors, phasor algebra (8hrs)

AC Circuits:- R, L, C, Circuits, RL, RC, RLC circuits; series and parallel circuits; current, voltage & power relationships, impedance triangle; Resonance. (10hrs)

Module IV

Elementary Concepts of Generation: Conventional sources of electrical energy - Hydro, Thermal, Nuclear and Diesel power stations. (6hrs)

Poly phase circuits:- 3 phase system; vector representations, phase sequence, star and delta connections , current and voltage relations. (4hrs)

Module V

Power Transmission and Distribution: Two wire and 3 wire DC distribution. AC distribution: single and three phase transmission and distribution, comparison of DC and AC transmission. 2-wire, 3-wire & 4-wire AC distribution, Radial, Ring main and Interconnected distribution schemes. (6hrs)

Wiring Systems:-House wiring, types; ISI Rules; wiring accessories and wires, diagrams; Earthing; method of measuring earth electrode resistance. (4hrs)

Electrical Safety Precautions:- Electric shock, precaution to avoid electric shock treatment.
Fuses:- Different types of fuses – rewireable, HRC fuse, Circuit breakers, Miniature circuit breakers (4hrs)

References:

1. Robert L. Boylestad. (2012). *Introductory circuit analysis*. (twelfth edition). Pearson Education, New Delhi.
2. Cotton, H. (2005). *Electrical technology*. (seventh edition). CBS Publishers and Distributors, New Delhi.
3. Leonard S. Bobrow. (1996). *Fundamentals of electrical engineering*. Oxford University Press, New Delhi.
4. Rajendra Prasad. (2009). *Fundamentals of electrical engineering*. (second edition). PHI Learning, New Delhi.
5. Edward Hughes. (1995). *Electrical technology*. Addison Wesley Longman, Boston.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0106 ENVIRONMENTAL STUDIES AND TECHNICAL COMMUNICATION

PART – A: ENVIRONMENTAL STUDIES (36hrs)

Course Outcomes:
On completion of this course the student will be able to:

1. Identify the natural resources and suitable methods for conservation and sustainable development
2. Realise the importance of eco system and biodiversity for maintaining ecological balance
3. Identify environmental pollutants and abatement mechanisms
4. Understand environmental problems arising due to developmental activities and population growth

Module I

Natural resources - issues related to the use and over exploitation of forest resources, water resources, mineral resources, food resources, energy resources and land resources- role of an individual in conservation of natural resources - equitable use of resources for sustainable life styles.
Concept of an ecosystem - structure and function - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - structure and functions of a forest ecosystem and an aquatic eco system.
Definition of biodiversity - genetic, species and ecosystem diversity - biogeographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Threats to biodiversity, Conservation of biodiversity.

Module II

Environmental Pollution - Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, marine pollution, thermal pollution and nuclear hazards - Causes, effects and control measures of urban and industrial solid wastes -Role of an individual in prevention of pollution - An overview of the various environmental legislations in India - Issues involved in enforcement of environmental legislation. Disaster Management: Floods, earth quake, cyclone and landslides. Role of public awareness in disaster management.
The concept of sustainable development - Urban problems related to energy - Water conservation,

rain water harvesting, water shed management - Resettlement and rehabilitation of people; its problems and concerns - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies - Population growth and problems of population explosion – Environment and human health – Human rights – Value education – Role of Information Technology in environment and human health - Environmental ethics: issues and possible solutions.

References:

1. Rajagopalan. R, Environmental Studies: From Crisis to Cure, Oxford University Press, 2005
2. Erach Bharucha, Textbook of Environmental Studies and Ethics, Universities Press (India), Hyderabad, 2005.
3. Jayashree A. Parikh, V.M. Balsaraf, P.B. Dwivedi, Environmental Studies, Ane Books Pvt. Ltd., 2010.
4. Anindita Basak, Environmental Studies, Pearson, 2009.
5. Gouri Suresh, Environmental Studies and Ethics, I.K. International Publishing House Pvt. Ltd., New Delhi, 2007.
6. S.P. Misra, Essential Environmental Studies, 3rd Edition, Ane Books Pvt. Ltd., 2011.
7. Benny Joseph, Environmental Science & Engineering, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
8. Meenambal T , Uma R M and K Murali, Principles of Environmental Science and Engineering, S. Chand & Company Ltd, 2005

PART – B: TECHNICAL COMMUNICATION (54hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Understand basic grammar principles and comprehend English speech sound system, stress and intonation
2. Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.
3. Read, comprehend and answer questions based on literary, scientific and technological texts
4. Write instructions, recommendations, check lists, CV, process description, letters and reports.

Module I

English & Remedial Grammar :

Revision of knowledge of Parts of speech , Tense , Narration, Analysis, Change of voices, Appropriate prepositions etc. - 18 hrs

Module II

Theory of Communication:

Communication and its importance. Means & barriers of communication . Verbal & non verbal communication , Interpersonal communication . Communication gap and ways to reduce the communication gap . Means of communication on board ship , Means of communication between shore staff, office and ship staff . Need for good communication with friends & family . Leadership and communication . (8 hrs)

Written Communication

(a) Formal and ordinary letters, formal invitations, letters to friends and relative
(b) Official and semi-official letters. Application for application for appointment. Commercial letters. Letter to influence public opinion.
(c) Notices, agenda & minutes writing.
(d) Essay writing.
(e) Writing factual reports, accidents and maintaining a diary and a log book.
(f) Summarizing / abstracting the main ideas of an unseen passage, given a working outline.
(g) Stress marking and use of idioms and phrases. (10hrs)

Module III

Development of Skills of oral communication.

Use of English in different situation with elementary phonetic drill.

(a) Speech training : Elocution, debating and extempore speech.
(b) Group discussions and interviews.
(c) Delivery of welcome address.
(d) Sea speak. Use of Marine Vocabulary .

Selected tests to be conducted to test skill in comprehension and speech. (18 hrs)

References:

1.John Seely, Oxford Guide to Writing and Speaking, Oxford University Press.
2.C. Muralikrishna and Sunita Mishra, Communication Skills for Engineers, 2nd Edition, Pearson, 2011.
3.Meenakshi Raman and Sangeetha Sharma, Technical Communication: Principles and Practice, Oxford University Press, 2004.

4.Krishna Mohan and Meenakshi Raman, Effective English Communication,Tata Mc-GraHill,2000.
5.William Sanborn Pfeiffer, T.V.S. Padmaja, Technical Communication – A Practical Approach, Pearson, 2007.
6.R.C. Bhatia, Business Communication, 2nd Edition, Ane Books Pvt. Ltd., 2008.
7.Krishna Mohan and Meera Banerji, Developing Communication Skills, Mac Millan India Ltd, 2000.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0107 ELECTRICAL ENGINEERING WORKSHOP

Course Objectives:

The objective of this course is to introduce the student to various types of wiring.

Course Outcomes:

On completion of this course the student will be able to:

Apply basic electrical engineering knowledge for house wiring practice

Experiments:

1. One lamp controlled by one switch
2. Series and parallel connections of lamps.
3. Stair case wiring.
4. Hospital Wiring.
5. Godown wiring.
6. Fluorescent lamp.
7. Connection of plug socket.
8. Different kinds of joints.
9. Winding of transformers.
10. Soldering practice.
11. Familiarisation of CRO.
12. Single Phase Distribution Board Wiring.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for semester end examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the semester end examination for a pass.

19-208-0108 LANGUAGE LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. Have better pronunciation skills through stress on word accent, intonation, and rhythm.
2. Use English language effectively for writing business letters, resume, minutes of meeting and reports.
3. Use English language effectively to face interviews, group discussions, and public speaking.

SYLLABUS :

The following course content is prescribed for the **English Language Laboratory** sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Preparing business letters
4. Preparing a resume
5. Conducting a meeting and writing the minutes
6. Writing a report
7. Situational Dialogues / Role Play.
8. Oral Presentations- Prepared and Extempore.
9. 'Just A Minute' Sessions (JAM).
10. Describing Objects / Situations / People.
11. Debate
12. Group discussion

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for semester end examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the semester end examination for a pass.

19-208-0109 NATIONAL SERVICE SCHEME (NSS)

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the community in which they work
2. Utilise their knowledge in finding practical solution to individual and community problems

A student enrolling as member of NSS will have to complete 30 hours of training / social service to be eligible to earn the credits specified in the curriculum.

Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

NATURE CONSERVATION

Course Outcomes:

On completion of this course the student will be able to:

1. Practice and spread the message of sustainable life styles
2. Understand the importance of green plants in mitigating global environmental problems
3. Identify suitable waste management practices for the local community

A student enrolling as member of the Nature Conservation Club will have to complete 30 hours of campus cleaning and greening activities to be eligible to earn the credits specified in the curriculum.

Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the activities and the extent of active involvement.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for semester end examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the semester end examination for a pass.

19-208-0201 ENGINEERING MATHEMATICS II (90Hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Solve linear system of equations and to determine Eigen values and vectors of a matrix.
2. Solve ordinary differential equations and linear differential equations of higher orders with constant coefficient and apply them in engineering problems
3. Determine Fourier series expansion of functions and transform.
4. Solve linear differential equation and integral equation using Laplace transform.
5. Understand the basic concepts of probability and different probability distributions.

Module I

Matrix Algebra: Concept of rank of matrix, Echelon and normal form, linear systems of algebraic equations, consistency, Gauss elimination method, homogenous system of equation, Eigen values and Eigen vectors, Cayley-Hamilton (no proof), Eigen values of Hermitian and Skew-Hermitian and unitary matrices, real quadratic forms, diagonalisation of quadratic forms. LU decomposition, Direct methods of solution: Gauss elimination method, Gauss Jordan method, Iterative methods of solution: Jacobi 's iteration method, Gauss- seidel iteration method (18 hours)

Module II

Differential equations of first order: Formation of differential equations, variable separable, equations reducible to variable separable form, linear first order differential equation, Orthogonal trajectories (8 hours)

Ordinary differential equations of higher order: Linear equations with constant coefficients, methods of solution of these equations, solution of homogeneous and non-homogeneous simultaneous linear differential equations, (10 hours)

Module III

Fourier Series: Periodic functions, Euler formulae for Fourier coefficients, Functions having arbitrary period, even and odd functions, half range expansions, Fourier integral.
Gamma and Beta functions, error functions – definitions and simple properties. (18hours)

Module IV

Laplace transforms: Linearity property, transforms of elementary functions, Laplace transforms of derivatives and integrals, differentiation and integration of transforms, convolution theorem (no proof), use of Laplace transforms in the solution of initial value problems, unit step function, impulse function – transform of step functions, transforms of periodic functions. (18hours)

Module V

Probability and Statistics: Addition theorem, Multiplication theorem, Conditional Probability, Bayes' theorem, random variables, discrete and continuous Probability distribution, joint probability distribution, Independent Random Variables, Conditional distributions., Mathematical expectations,

variance and standard deviation, , Conditional Expectation, Binomial, Poisson,t and Normal distributions and their properties. (18 hours)

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers,2005.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern,2010.
3. Potter, Goldberg Mathematical Methods, Prentice Hall, 2008.
4. David Lewis, Matrix Theory, Allied Publishers,2008.
5. R.V. Churchill, Operations Mathematics, Tata McGraw Hill.
6. Kaplan W , Operational methods for linear Systems, Addison Wesley.
7. S. Narayanan, Manickavachagom Pillai & Dr. G. Ramanaish, Advanced Mathematics for Engineering.,S.Viswanathan Publishers, Chennai, 2002.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19- 208- 0202: APPLIED THERMODYNAMICS

Course Outcomes:

On completion of this course the student will be able to:

1. Understand basics of thermodynamics and find the work done and heat transferred in different thermodynamic processes.
2. Understand the different types of boilers and vapour power cycles and calculate their efficiencies.
3. Gain knowledge on the working of steam nozzles and steam turbines and calculate the work output.
4. Identify the different ideal gas cycles used in IC engines and calculate their efficiencies.
5. Calculate the properties of gas mixtures as applied to air conditioning.

Module I

Thermodynamics:- First and second law of thermodynamics, Carnot theorem, Thermodynamic temperature scale, Internal Energy and entropy, Claussius inequality, entropy charge in various thermodynamic processes of ideal gases, Application of first and second law of thermodynamics for steady flow processes, reversibility, irreversibility & Availability.

Module II

Steam Generator & Properties of Steam:- Different types of boilers, boiler mountings and accessories. Formation of steam at constant pressure, Thermodynamic properties of Steam, steam table and Mollier diagram, Analysis of vapour process, thermodynamic analysis of steam power cycles– Rankine, reheat, and regenerative , binary vapour cycles.

Modern steam generators – performance calculations of boilers.

Module III

Steam nozzles:- mass flow rate, throat pressure for maximum discharge, throat area, effect of friction, super saturated flow, critical condition, effect of back pressure.

Steam turbines:- General principles of impulse and reaction turbines, compounding of Turbines- velocity, pressure and pressure-velocity compounding, velocity diagrams of impulse and impulse turbines, effect of friction on blades, force on blades, work done by blades, axial thrust, diagram efficiency, stage efficiency, overall efficiency . Condition for maximum energy transfer in impulse Turbines, Parson's Reaction Turbine, Degree of reaction, Velocity diagrams, Condition for maximum energy transfer, Stage efficiency, overall efficiency and reheat factor, condition curve.

Module IV

Ideal Gas Cycles:- Constant Volume Cycle; Constant Pressure Cycle; Diesel Cycle; Dual Combustion Cycle; 4-Stroke & 2-Stroke Cycle; valve timing diagrams, Criteria of Performance; Compression Ratio and Thermal Efficiency; Indicator Diagrams; Indicated Power; Brake Power; Friction Power; Morse test; Mechanical Efficiency; Specific Fuel consumption; Energy Balance; Applied Problems. (12 hrs.)

Module V

Properties of Mixtures of Gases:- Ideal, perfect and real gases, Dalton's law of Partial Pressure, Amagat's law of Partial volume, Volumetric and Gravimetric analysis of Gas mixtures, Gibb's Dalton Law, Mean

value of Gas constant, Equivalent Molecular weight, Density, Specific volume, specific heat and Molar heat capacity of gas mixture, Advanced Problem on Adiabatic mixing.
Air and water vapour mixture:-, Specific Humidity, Relative Humidity, Dew point, unsaturated and saturated Air. Principle of Cooling Tower and Air Leakage Problem in surface condenser.
- 4 hrs.

References:

1. Spalding D.B. & Cole, E.H., Engineering Thermodynamics, Edward Arnold, London, (1967).
2. Holman, J. P., Thermodynamics, 4th Edition, McGraw Hill Inc., (1987).
3. Nag, P. K., Engineering Thermodynamics, 4th Edition, Tata McGraw Hill, (2008).
4. Bacon, Engineering Thermodynamics, Newnes- Butterworth, (1972).
5. Maleev, V. L., Internal Combustion Engines, 2nd Edition, McGraw Hill, (1945).

Type of Questions for Semester End Exam.

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19-208-0203 ENGINEERING GRAPHICS (82 hrs)

Course Outcomes

On completion of this course, the students will be able to

1. Prepare drawings as per Indian standards
2. Produce orthographic projection of straight lines and planes.
3. Draw orthographic projection of solids.
4. Understand development of surface of different geometric shapes
5. Construct isometric scale, isometric projections and views.

Module I

Introduction to Technical Drawing: Drawing instruments and their use, Lettering, dimensioning, types of lines, Indian Standard Code of Practice for general engineering drawing. -6hrs

Scales: Plain Scale, Vernier Scale, Diagonal Scale. -4hrs

Curves used in Engineering practice: Conic Sections – Construction of ellipse, parabola, hyperbola – construction of cycloid, involute, Archimedian spiral and logarithmic spiral – drawing tangents and normals to these curves. -8hrs

Module II

Orthographic Projections: Plane of projection of first angle and third angle projections, projection of points in different quadrants. -4hrs

Orthographic projection of straight lines: Lines parallel to one plane and inclined to the other plane, straight lines inclined to both the planes, true length and inclination of lines with reference planes, traces of lines. -8hrs

Projection of plane lamina: Projection of plane lamina of geometrical shapes in oblique positions.-4hrs

Module III

Projection of solids : Projection of solids with axis perpendicular to one plane, axis parallel to both plane, axis inclined to horizontal or vertical planes and parallel to the other plane, axis inclined to both planes. -10hrs

Section of Solids: Projection of solids sectioned with planes perpendicular to H.P. or VP, inclined to axis of the solids. Drawing true shape of the section. -6hrs

Module IV

Development of surface: Developing the surface of prisms, cylinders, pyramids and cones. -8hrs

Intersection of surfaces: Drawing the curves of intersection prism to prism, intersection of cylinder to cylinder and intersection of cylinder to cone. -8hrs

Module V

Isometric projection: Isometric scales, isometric views, isometric projections of prisms, pyramids, cylinders, cones and spheres. Sectional views of simple machine components in isometric. -10hrs

Perspective projections: Visual ray method and vanishing point method of perspective projection of circles, prisms and pyramids. -6hrs

References:

1. John, K.C. (2013). *Engineering graphics*. PHI Learning, New Delhi.
2. Bhat, N.D. (2010). *Elementary engineering drawing*. (forty ninth edition). Charotar Publishing House, Anand.
3. Gill P.S. (2012). *Geometric drawing*. B.D Kataria &Sons, Ludhiana.
4. Varghese P.I. *Engineering graphics*. VIP Publishers, Thrissur.

Type of questions for Semester End Examination

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0204 BASIC ELECTRONICS AND MEASUREMENTS (72 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Characterise semiconductors, diodes and transistors
2. Explain the construction, characteristics and working of various semi-conductors devices
3. Understand the working of oscillators and other wave shaping and switching circuits.
4. Use different meters and balance bridge to find unknown values
5. Use digital voltmeters, CRO, multimeters

Module I

Electron Emission: Thermionic emission, Photoelectric emission, Electric field emission and their applications. (3hrs)

Semiconductors: Intrinsic & Extrinsic semiconductors, drift & diffusion current, mobility& conductivity, Varistors, Thermistors. (3 hrs)

Semiconductor Diodes: PN junction diode, V-I characteristics of PN diodes, diode as a rectifier, Zener diode. (4 hrs)

Transistors: Junction transistor, Working of a transistor, Transistor configurations & characteristics, Biasing-fixed biasing and Voltage divider biasing, Effect of positive and negative feedback. (6 hrs)

Module II

Transistor Circuits: RC coupled amplifier, frequency response curve, transistor as a switch. (4 hrs)

JFET, MOSFET, SCR, UJT, TRIAC, DIAC (Basic characteristics & working) (7 hrs)

Regulated power supplies: Simple zener controlled voltage regulator, Transistor series voltage regulator, Transistor shunt voltage regulator. (3 hrs)

Module III

Oscillators: Requirements for oscillations, Tank circuit, LC oscillators- Hartley and Colpitts Oscillator, RC phase shift oscillators, Wein Bridge oscillators, Crystal Oscillators. (8 hrs)

Wave Shaping & Switching: Clipping, Clamping, Integrator, Differentiator, Multivibrators (6 hrs)

Module IV

Basic requirements of measuring instrument, control and damping devices, moving coil, moving Iron, dynamometer and thermocouple type of ammeters, voltmeters and watt meters, extension of Instrument range, measurement of energy.

Single phase and three phase wattmeter for power measurement, measurement of frequency and phase difference, measurement of resistance, inductance and capacitance by bridge method, Localization of cable faults, Meggar, Potentiometers. (16 hrs)

Module V

Magnetic measurements, Transducers and its application in the measurement of pressure , velocity, flow and temperature, Illumination and its measurements. Electronic measuring devices: - CRO, Signal generator, Multimeters, Digital voltmeter, Q meter, frequency meter. (12 hrs)

References:

1. Thomas L. Floyd. (2008). *Electronic devices*. (seventh edition). Pearson Education Inc. Boston.
2. Neil Storey. (2011). *Electronics: A systems approach*. Pearson Education Inc., Boston.
3. Wayne Tomasi. (2009). Electronic *communication systems: Fundamentals through advanced.* (fifth edition). Pearson Education Inc., Boston.
4. Tocci, R. J. and Widmer, N. S. (2001). *Digital systems – principles and applications*. (eighth edition). Pearson Education India, New Delhi.
5. Doblin, Measurements, Tata Mc Graw Hill, 2007.
6. A.K.Sawhney, A course in Electrical and Electronics Measurements and instrumentation,
7. Dhanpat Rai & Sons,2001.
8. . M.M.S.Anand, Electronic Instruments and Instrumentation Technology, Prentice Hall of India Pvt.Ltd.,2004.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0205 COMPUTER PROGRAMMING (72 hrs)

Course Outcomes

On completion of this course the student will be able to:

1. Write algorithms for problems
2. Acquire knowledge of the syntax and semantics of C programming language for solving problems
3. Code a given logic in C language using arrays
4. Handle data using SQL and understand basics of OOP
5. Write programs involving structures and do file management.

Module I

Basics of Computer & Information Technology: Important components of a computer system – secondary storage devices- Central Processing Unit, Memory, Input-Output devices. Secondary storage devices, machine language, assembly language, and high level language, system software, operating systems, Compilers and assemblers, General introduction to various computer network systems such as, LAN, WAN, etc. (12hrs)

Module II

Introduction to programming in C : Fundamental data types – integer, floating point and enumerated data types, Expression – arithmetic, relational and logic operations, type convention – simple and compound statement, IF, SWITCH, WHILE, DO WHILE, FOR, BREAK, CONTINUE, GOTO, RETURN statements. (16hrs)

Module III

Dynamic Data Structures : Declaration and functions, parameter passing mechanism, storage classes – scope, visibility and life time of variables, AUTO, EXTERN, STATIC and REGISTER modifiers, Recursion. -13hrs

Arrays : Single and multi dimensional arrays, storing, selection sort, search-linear search and binary search, Structures to union, pointer and addresses, pointer arrays, function returning pointers, pointers to function, pointer arithmetic, pointer to structures, arrays of structures, preprocessor directive, command line arguments, type def. (14hrs)

Module IV

Introduction to DBMS : Relational, network and hierarchical models (description only).
Introduction to relational algebra and SQL. -

Object Oriented Programming (OOP): OOP concepts and fundamentals, encapsulation, definition of an object, inheritance and multiple inheritance, attributes and methods, polymorphism, Interfaces, class diagrams, virtual functions. (16hrs)

Module V

User defined data types: Structure – Union - Enumerated data type – programs involving structure and union.

Files: File concept – File pointer – File handling operations (open, close, read, write etc.) on sequential and random access files. Programs on file manipulations using fgetc(), fgets(), fseek(). (14hrs)

References:

1. Dey, Pradip and Ghosh, Manas. (2013). *Computer fundamentals and programming in C*. (second edition). Oxford University Press, New Delhi
2. Ghosh, Smarajit. (2009). *All of C*. PHI Learning Pvt. Ltd, New Delhi..
3. Gottfried, Byron. (2006). *Programming with C*. (second edition). Tata McGraw-Hill, New Delhi.
4. Brian W. Kernighan and Dennis M. Ritchie. (2001). *The C programming language*. (second Edition). Pearson Education, New Delhi.
5. Dromey, R.G. (2008). *How to solve it by Computer*. Pearson Education, New Delhi.
6. Dey, Sukhendu and Dutta, Debobrata. (2009). *Complete knowledge in C*. Narosa Publishing House, New Delhi.
7. Kanetkar Y. (2007). *Let Us C*. (eighth edition). BPB Publications, 2007
8. Paul, Varghese. (2007). *Computer fundamentals*. (second edition). Educational Publishers & Distributers, Ernakulam.
9. Programming in C: Rajaraman V (Schaum seris, TMH)

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0206 MECHANICS OF SOLIDS (90 hrs)

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand and apply the concept of stress and strain to analyze statically eterminate and indeterminate problems and design structural members and machine parts
2. Determine principal stresses strains and apply the concept of theories of failure for design.
3. Determine the stresses and strains in the members subjected to axial, bending and torsional loads
4. Evaluate the slope and deflection of beams subjected to loads
5. Analyze and design thin, thick cylinders and springs

Module I

Stress and Strain : Concept of stress and strain, and their relationship in deformable solids. Hook's law, Poisson's ratio, relationship between three elastic constants, Stress in axially loaded members, statically indeterminate problems, axial stresses in composite materials, thermal stress, elastic strain energy for uni-axial stress and strains, strain energy due to impact loads. -12hrs

Compound Stress and Strain: Stresses on an oblique section, general two dimensional stress system, Principal planes and Principal stresses, Mohr's diagram for stress. -4hrs

Theories of failures: Various theories of failure and their applications to ductile materials. -2hrs

Module II

Bending Stresses: Pure bending, stresses due to bending, position of Neutral axis, radius of curvature, combined bending and direct stress, short column with eccentric loading, composite beams, shear stresses in beams. - 10hrs

Axial force, Shear force & Bending Moment Sign convention, Relation between intensity of loading, shearing force and bending moment, graphical construction of shear force and bending moment diagrams. -10hrs

Module III

Deflection of Beams: Deflection by integration, Macaulay's method and moment area method of deflection coefficients. -8hrs

Built-in and Continuous Beams: Moment-area method, fixed beam withconcentrated loads, fixed beam with uniformly distributed load, continuous beam. -10hrs

Module IV

Torsion : Torsion of circular shafts, stiffness and strength, shafts with linear and compound shafts, Partial hollow shafts, statically indeterminate problems. -12hrs

Theory of Columns : Euler's theory and Euler's buckling load, Struts with both ends pin joined, both ends fixed, one end fixed and one end free, one end fixed and one hinged, pin joined strut with eccentric load, Rankine-Gordon formula, Applied problems formulae, effect of end conditions - 4hrs

Module V

Thin Shells : Stresses and strains in thin walled shells subjected to internal pressure, stresses and strain in submersibles. Strengthening of thin walled shells by wire or tape winding, effect of temperature; volumetric strain on capacity. -6hrs

Thick Cylinders : Stresses and Thick cylinders, Lame's theory, compound cylinders. Solid shaft subjected to radial pressure, shrinkage allowance, Applied problems. -6hrs

Springs: Torsion applied to closed coil springs, springs with axial loads, Calculation of mean diameter of the spring, wire diameter and number of coils. Strain energy in torsion. -6hrs

References:

1. Gere and Timoshenko, Mechanics of Materials, 2nd Edition, CBS Publisher, (2004).
2. Popov, E.P, Introduction to mechanics of solids, Pearson Education, (1998).
3. Beer & Johnston, Mechanics of Solids, 3rd Edition, Mc Graw Hill, (2002).
4. Shames & Pittaresi, Introduction to Solid Mechanics, 3rd Edition, PHI, (2009).
5. Mott, Applied strength of materials, 5th Edition, PHI, (2009).
6. Carl, T.F., Ross, Strength of Materials & Structures, 4 th Edition, Elsevier, (1999).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0207 MECHANICAL ENGINEERING WORKSHOP (54 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Identify and use tools, and make different types of joints used in carpentry, fitting, and sheet metal shop.
2. Have hands on experience on basic fabrication techniques of different types of welding.

Preliminary exercises for beginners in all the following shops. Specific models may be designed by the teachers.

Experiments:

1. Fitting Shop
2. Sheet metal Shop
3. Smithy Shop
4. Welding Shop
5. Carpentry Shop

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for semester end examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the semester end examination for a pass.

19-208-0208 COMPUTER PROGRAMMING LABORATORY (54 hrs)

Course Outcomes:

On completion of this course the student will be able to:

- Write and execute C programs for small applications.

Application packages

Word	1. To create an advertisement in Word. 2. To illustrate the concept of mail merging in word.
Spread Sheet	3. To create a spread sheet to analyse the marks of the students of a class and also to create appropriate charts.
Power Point	4. To create the presentation for the department using Power Point.

C Programming Basics

Operators & Expressions	5. To write a simple menu driven calculator program 6. To write Programs illustrating switch and break statements.
IO Formatting	7. To write a program to print Pascal's triangle.
Decision Making	8. To write a program for electricity bill preparation.
Looping	9. To write a program to print the sine and cosine series 10. Calculating averages for different sets of numbers using nested loops
Arrays	11. To write a program to perform Matrix multiplication. 12. To write a program to prepare and print the sales report. 13. Largest and smallest of a set of numbers using function. 14. Programs illustrating relationship between array elements & their addresses. 15. Arranging an array of numbers in an order using different sorting algorithms.
String	16. To write a program to perform string manipulation manipulations function like string concatenations, comparison, find the length and string copy without using library functions.
	17. To write a program to arrange names in alphabetical order.
Functions	18. To write a C program to calculate the mean, variance and standard deviation using functions 19. To write a C program to perform sequential and binary search using functions. 20. Calculating factorial of a +ve number using function
Recursion	21. To write a program to print the Fibonacci series and to calculate the factorial of the given number using functions. 22. Calculating factorial of a +ve number using recursion.
Structures	23. To print the mark sheet of n students using structures.
Pointers	24. To write a program using pointers to access the elements of an

array and count the number of occurrences of the given number in the array.

25. To design a simple class object.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the semester end examination for a pass.

19-208-0301 ENGINEERING MATHEMATICS – III (72 hrs)

Course Outcomes:

On completion of this course the student will be able to :

1. Transform a region to another region using conformal mapping and calculate residues.
2. Understand different sampling distributions for statistical analysis of data and fit a best curve to the data.
3. Solve algebraic and transcendental equations and differential equations by numerical methods.
4. Solve difference equations and apply it to engineering problems.
5. Perform numerical differentiation and integration

Module I
Complex Analysis

Complex variables, limit, derivative, analytic functions, Cauchy-Riemann equations(no proof),Cauchy's integral theorem, Cauchy's integral formula, derivative of an analytic function, Taylor's series and Laurent series, zeroes, poles, singularities, residue theorem. (12 hours)

Module II
Sampling Theory: Population and sample, sampling with and without replacement, Random samples, Population parameters, sample statistics, sample mean, sampling distributions of means, sample variance mean variance and moments for grouped data. (8 hours)

Regression and Correlation

Curve Fitting, the method of least squares, least square lines in terms of sample variance and covariance, regression lines, regression coefficient, the least square parabola, multiple regression, standard error of estimate, linear correlation coefficient , probabilistic interpretations of regression and correlation.
(8 hours)

Module III

Numerical Analysis
Introduction to errors in numerical calculations, absolute error, relative error, percentage error, solution to algebraic and transcendental equations: bisection method, the method of false position, Newton Raphson method. (8 hours)
Numerical solution of first order differential equations
Taylors method, Picards methods, Euler's method, Modified Euler's method, Runge's method, Runge kutta method, Milne's method (8 hours)

Module IV
Calculus of Finite Differences: Differences of a function, fundamental operators of the calculus of finite differences, Algebra of finite difference operators, fundamental equations satisfied by finite difference operators, difference tables, difference equation with constant coefficients. Application to oscillation of a chain particle connected by strings and an electrical line with discontinuous leaks. (14 hours)

Module V
Interpolation Formulae: Newton-Gregory forward and backward interpolation formulae, Legrange interpolation formula, Newton's Divided difference interpolation formula, Sterling interpolation formula. Derivative of tabulated function, Integral of a tabulated function, Summation formula. (14 hours)

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References:

1. Ervin Kreyszig: Advanced Engineering Mathematics, Wiley Eastern

2. Potter, Goldber:: Mathematical Methods, Prentice Hall India 2011
3. Churchill R.V. : Fourier series and Boundary Value problems, Tata McGraw Hill.,2011
4. Irvin Miller & John E. Friend: Probability and Statistics Engineers, Prentice Hall India 2005

5. Bowker and Lieberman : Engineering Statistics and Probability for Engineering Science and Technology, Prentice Hall.
6. Krik-Patrick : Introductory Statistics and Probability for Engineering Science and Technology, Prentice Hall.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0302 ELECTRICAL TECHNOLOGY (90 hrs)

Course Outcomes:
On completion of this course the student will be able to:

1. Understand the construction and working of transformers, transformer losses, current transformer, and potential transformers.
2. Study the different types, constructional details, operational principles, and performance characteristics of DC motors and DC generators.
3. Understand the constructional details, operational principles, and performance characteristics of induction motors and alternators.
4. Learn about the constructional details, operational principles, and performance characteristics of and alternators.
5. Understand the constructional details, operational principles, and performance characteristics ofsynchronus machines.

Module I

Transformers : Working principle, constructional feature of single phase transformer, e.m.f. equation, phasor diagram under no load and load conditions, leakage reactance, equivalent circuits, voltage regulation, losses and efficiency, open circuits and short rests, parallel operation, three phase transformers – core and shell type, current and potential transformers, auto transformer – single phase and three phase.

(18hrs)

Module II

D.C. Machines : Principle of Direct current machines, Their construction, winding, e.m.f. equations, Armature reaction, commutation, brush shift, compensating winding. (6hrs)

D.C. Generator: Characteristics, methods of excitation, parallel operations, performance equations. (8hrs)

D.C. Motor: Characteristics, starting and reversing, speed-torque equations, starters, speed control including electronic method, testing of D.C. machines for finding losses and efficiency, Reversing & braking of D.C. motor. (10hrs)

Module III

Induction Motor : Three phase induction motor: Principals of operation and theory of action, slip speed, rotor to stator relationship, rotor frequency, rotor e.m.f. and current, equivalent circuit relationship between rotor I^2R loss and the rotor slip, torque-slip characteristics, starting torque and maximum running torque, reversing, speed control of induction motor, starting of induction motor, method of starting- D.O.L., Star/Delta, Autotransformer, testing – No load & blocked rotor tests; circle diagram (15hrs)

Single phase induction motors : Principle and operational characteristics, starting control, constructional details. (5hrs)

Module IV

A.C. Machines : Alternator: General arrangement of alternator, construction of salient pole and cylindrical-rotor type, types of stator windings, e.m.f. equation of an alternator, distribution and pitch factor, wave form of generated e.m.f., load characteristics and regulation, parallel operation of alternators, KW & KVA sharing. (14hrs)

Module V

Synchronous alternator & motor : Production of rotating magnetic field, conditions of its production and reversal of its direction. Principal of operation of 3-phase synchronous motor, Armature reaction, open circuit & short circuit tests, torque/angle characteristics and hunting, Methods of starting, merits and limitations of synchronous motor over others. (14hrs)

References

1. Hughes, K, Electrical Technology, English Language Book Society, (1996).
2. Cotton, H., Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi, (1984).
3. Nagrath, I. J, Kothari D.P, Electrical Machines, Tata McGraw Hill Publishing Co. Limited, (1997).
4. Bimbra, F. S., Electrical Machines, 7th Edition, Khanna publishers, (2007).
5. Gupta B.R and Vandana Singhal, Fundamentals of Electric machines, D. K Publishers, (2000).
6. Vincent Del Toro, Electrical Machines & Power systems, Prentice Hall, (1998).
7. Chapman, S. J, Electric Machines & Power systems, McGraw H ill, (1999).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0303 PRODUCTION TECHNOLOGY (72 hrs)

Course Outcomes: On completion of this course the student will be able to:

1. Understand the different Metal fabrication processes and their characteristics.
2. Understand the principle of working, specification, different types, and different operations performed in lathe and drilling machine.
3. Learn the principle of working, specification, different types, and different operations performed in shaping machines, milling and grinding machines.
4. Gain knowledge about the different measuring instruments and overhauling on board equipments.
5. Get the concept of the different welding methods.

Module I

Common workshop tools: description and uses of different types of calipers. Straight edges, try squared, vices, hammers, chisels, scrapers, files, drills, reamers, tapes, v-blocks, face plates, marking blocks, carpentry tools, pattern markers tools, Smithy tools and Moulding tools. (6hrs)

Machine process: The geometry of cutting process, mechanics of cutting, chip formation, cutting forces, stresses and power friction of chip on tool. Generation and dissipation of heat in cutting. Standard nomenclature for cutting tools. Cutting speeds and feeds, estimation of machining time. The fundamental of cutting process, application in hand tools as chisel, file and saw geometrical control of cutting edge. (8hrs)

Module II

Machine tools: Kinematic analysis, specification, operation and inspection of important types of metal cutting machine tool including center lathes, capstan and turret lathes, automatic lathes, Turning, screw cutting and taper turning process on center lathe, drilling and boring machines (12 hrs)

Module III

Machine tools: Shaping slotting and planning machines, milling and broaching machines. Abrasive process, Grinding, honing and lapping by and machines. Shears and punches, wood working machines, Principles of jigs and fixtures standardization.

(12 hrs)

Module IV

Measuring instruments and inspection. Description and use of steel rule venires scale, micrometer, dial guage, depth gauge, feeler gauge, wire guage, pattern markers scale, taper guage, snap guage, optical methods of measurement, principles of interchangeability, limit system, use of limit gauss. (6 hrs)

Fitting and overhauling: Types of packing and jointing materials and their uses, design considerations and construction of various types of valves and cocks, reducing valves for steam and air. Bedding of bearings, marking of engine parts for fitting, machining operations fittings of keys, cotters, etc. (6hrs)

Safety measures: sources of danger and methods of protection. Types of guards and safety devices, factory act regulations. (4hrs)

Module V

Welding: Welding equipment and applications, electric welding A.C. and D.C. spot welding, gas welding. Soldering and brazing, Different welding electrodes, solders and brazing fluxes. (18hrs)

References:

1. Campbell J. S., Principles of Manufacturing m aterials and Processes, McGraw Hill, (1961).
2. Rowe G. W., Elements of metal working theory , Edward Arnold, London, (1979).
3. Little R. L., Welding and welding technology, Tata McGraw Hill , (1996).
4. Patte H. E., Technological Advances in welding and other joining processes, Battelle Press, (1982).
5. Kaushik, Manufacturing Processes, PHI, (2010).
6. Rao, P.N., Manufacturing Tec hnology, 3rd Edition, Tata McGraw Hill, (2008).
7. Boothroyd –Fundamentals of Metal Matching and Machine Tools –McGraw Hill
8. Black -Theory of Metal Cutting [McGraw Hill

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0304 MARINE ELECTRONICS (72 hrs)

Course Outcomes:

On completion of this course the student will be able to :

1. Understand the circuit and working of Power amplifiers, Operational Amplifiers and linear Op-amp circuits.
2. List and explain the different number system and their conversions, binary codes and Boolean algebra. To acquire knowledge on logic gates and its application in digital circuits like multiplexers, flip-flops, counters and registers.
3. Learn analog to digital converters and digital to analog converters and basic programming of 8085 microprocessor
4. Understand the basic structure and working of semiconductor memories and Industrial electronics devices.
5. Gain basic knowledge on communication system and its application in different communication system.

Module I

Transistor power amplifiers: Class A, B, AB & C amplifier, efficiency and distortion, Complementary Symmetry and Push Pull amplifier, Phase inverter, Transistor dissipation and Heat sink. (10 hrs)

Operational Amplifier theory: Concept of differential amplifiers, Ideal Op-Amp characteristics, Common Mode Rejection Ratio, Slew Rate (4 hrs)

Linear Op- Amp Circuits: Voltage follower, Inverting amplifier, Non- inverting amplifier, Summer, Differentiator, Integrator, Differential amplifier, Instrumentation amplifier. (4 hrs)

Module II

Number systems: Binary, Decimal, Octal and Hexadecimal number systems and their conversions, Complements, Binary arithmetic- addition and subtraction. (4 hrs)

Binary Codes: Weighted and Non-weighted binary codes- BCD Code, 8421 code, Gray code, Excess 3 code, ASCII code, and EBCDIC code. Logic gates- AND, OR, NOT, NAND, NOR, XOR, X-NOR. Universal gates, design of other gates using universal gates. (4 hrs)

Boolean Algebra: Boolean postulates and laws, De-Morgan's Theorem, Duality, Minimization of Boolean expression using Boolean postulates and laws. (4 hrs)

Digital Circuits: Introduction to Multiplexers, flip flops (S-R flip flop, J-K flip flop, T- flip- flop & D- flip flop), Counters (2 bit, 3bit, 4bit, and decade counter) and Registers (SISO, SIPO, PISO, PIPO). [Design not included] (6 hrs)

Module III

Converters (A-D and D-A): Analog to Digital and Digital to Analog converters. (6 hrs)

Microprocessors: 8085 Architecture, Pin out, Instruction set, Basic programming using Assembly language. (6 hrs)

Module IV

Digital Integrated Circuits: TTL & CMOS Gates, Semiconductor memories- ROM, RAM and PROM (8 hrs)

Industrial Electronics: Power rectification, Silicon Controlled Rectifier power control, Photo-electric devices, Inverters. (8 hrs)

Module V

Communication: Modulation, Demodulation, AM/FM/PM wireless, Radio Transmitters and Receivers, T-V Radar, Pulse communication, Satellite communication as applicable to GMDSS. (8 hrs)

References:

1. Milman & Halkias, Electronic Devices and Circuits, McGraw Hill, (2015).
2. Millman & Halkias, Integrated Electronics, Tata McGraw Hill, (2010).
3. N.N. Bhargava, Basic Electronics, McGraw Hill, (2013). :
4. NED Mohan, Power Electronics, Wiley India, (2007). :
5. Rolf IseRmann, Mechatronic Systems Fundamentals, Springar Verlag, (2005).
6. W. Bolton, Mechatronics, Pearson Education, (2003).
7. Singh & Joshi, Mechatronics, PHI, (2006).

Type of Questions for Semester End Exam.

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19- 208- 0304: FLUID MECHANICS (90 Hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the basics of fluid properties, manometry, forces on submerged bodies, bouncy and Metacenter.
2. Understand the basics of fluid dynamics, and continuity equations, Bernoulli's equation and its applications.
3. Solve the problems in one dimensional flow through pipe
4. Understand the basics of laminar viscous flow.
5. Gain the concepts of vortex flow and flow over submerged bodies and calculate drag and lift force.

Module I

Fluids and their Properties : Fluids, shear stress in a moving fluid, viscosity, Newtonian and Non-Newtonian fluids, properties of fluids- viscosity, surface tension, capillarity. (2hr)

Hydrostatics : Pressure, variation of pressure in a static fluid, absolute and gauge pressure, measurement of gauge pressure, hydrostatic forces on plane and curved surfaces, center of pressure, Total force and center of pressure on immersed surfaces such as tanks, bulkheads, lock gates, manhole doors etc. buoyancy and stability of submerged and floating bodies, metacentric height. (16hrs)

Dimensional Analysis & Dynamic Similarity: Use of dimensions for finding conversion factors, Dimensions of common quantities, Dimensions equations, Rayleigh's method, Buckingham π-theorem, Geometrical and dynamical similarity, general principles, similarity problems. (4hrs)

Module II

Fluid in Motion: Ideal fluids, Equations of continuity in the differential form, rotational and irrotational flow, Stream function, Velocity potential, one dimensional flow along a steam line, Euler's equation, Burnaulli's equation and its limitations, discharge through orifice, experimental determination of orifice coefficient, venturimeter, orifice meter, flow nozzles, notches and weirs, time required to empty reservoirs of various shapes, flow from one reservoir to the other reservoirs. (18hrs)

Module III

Flow through Pipes: Losses of energy in pipe lines , Losses due to sudden expansion and contraction, friction losses, Transmission of power by pipe line, condition for max. power transmission, derivation of Darcy and Chezy's formula, Pipes in series, equivalent pipe, parallel flow through pipes. (18hrs)

Module IV

Fluid Friction, Viscous and Laminar Flow: Resistance coefficient, variation of resistance coefficient with Reynlod's No, Critical velocity, Navier – Stokes equations, viscous flow through pipes, Power required for viscous flow, flow between parallel planes, power absorbed in bearings, Dashpot, measurement of viscosity. (18hrs)

Module V

Vortex Motion & Radial Flow: steady and unsteady flow, Two dimensional flow theory, forced vortex, free vortex, Radial flow free spiral vortex, compound vortex.Illustrative problems related with centrifugal pumps and separators. (8hrs)

Flow around submerged bodies:- Expressions for Lift Drag, Drag on a sphere, Ligt and Drag on Airfoil, Flow around a corner, Flow over cylinder- stationary cylinder, cylinder with circulation, Kutta- Jokowski equation, Magnus effect. (10hrs)

References:

1. Shames, I.H., Mechanics of fluids, Mc Graw Hill Book Co., (1962).
2. Frank M. White, Fluid Mechanics, 7th Edition, Tata Mc Graw Hill, New Delhi, (2008).
3. Victor L. Streater, E. Benjamin Wylie, Keith W. Bedford, Fluid Mechanics, 7th Edition, Mc Graw Hill Book Co., (1998).
4. Som S. K., and Biswas G., Fluid Mechanics and Fluid Machines, 2nd Edition., Tata McGraw Hill, (2004).
5. Cohen and Kundu, Fluid Mechanics, 6th Edition, Elsevier, (2015).
6. Babu, V., Fundamentals of Incompressible flow, 1st Edition, CRC Press, (2010).
7. Massey, Fluid Mechanics, English Language Book Society, (2006).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0306 MRE 306 MACHINE DRAWING (80 hrs)

Course Outcomes:

On completion of this course the student will be able to :

1. Convert a pictorial view in to orthographic view
2. Draw the different views of threaded nuts and bolts
3. Draw the orthographic views of cotter joints, pipe joints, couplings and bearings
4. Draw the assembly drawing of machine parts

Module I

Introduction to Machine Drawing: Conversion of pictorial views to orthographic views . Screwed fastenings: Screw thread forms, V and Square threads, Conventional representation of threads, Hexagonal headed bolt and nut, Square headed bolt, Nut locking arrangements, Foundation bolts- ray bolt and Lewis foundation bolt.

Cotter and Pin joints: Socket and Spigot joints , Gib and Cotter joint for rectangular rods, Sleeve and Cotter joints, Knuckle joint.

Module II

Pipe joints : Coupler joints, Nipple joints, Union, Socket and Spigot joints, Integral flanged joint s and Hydraulic joints.

Couplings: Parallel and Tapered sunk keys, Saddle keys, Feather keys and Pin keys, Muff coupling, Protected type flange coupling, Pin type flexible coupling.

Bearings : Solid journal bearings, Bushed bearings, Plummer block, Foot step bearing, Thrust bearings.

Module III

Assembly of machine parts: Machine Vice, Tail - Stock of Lathe Steam Engine parts: Stuffing box, Cross head.

I.C. engine: Piston and Connecting rod.

Valves: Steam stop valve, Spring loaded safety valve, Lever safety valve, Ramsbottom safety valve.

References:

1. Bhatt, N.D., Elementary engineering drawing, 30 th Edition, Charotar publishing house, (1990).
2. Parkinson, First year engineering drawing, Pitman, London, (1958).
3. Gill, P.S., Machine drawing, 18 th Edition, Kataria & Sons, (2013).
4. John, K.C., Text Book of Machine Drawi ng, 1st Edition, PHI, (2009).
5. Basudeb Bhattacharyya, Machine drawing, Oxford University Press, (2011).

Note: Duration of the Semester End Exam is 4 hours

Type of Questions for Semester End Exam.

Question Nos. I, II with sub sections (a), (b) if required -- -- (20 marks each with options to answer either I or II) from Module I.

Question Nos. III, IV with sub sections (a), (b) if required -- -- (25 marks each with options to answer either I II or IV) from Module II.

Question Nos. V, VI with sub sections (a), (b) if required ---- (30 marks each with options to answer either V or VI) from Module III.

The maximum marks that can be awarded for the Semester End Examination will be only 60 even though the questions are for 75 marks.

19-208-0307: STRENGTH OF MATERIAL LABORATORY (34 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Design the required experiments.
2. Conduct different experiments on the specimens to find out the material properties using the theoretical knowledge
3. Tabulate the data and use necessary theoretical knowledge to find out the results.
4. Interpret the results.

Experiments

1. Shear test on M.S.Rod.
2. Vicker's pyramid hardness test.
3. Brinnel Hardness test.
4. Tension test on M.S.Rod.
5. Impact test.
6. Spring test.
7. Bonding test on wooden Beam.
8. Rockwell hardness test.
9. Torsion test.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the semester end examination for a pass.

19-208-0308 WORKSHOP PRACTICES (36 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Design the required experiments.
2. Prepare the required specimen to perform the experiments.
3. Perform different machining operations using the theoretical knowledge.
4. Measure the dimensions.

Introduction to Machine Tools : Types of Machine tools, Spindle drive – work holding devices tool holders – tool movement – selection of speeds. Feed and depth of cut – use of cutting coolants – principle of thread cutting – V- thread and Square thread – thread standards – cutting tool types – grinding of tools – selection of cutting speeds.

Practical : Exercises on Lathe: cylindrical turning, Taper Turning, Facing, Shoulder turning and curve turning – thread cutting, internal thread

Exercises on Milling Machine: Face milling, End Milling, Gear cutting

Exercises on Drilling and Boring Machines

Thread cutting by Taps and Die.

Exercise on Thread cutting by Taps and Die.

Exercises on Shaping and Slotting Machines

Exercises on Grinding Machines

References:

1. HMT, Production technology, Tata Mc Graw Hill, (2001).
2. Wilson F. W., ASTME, Tool Engineer's hand book, Mc Graw Hill, (1959).
3. Boguslavsky, B. L., Automatic and semi- automatic lathes, Peace publications, (1963).
4. ASTME, Fundamentals of tool design, Prentice Hall, (1987).
5. Axelrod Burghard, Machine tool operation, M c Graw Hill, (1959).

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0401 MECHANICS OF MACHINERY (72 hrs)

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the different kinematic chain and their inversions and analyse their kinematics.
2. Analyze the different path generation mechanism and design cams and followers for specified motion profiles.
3. Understand different types of governors and their characteristics.
4. Evaluate gear tooth geometry and select appropriate gears for the required applications.
5. Design belts & ropes, clutches, brakes and dynamometers for industrial applications.

Module I

Introduction :- Machines and mechanisms, lower and higher pairs, kinematic chains, kinematic inversions of four bar, slider crank and double slider crank chains, equivalent linkages. (5hrs)

Kinematic analysis of plane mechanisms:- General case of plane motion, Arnold Kennedy's theorem, velocity analysis using instantaneous center method, velocity and acceleration diagrams, Coriolis component of acceleration. (7hrs)

Module II

Path generator: Pantograph, exact straight line mechanism- Peaucellier mechanism & Thompson indicator mechanism., Watt mechanism, Geneva mechanism, Steering mechanism, Hooke's joint. (5hrs)

Cams: Classification of cams and followers; geometry of radial cam; displacement diagram; uniform, simple harmonic, parabolic and cycloidal motions; graphical layout of cam profiles; basic follower motions; displacement, velocity and acceleration; comparison of follower motions; pressure angle, comparison of follower curvature; analysis of tangent cam, convex and concave sided cams with roller follower and with flat footed follower. (10hrs)

Module III

Governors: Function of a Governor, comparison between a Governor and a fly wheel, Various types of Governors, centrifugal and inertia types of Governors, Sensitiveness, Stability, Hunting of Governors, isochronism, Governor effort and power, consideration of friction in Governors. (10hrs)

Module IV

Spur gears: Gear terminology; conjugate motion; involute arc of action; contact ratio; generation of gear tooth profiles; undercutting and interference; cycloidal properties; comparison of characteristics of involute and cycloidal profiles; interchangeable gears; standard and non-standard gear tooth properties; description of different types of gears such as helical, bevel, and worm gears. (10hrs)

Gear trains: Introduction; example of gear trains; simple, compound and reverted gear trains calculation of gear ratios, epicyclic gear train, solution of epicyclic gear train problems. (5hrs)

Module V

Belt and Rope Drives: Length of belt, Ratio of belt tensions, power transmitted, centrifugal tension, and initial tension, flat belts, v-belts and ropes. (8hrs)

Clutches: Analysis of single plate, multi-plate and cone clutches. (4hrs)

Brakes: Analysis of different types of brakes-block brake, band brake, internal expanding shoe brake, condition for self locking and self energizing brake, power transmitted and heat generated. (6hrs)

Dynamometers: rope brake dynamometer, belt transmission dynamometer, prony brake dynamometer (2hrs)

References:

1. J.E.Shigley & J.J.Uicker, Theory of machines and mechanisms, Oxford University Press,2003.
2. J.E.Shigley, Kinematic analysis of mechanisms,Tata McGraw Hill,1969.
3. Thomas Beven, Theory of machines, CBS, 1996.
4. Zimmerman, Elementary kinematics of mechanism, John Wiley Publication.
5. Rattan, Theory of machines, Tata McGraw Hill, 2009.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0402 THERMAL ENGINEERING AND HEAT TRANSFER (72 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the combustion of fuel gas turbine plant.
2. Calculate the work requirement foe a given compression ratio.
3. Get an insight on conduction and apply it for optimizing the thickness of insulation.
4. Solve convective heat transfer problems and understand radiation heat transfer.
5. Attain information of parallel and counterflow heat exchangers and their design aspects

Module I

Fuels and combustion:- Solid, liquid and gaseous fuels , calorific value, calorimeter, combustion equation, Air – Fuel ratio gravimetric & volumetric analysis, excess air, Enthalpy and Internal Energy of Combustion, application of first law of thermodynamics to chemical reaction (combustion), adiabatic flame temperature, application of second law of thermodynamics to chemical reaction.

(10hrs)

Gas Turbine Plants : Constant volume or Explosion cycle Gas Turbine plant, constant pressure cycle or Joule – Brayton cycle Gas turbine plant simple C-B-T cycle, condition for maximum work output and thermal efficiency in simple cycle. Methods of improvement of Thermal Efficiency and work ratio of Gas Turbine plants. C-B-T-H cycle, complex cycles, closed cycle operation of Gas turbine plants, their merits and demerits. Total head or stagnation conditions. (8 hrs)

Module II

Reciprocating Air Compressors : Ideal cycle for compressors, work Transfer in single stage compressor, Mass and volume flow, Free Air Delivery, Effect of clearance and volumetric Efficiency in Single stage compressors, Multi-stage compression neglecting clearance and with clearance. Condition for Minimum work Input and Perfect Intercooling. Tandem and In-line arrangement in compressors. Rotary positive Displacement Types of compressors. Compressed air Motors. Applied Problems (12hrs)

Module III

Conduction heat transfer:-Introduction to heat transfer – basic modes of heat transfer – conduction heat transfer –Fourier law of heat conduction– temperature dependence of thermal conductivity - general heat conduction equation in cartesian, cylindrical and spherical coordinates – boundary conditions – one- dimensional steady state conduction - critical insulation thickness - one- dimensional steady state conduction with heat generation - extended surface. (12hrs)

Module IV

Convective heat transfer:- Newton's law of cooling – Prandtl number – laminar forced convection heat transfer from flat plates – fully developed laminar flow in pipes – turbulent forced convection.

(8hrs)

Radiative transfer:- electromagnetic radiation spectrum – thermal radiation –radiation properties - black body, gray body – monochromatic and total emissive power – Planck's law – Stefan- Boltzman law – Wien's displacement law – Kirchhoffs identity – shape factor- reciprocity relation. (6hrs)

Module V

Heat Exchangers: Type of heat exchangers- overall heat transfer coefficient - fouling factors - Logarithmic mean temperature difference (LMTD) - derivation of LMTD for parallel flow and counter flow heat exchangers - LMTD correction factor - effectiveness, NTU method of heat exchanger analysis- effectiveness derivation for parallel flow and counter flow heat exchangers. Design of parallel flow - counterflow - shell and tube multipass heat exchangers - condensers.

(16hrs)

References:

1. Cengel, Heat Transfer, 3rd edition, Tata Mc Graw Hill, (2007).
2. Holman J. P., Heat Transfer, 10th edition, McGraw Hill International Students Edition, (2009).
3. Kreith F., Heat Transfer, International Text Book Company, (1958).
4. Rajput, R. K., Heat and Mass Transfer, S Chand, (2007).
5. Spalding D.B. & Cole, E.H., Engineering Thermodynamics, Edward Arnold, London, (1967).
6. Holman, J. P., Thermodynamics, 4th Edition, McGraw Hill Inc., (1987).
7. Nag, P. K., Engineering Thermodynamics, 4th Edition, Tata McGraw Hill, (2008).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0403 METALLURGY AND MATERIAL SCIENCE (72 hrs)

Course objective: At the end of the course, the student will be able to :

1. Understand the crystal structure of metal, defects occurring in crystals of metals and the process of solidification of metals under slow and fast cooling.
2. Understand the phase rule, phase diagrams, solid solutions, examples of binary solid solutions and to understand the mechanism of corrosion and its prevention methods.
3. Understand about different heat treatment methods and different metals and alloys.
4. Gain knowledge about the phenomena of failures occurring in metals.
5. Learn about the different destructive and non- destructive tests and the different metals used onboard and in marine applications.

Module I

Crystallography : crystal structure, space lattice, crystal systems, miller indices of crystal planes and directions, atomic density of crystallographic planes and lines, atomic packing factor, co-ordination number, inter planar spacing. (6hrs)

Crystal imperfections : point defect, line defect, edge dislocation, screw dislocation, interaction between dislocation, planar defects, stacking faults, grain boundary, twist and twin boundaries, volume defects. (4hrs)

Solidification of metals : homogenous and heterogeneous nucleation, crystal growth, grains and grain boundaries, equi-axed and columnar grains, dendritic pattern, polymorphism. (4hrs)

Module II

Solid Solutions: Equilibrium between phases, Gibb's phase rule, solid solution, interstitial, substitutional, ordered and disordered types, Hume – Rothery rules, equilibrium phase diagrams of binary alloys-complete solid solubility, partial solid solubility, no solid solubility,: eutectic, peritectic and eutectoid reactions, intermetallic compound, Iron-carbon Euillibrium diagram. (12hrs)

Corrossion and Prevention: Basic principles and mechanism of corrosion, factors influencing corrosion, types of corrosion – crevice corrosion, atmospheric corrosion, pitting and inter granular corrosion, selective leaching erosion corrosion, stress corrosion, hydrogen damage and fatigue corrosion, microbial corrosion, corrosion due to befouling, testing and measurement of corrosion rate, corrosion prevention and control- material selection, comparison of anodic and catholic protection, Protective coating - metallic coating and other inorganic coating, paints – antifouling paints, bio – fouling control, marine coating – corrosion resistance materials for propellers, pumps, system, heat exchangers, hulls. (6hrs)

Module III

Heat treatment of steel: Definition and aims of heat treatment, T T T diagram, isothermal and continuous cooling, annealing, normalizing, hardening, tempering, austempering, martempering, hardenability of steels, jomini test, surface treatments –case hardening, carburising, cyaniding, nitriding, flame hardening, induction hardenting, metal coating- hot dipping, electro plating, metal cladding, impregnation, metal spraying. (8 hrs)

Metals and Alloys: Cast Irons **:** classification- gray, white, malleable, and spheroidal graphite cast irons, composition, properties and uses. Steels : Classification of steels, function of alloying elements of steels, composition and properties of common commercially important alloy steels.

Non-ferrous alloys: composition, properties and use of common commercial alloys of Cu, Al, Mg, bearing metals.

Classification society rules – National & International standards of different class of steels.

(10hrs)

Module IV

Deformation of metals : Elastic, anelastic and visco elastic behaviour, plastic deformation, mechanism of slip, slip planes and slip directions, mechanism of twinning, strengthening mechanisms, work hardening, grain boundary hardening, precipitation hardening, cold working, hot working, recovery, recrystalisation and grain growth. (8hrs)

Failure of metals : creep, mechanism of creep, creep curves, creep resistant materials, fracture, brittle fracture, Griffith's theory, ductile fracture, ductile-brittle transition, protection against fracture, fatigue, mechanism of fatigue, S-N Curve. (8hrs)

Module V

Testing of Materials: Destructive tests – Tensile test, compression test, hardness test, bend test torsion test ,and impact test. Non-destructive tests – Magnetic dust test, Fluoresent test, Ultrasnic test Radiographic test. (6hrs)

Uses of Materials in Shipboard Application: Chromium, Ceramic, Titanium, PTFE in shipboard systems. Characteristics of the above materials. (2hrs)

Selection of materials in shipbuilding &Marine Engineering : Boilers, Steam and Gas turbines, Purifiers and Diesel engine components, Pumping Machinery, Components and piping system, Engine seating, Propellers and Rudders. Composition, strength value and other requirements for materials used. (8hrs)

References:

1. L.W. Van Vlack, Elements of material science – Addison – Wesley.
2. Reed Hill, Physical metallurgy principles – Affiliated east-west press N.Delhi.
3. Clark & Varney, Physical metallurgy for engineers – Van Nostrand
4. V.Raghavan, Material science and engineering, Prentice Hall of India
5. Dieter, Mechanical metallurgy, McGraw Hill
6. Avner, Mechanical metallurgy, McGraw Hill
7. Narula, Material Science, Tata McGraw Hill
8. William D Callister, Callister's Materials Science and Engineering 2 edition
9. R Winston Revie Herbert H. Uhilig : Corrossion Engineering, and Corrossion Control – An introduction to corrosion science and Engineering, Fourth edition, John Wiley & Sons.
10. Mars G Fontana, Corrossion Engineering Tata Mc Graw Hill, Delhi Third Edition 2007.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19- 208- 0404:MARINE AUXILIARY MACHINERY-1 (72 hrs)

Course Outcomes:

On completion of the course the student would be able to :

1. Understand Engine room lay out, piping arrangements and fittings of ships.
2. Gain knowledge of bunkering procedures, blowers and compressors.
3. Understand the different of valves and cocks, filters, pumps, packings and seals used on board ship.
4. Understand the working of heat exchangers, evaporators and deck machinery.
5. Gain knowledge about the oil purification and treatments.

Module I **(18)**

Engine Room Layout:

Lay out of main and auxiliary machinery in engine rooms in different ships. (4hrs)

Engine Room Piping Arrangements & Fittings:

Pipe material, Colour code and safety fittings of piping systems.

Piping system arrangement for bilge, ballast, steam systems, Lub oil, and fuel oil and cooling water systems for main and auxiliary engines. Main and Aux. cooling sea water systems. Domestic fresh water and sea water hydrophore system. Line diagram for H.F.O & D.O bunkering. (14hrs)

Module II **(16)**

Bunkering procedure, pre bunkering confirmation, initial preparation, precautions taken, procedure for confirming the quality and quantity of oil bunkered (6hrs)

Job requirement for a watch-keeping Engineer. (4hrs)

Blowers and Compressors:

Uses of compressed air onboard a ship. Compressed air system for a ship. (2hrs)

Constructional details of blowers, Fans and compressors used on board ships.

Operation and maintenance of reciprocating compressors. Safety precautions in working with compressors and air systems (4hrs)

Module III **(14)**

Valves and cocks: Straight way cocks, right angle cock, 'T' cock, spherical cock, Boiler gauge glass cock (cylindrical cock). Globe valves, SDNR valve, swing check valve (storm valve), gate valve, butterfly valve, relief valve, quick closing valve, pressure reducing valve, control valve, change over valve chest, fuel oil transfer chest, valve actuators and steam traps. (6hrs)

Filters: Strainers and filters. Types of marine filters, Static filters, auto clean and Duplex filters, Priming and core maintenance of filters. (2hrs)

Pumps: Types of pumps used for various requirements onboard. Care Maintenance of Centrifugal Pumps, Gear Pumps, Screw Pumps and Reciprocating Pumps. (4hrs)

Jointings ,Packings & Seals : Types and use of different packing materials. Various applications Seals- purpose of bearing seal, description and application of non rubbing seals and rubbing seals, simple felt seal, seals suitable for various peripheral speeds, V-ring seals, Lip seals.

Insulation of materials: Types – Various uses onboard. (2hrs)

Module IV **(12)**

Heat Exchangers: tubular and plate type, reasons of corrosion, tube removal, plugging, and materials used. (4hrs)

Evaporators: Construction and Operation of different types of evaporators, Fresh Water generators and distillers. Conditioning arrangement of distilled water for drinking purpose. (4hrs)

Deck Machinery: Various types of deck machinery used in ships e.g. Winches and Wind lass and their requirements. Operation and maintenance Deck Cranes, Hydraulic deck machinery; hydraulic motors, line filters and systems. (4hrs)

Module V

Oil Purification & treatment: Theory of oil purifications, various methods of oil purifications, Principles of operation and construction of different Centrifuges for heavy fuel and lubricating oil systems, Self desludging purifiers . Uses of Homogenizers, Use of setling / service tanks & precautions taken before entering / cleaning tanks. Treatment of Fuels for combustion in Marine I.C.E. and Steam Plants. Residual fuels, Emulsified Fuels, Merits and demerits of such fuel in marine engines.

(12hrs)

References:

1. H. D. McGeorge, Marine Auxiliary Machinery, Butterworth Publication London, (1998).
2. Smith D.W., Marine Auxiliary Machinery, Butterworth Publication London.
3. Khetagurov.M., Marine Auxiliary Machinery and Systems MIR Publishing House, Moscow.
4. I. M. E., The Running and Maintenance of Marine Machinery.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19- 208- 0405: HYDRAULIC MACHINERY (72hrs)

Course Outcomes:

On completion of this course the student will be able to :

1. Understand dimensional analysis and principles of similitude.
2. Apply the momentum principles to impinging jets and analyse the performance of hydraulic turbine.
3. Learn the performance characteristics of various hydraulic turbines, their specific speed and peed control.
4. Understand the working of roto - dynamic pumps and positive displacement pumps.
5. Study the principle of working of hydraulic devices.

Module I

Dimensional Analysis & Similitude:- Rayleigh's method, Buckingham's Pi theorem, nondimensional parameters in fluid mechanics and machinery – principles of similitude – geometric, kinematic and dynamic similarities – model studies. Physical meaning of important dimensional groups of fluid mechanics and their practical use. (10hrs)

Module II

Dynamic action of fluid :- Momentum equation applied to a control volume, impact of jets, flow of an incompressible fluid over fixed and moving vanes, work done and efficiency. (4hrs)

Hydraulic turbines:- Impulse and Reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine, their constructional features, Velocity triangles, Performance characteristics. (14hrs)

Module III

Performance of Turbines:- non dimensional parameters for comparative study of turbine study of turbine performance, Specific speed, Unit speed, Unit power, theory of draft tubes, speed regulation of turbines, Cavitation, Selection of type and speed of turbines. (12hrs)

Module IV

Pumping machinery: general features of positive displacement and rotodynamic pumps, centrifugal pumps, classification, principle of working, velocity diagrams, work done, efficiency, minimum speed, specific speed, losses in pumps, circulatory flow, multistage pumps, propeller pumps, priming, Cavitation and its significance. (8hrs)

Reciprocating pumps: Working, single acting and double acting pumps, Slip, Acceleration head, effect of friction, use of air vessels, Indicator diagrams, efficiencies, pump characteristics. (6hrs)

Module V

Hydraulic Press, Hydraulic Ram, Hydraulic Intensifier, Hydraulic lift, Hydraulic Accumulator, Hydraulic Crane, Hydraulic Coupling, Hydraulic Torque Converter, Surge tank, Vane pump, gear pump, Working principles of axial and radial pumps, Application to hydraulic devices, Fluid transients, Free and Forced vortex apparatus. (18hrs)

References:

1. Shepherd, D.G., Principles of turbo machinery, MacMillan & Co. Ltd., (1957).
2. Agarwal, Fluid mechanics & Machinery, Tata McGraw Hill, (2001).
3. R K Bansal, Fluid mechanics, Luxmi Pulications, (2008).
4. Vallentine, Applied hydrodynamics, Newnes - Butterworths, London,(1969).
5. Herbert Addison, A treatise on applied hydraulics, 5th Edition, Chapman & Ha ll, (1972).
6. Stepanof, A. J., Centrifugal and axial flow pumps, Wiley, New York, (1957).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0406 SEAMANSHIP AND NAVIGATION (54 hrs)

Course Outcomes:

On completion of this course the student will be able to :

1. Understand the nautical terms deck equipments and the navigational light.
2. Familiarize rope knots and mooring and dropping anchor.
3. Gain basic knowledge about navigation.
4. Know about life boat, life raft and abandoning ship.
5. Understand the survival of life at sea and marine pollution control.

Module I

Seamen and their duties: Ship's Department, general ship knowledge and nautical terms like poop-deck forecastle, bridge etc. (2hrs)

Deck equipment: winches, derricks cranes, gypsy, capstan, hatches, and their function. (2hrs)

Navigational lights and signals: Port and Star board, forward and aft mast lights, colors and location. Look out, precautions and bad weather, flags used on ships, flag etiquette, morse and Semaphore signaling, sound signals. (6hrs)

Module II

Rope knots and moorings: Types of knots, Practice of knot formation, materials if ropes, strength, care, and maintenance, use of mooring line, heaving line, rat guards, canvas and its use. (2hrs)

Anchors: their use, drooping and weighing anchor, cable stopper. (6hrs)

Module III

Navigation: General knowledge of principle stars. Sextant, navigation compasses echo sounder, log and uses, barometer and weather classification, G.M.T. and zonal time, wireless navigational instruments, radar satellite navigation etc. (6hrs)

Module IV

Life boats and life rafts: Construction, equipment carried, carrying capacity. Davits and their operation. Launching of life rafts (inflatable type). Embarkation into life boat and life raft. Stowage and securing arrangement, Equipments inside life boats and life rafts, including radio life saving appliances, satellite EPIRBs, SARTs, immersion suits and thermal protective aids. (6hrs)

Abandon ship: Manning of life boats and life raft, rescue boats, Muster list. Radio and alarm signals, distress signal S.O.S. Distress Calls time and radio frequency. Pyro-techniques. (8hrs)

Module V

Survival at sea: survival difficulties and factors, equipment available, duties of crew members, initial action on boarding, maintaining the craft. (4hrs)

Practical: Knots, bend and hitches, Ropes splice, donning of life jackets, Life boat drills, Lowering and hoisting and life boats (model). (8hrs)

MARPOL Convention and its annexes, Regulatory control towards environmental pollution at sea. (4hrs)

Note: Lesson plans to comply with the requirements of STCW-2010

References:

1. John R., Annapolis Book of Seamanship Symon and Schuster Publication.
2. Graham Danton, Theory and Practice of Seamanship, Routledge,(1996).
3. David J House, Seamanship Technics,Butterworths- Heinemann,(2004).
4. Marine Survival and Rescue System by House . D.J. Wetherby & Company,(1997).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0407 SHIP TECHNOLOGY (72 hrs)

Course Outcomes:

On completion of this course the student will be able to :

1. Understand the different terms used in ship construction and to analyse the stresses in ship structure.
2. Gain knowledge about the constructional details of bottom & side framing, shell & deck and bulk heads & deep tanks.
3. Understand fore end and aft end arrangements.
4. Calculate load line and tonnage and familiarize with the shipyard practice.
5. Understand offshore technology and the details of ship surveys.

Module I

Ships Terms : Various terms used in Ship Construction with reference to Ship's parameter e.g. L.B.P., Moulded Depth, Moulded Draught etc., General Classification of Ships. (4hrs)

Stresses in Ship's Structure : Bending, Shear, Hogging, Sagging, Racking, Pounding, Painting, etc., and Strength members to counteract the same. (6hrs)
Sections and materials use : Type of section like Angles, Bulb Plates, Flanged beams used in ship construction. Rivetting & Welding. Testing of Welds. Fabricated components. (6hrs)

Module II

Bottom & Side Framing : Double bottoms, Water tight floors, Solid and bracket floors, Longitudinal framing keels, side framing like Tank side brackets, Beam Knee, Web Frame, etc. (7hrs)

Shell & Decks : Plating systems for shells, Deck plating & Deck girders, discontinuities like hatches and other openings, supporting & closing arrangements, mid-ship Section of ships. (7hrs)

Bulk Heads & Deep Tanks : Water tight bulk heads, Arrangements of plating and stiffeners. Water tight sliding doors, Water tight openings through bulk heads for electric cables pipes and shafting. Deep tank for oil fuel or oil cargo corrugated bulk heads. (7hrs)

Module III

Fore-End Arrangements : Stem construction, arrangements to resist panting, panting stringers, Forepeak-Collision bulk heads, Bulbous bows. Anchor and Cable arrangements. (6hrs)

After-End Arrangements : Types of Stems, Stem frame and rudder. Types of rudder. Supporting of rudder, Locking pintle, Bearing pintle, Pallister bearing, Shaft tunnel, Tunnel bearings. (7hrs)

Module IV

Loadline and Tonnage: Definition of freeboard and various assigning conditions, List of closing appliances, Loadline Surveys, Tonnage regulations, calculation as per 1969 convention, details of markings permanently carved. (6 hrs)

Shipyard Practice : Layout of a Shipyard, Mould loft, Fabrication of assembly, Subasembly, units in construction, role of Surveyors in construction of Ship; Keel laying, Launching, Sea trial. Use of computers in ship design with cost implication. (4hrs)

Module V

Offshore Technology : Drilling Ships and Platforms, Supply/Support Vessels-types and Constructions, Dynamic Positioning, Deep Sea Diving System, Fire Fighting Arrangement, Cable Laying Vessels. (4hrs)

Ship Surveys : Survey, Rules, Functioning of Ship Classification Societies, Surveys during Construction, Periodical Surveys as per statutory regulations, retention/suspension of class of a ship, constructional features and rule guidelines for a merchant vessel as per Marpol regulations, IBC and IGC codes. Statutory Certificates and their validity, Ships registration formalities, Intact Stability Criteria under damaged conditions (constructional point of view in compliance with statutory regulations), Enhanced Survey requirements, HSSC. (8hrs)

References:

1. Muckle W, Naval Architecture for Marine engineers.7th edition, Butterworths Heinemann(1987).
2. Tupper E.C., Introduction to Naval Architecture, Butterworths Heinemann(2013).
3. Comstock, Principles of Naval Architecture, Society of Naval Architects(1967).
4. Philip A Wilson, Basic Naval Architecture, Springer International Publishing(2017).
5. Harey Benford, Naval Architecture for non-Naval Architects, Society of Naval Architects(1991).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0 408: ELECTRICAL MACHINES LABORATORY (54 hrs)

Course Outcomes:

On completion of this course the student will be able to :

1. Design the required experiments.
2. Conduct different performance tests on electrical machines using the theoretical knowledge.
3. Tabulate the data and use necessary theoretical knowledge to find out the results.
4. Interpret the results.

Experiments:

1. Calibration of the single phase energy meter by direct loading at various power factors.
2. Measurement of power in the three phase circuit using single, two and three watt meters for balanced/unbalanced load and three and four wire systems.
3. To study an auto- transformer and load it at about 10% (a) higher and (b) lower input voltage.
4. Determination of the efficiency and regulation of the single phase transformer by direct loading.
5. Determination of Equivalent circuit of a transformer by open and short circuit test calculation of efficiency and regulation at various loads and power factors.
6. Parallel operation of two single phase transformer.
7. To study dismantled parts of a D.C. machine.
8. To study dismantled parts of an A.C machine.
9. Emf induced in a d.c. machine.
10. Parallel operation of two identical DC shunt generators.
11. To study and run a rotary convertor under different conditions to record the generated voltage on D.C side against variation of load.
12. To perform a load test on a 6-pulse, 2-way bridge rectifier and to obtain the characteristic curves.
13. To study different types of motors, connect A.C. supply, run the motor and obtain its speed load characteristics (The experimental multi motor set).
14. To study the slip-torque characteristics of an induction motor and to find the full load slip.
15. To compute full load input, torque, slip, power factor, efficiency of 3-phase induction motor from circle diagram. Also to compare the results from the circle diagram with actual full load test on the motor.
16. Determination of the regulation of a 3-phase alternator by synchronous impedance method.
17. Synchro transmitter and Repeater.
18. Determination of phase sequence in a 3-phase supply.

19. Study of a single phase controller.

20. Observation of wave form of magnetizing current and hysteresis loop.

21. Study of transformer differential delay.

22. Determination of the regulation of the alternator by emf and mmf methods.

23. Synchronisation of alternator to the A.C. mains and studying the effect of changes in excitation of alternator and power input to their alternator by plotting the V-curve.

24. Starting the cage induction motor using star-delta switch and plotting the performance characteristics.

25. Conducting the no load and blocked rotor tests on slip ring induction motor –determining equivalent circuit and calculating torque-slip characteristics.

26. a) Plotting OCC of a D.C. shunt generator at rated speed – determining the critical resistance.

    b) Conducting load test on D.C. shunt generator and plotting external characteristics – deducting internal characteristics.

27. Conducting load test on D.CL Series motor and plotting the performance characteristics.

28. Study of single phase capacitor start and capacitor run induction motors – plotting speed – voltage relation of single phase fan motor.

Note: Students must present the laboratory records duly certified by the teacher to the Head of the Department before commencement of the semester examinations.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0408 BOILER CHEMISTRY AND HEAT ENGINES LABORATORY (54 hrs)

(A) BOILER CHEMISTRY LABORATORY (14 hrs)

Course Outcomes:

On completion of this course the student will be able to :

1. Design the required experiments.
2. Conduct different experiments to determine hardness and different chemical content in the water sample.
3. Tabulate the data and use necessary theoretical knowledge to find out the results.
4. Interpret the results.

Experiments:

1. To determine hardness content of the sample of boiler water in P.P.M. – in terms of $CaCo_3$.
2. To determine Chloride content of the sample of water in P.P.M. in terms of $CaCo_3$.
3. To determine Alkalinity due to Phenolphthalein, total Alk. And Caustic Alk. Of the sample of water in P.P.M.
4. To determine Phosphate Content of the sample of water.
5. To determine dissolved Oxygen Content of the sample of water.
6. To determine Sulphate content of the given sample of water.
7. To determine Ph-Value of the given sample.

(B) HEAT ENGINES & HEAT TRANSFER LABORATORY (40hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Design the required experiments.
2. Conduct different performance tests on different engines using the theoretical knowledge.
3. Tabulate the data and use necessary theoretical knowledge to find out the results.
4. Interpret the results.

Experiments:

1. To determine the absolute Viscosity and Kinematic Viscosity of oils by Red Wood viscometer
2. To determine the flash point and fire point of a given sample of oil.
3. To determine the percentage of CO_2 , CO and O_2 in the flue gases.
4. To determine the Calorific value of the fuel with the help of Bomb Calorimeter.
5. To conduct load test on a two stroke single cylinder Petrol engine
6. To conduct load test on a two stroke single cylinder Diesel engine.
7. To conduct load test on a 4 stroke single cylinder Petrol engine.
8. To conduct load test on a 4 stroke single cylinder Diesel engine.
9. To conduct load test on a 4 stroke 4 cylinder Petrol engine.
10. To conduct load test best cooling on a 4 stroke twin cylinder Diesel engine.
11. To determine the Thermal conductivity of good conductors
12. To determine the Thermal Conductivity of Insulating materials
13. Heat transfer Through Fins or extended surface.
14. Heat transfer through Forced Convection.
15. Heat transfer through Natural Convection

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0501 DYNAMICS OF MACHINERY (72 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Recall the concepts of free body diagrams, principles of statics and dynamics
2. Use graphical and analytic methods to do force analysis of planar mechanisms.
3. Apply these concepts in different machine elements for the evaluation of forces and moments
4. Analyze the dynamics of different mechanisms and machine elements and determine the various forces and torques.
5. Analyse different modes of vibrations and their practical applications.

Module I

Force analysis of plane motion mechanisms : Static Force Analysis: Analysis of four bar chain – slider crank chain – static force analysis with friction. Dynamic force analysis: D'Alembert's principle, inertia forces, dynamic force analysis of four bar chain, slider crank mechanism, shaking forces. - 8hrs

Dynamics of reciprocating engines: gear force, equivalent masses, inertia force in the single engine, bearing loads in the single cylinder engine. – 4hrs

Module II

Flywheels: inertia torque-turning moment diagrams for multi cylinder engines, coefficient of fluctuation of speed and energy, fly wheel mass calculation, effect of centrifugal tension on fly wheel. -8hrs **Gyroscopes :** motion of rigid body in 3 Dimension, Euler's equation of motion, gyrodynamics, gyroscope and gyroscopic couples, gyroscopic stabilization of ships and aeroplanes, gyroscopic effects on automobiles. - 8hrs

Module III

Balancing: Static and dynamic balancing, balancing of several masses in a plane, balancing of masses rotating in several planes, conditions for complete balancing of an engine, reciprocating and rotating parts, locomotive balancing- hammer blow, variation of tractive effort, swaying couple, locomotive balancing of opposed piston engines. Multicylinder in-line engines – radial engines and V engines. Balancing machines and their principles of working. - 12hrs

Module IV

Fundamentals of vibration: Kinematics of vibratory motion: simple harmonic motion, periodic motion and Fourier analysis.

Vibrations of single degree of freedom systems: natural vibration, equation of motion, natural frequency, equilibrium method, energy method, viscous damping, logarithmic decrement, coulomb damping, forced vibration, harmonic excitation with and without damping, non dimensional expression for amplitude and phase, rotating unbalance, critical speed for shafts, support excited motion, vibration isolation.

Vibration measuring instruments: Seismometer, accelerometer, vibration exciters. - 15hrs

Module V

Free vibration of two degree and multi degree freedom systems: solution for free vibration, normal modes, vibration absorber, coupled vibration, general solution, matrix method of formulation, numerical evaluation of natural frequencies and natural mode.

Approximate numerical methods: Rayleigh's method – Dunkerly method.

Torsional vibration in multi – rocker systems, geared system. - 15hrs

References:

1. Rattan, Theory of machines, Tata McGraw Hill
2. Hollowenko, Dynamics of machinery, McGraw Hill
3. Singeresu S.Rao, Mechanical Vibrations, Addison wesely
4. Myklestad, Fundamentals of vibration analysis, McGraw Hill
5. Denharto, Mechanical Vibration, McGraw Hill
6. Thomas Beven, Theory of machines – Longmans, Green and Co. Ltd.
7. A.Ghosh & A.Mallik,s and mechanisms, Prentice Hall

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0502 MARINE BOILERS & STEAM ENGINEERING (72 hrs)

Course Outcomes:

On completion of the course the student would be able to :

1. Understand basics of boiler design and the different types of smoke tube and fire tube marine boilers.
2. Gain knowledge about waste heat boilers and boiler mountings & accessories.
3. Understand operation and maintenance of boilers, and refractories and burners used in boilers.
4. Explain the working of steam engines and and steam turbines and their lay out, selection of materials and constructional details.
5. Understand the working of condensers and the operation and alignment of steam turbines.

Module I

General Considerations governing the design of Boilers: Types of marine boilers, comparison of smoke tube and water tube boilers; Destructive and Non-destructive tests on plates, rivets, welded seams, classification societies requirements for boilers construction, testing, commissioning, operation and repairs. (5hrs)

Smoke Tube Boilers: Various types in marine use, Principal dimensions and staying of flat surface of multi tubular cylindrical Boilers. Vertical Auxiliary Boilers. Modern compact skid-mounted auxiliary boilers. (5hrs)

Water Tube Boilers: General description with sketches of principal types of boilers in marine use. (5hrs)

Module II

Waste Heat Boilers: Waste Heat recovery calculation, Lamont exhaust gas boiler. Scotch composite Boiler, Cochran exhaust gas and composite boiler, Spanner marine exhaust gas and Composite boiler. Forced Water Circulation Boiler, Double evaporation Boilers. (6hrs)

Boiler Mountings: Safety Valves – Improved High Lift, Full lift and Full Bore type : Gauge Glass – Ordinary plate type and remote Indicator; automatic feed regulator, three element High & Low water level alarms, Main Steam Stop Valves, Retractable type Soot Blower etc. (4hrs)

Accessories : Superheater, Economizer, Air pre-heater & Steam pre-heater; Circulation and use of Unheated Down comers in highly rated boilers; Superheat temperature control, Attemperators and De-superheaters. (4hrs)

Module III

Operation, Care & Maintenance: Pre-commissioning procedures, Hydraulic tests, Steam raising and Operating Procedures, Action in the event of shortage of Water. Blowing down of Boiler, Laying up a boiler; general maintenance, External and Internal tube cleaning. Tube renewals, etc. Maintenance, inspection and survey of boilers. (6hrs)

Refractory : Purposes of refractory, types of refractory and reasons for failure. (2hrs)

Fuel burning : Procedure of Liquid fuel burning in open furnace, Various types of atomizer, Furnace arrangement for oil burning, Boiler Control System i.e. master control, fuel control, air control and viscosity control. Coal burning in modern boilers. (4hrs)

Module IV

Steam Engines & Turbines: History of multiple expansion marine reciprocating engines & steam turbines. Steam Turbines for main propulsion and for driving cargo pumps in Oil Tankers. (5hrs)

Layout of Plant: General layout of plant & description of a modern geared steam turbine installation. (4hrs)

Selection of Materials : Materials used in various components like blades, rotors, castings, sealing glands, gears etc. & their justification. (2hrs)

Constructional Details : Types of blades, method of fixing, solid built-up & drum rotor for impulse and reaction turbines, castings for HP and LP impulse and reaction turbines, diaphragms, nozzles, glands, carbon glands, labyrinth packing glands, main bearings and thrust bearings. (12hrs)

Module V

Condensers : Shapes and types of condensers, constructional details, location & method of securing, working principles, contraction and expansion allowances, leak test. Effect – temperature, circulating water quantity, main engine power, condenser surface. (5hrs)

Operation and Maintenance : Turbine drain system, turbine gland steam, warming through a turbine plant, control of speed and power of propulsion, throttle valve control and nozzle control, emergency controls, emergency operation of turbines, vibration in marine steam turbine, steam turbine losses. Breakdown and trouble shooting. (13hrs)

Checking of Alignment and clearances: By bridge gauge, poker gauge and feeler gauge allowances. static and dynamic balancing. (3hrs)

References:

1. J.H.Milton, Marine Steam Boilers, Transatlantic arts, (1970).
2. SC Mc Birnie and W J Fox, Marine Steam Engines & Turbines, Butterworths and Heinemann, (1980).
3. G T H Flangan, Marine Boilers, Butterworths and Heinemann, (1990).
4. L S Robertson, Marine Engines and Boilers, Forgotten Books, (2017).
5. Gustav Bauer, Marine Steam Turbines, Forgotten Books, (2018).
6. Marine Steam Boilers, Andesite Press, (2017).
7. Harrington, R. L., Marine Engineering, Society of Naval Architects, (1976).
8. Kandy Series Vol. IV : Steam Engines
9. Kandy Series Vol. II : Marine Boilers

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0503 MARITIME ECONOMICS & COMMERCIAL GEOGRAPHY (72 hrs)

Course Outcomes:

On completion of the course the student would be able to :

1. Understand basics of economic organization of shipping market and major shipping routes.
2. Gain knowledge supply and demand and their influence on freight rates.
3. Understand cost, revenue and the financial performance of shipping.
4. Explain the economics principles and global patterns of maritime trade.
5. Understand the economics of ship and ship design, economics of ship building and recycling and maritime forecasting and market research.

Module I

The economic organization of the shipping Market: The economic role of the shipping industry- The international Transport system- The demand for sea transport – The world merchant fleet- The role of ports in the transport system.

Major Shipping Routes- Ports:- types, Problems, factors for good port. Major ports of India and World. -14hrs

Module II

Supply, Demand and Freight rates: The shipping market model **-** The supply of sea transport – The demand for sea transport – The freight rate mechanism- Factors influencing in determining various equilibrium. -14hrs

Module III

Cost, Revenue and Financial Performance: The impact of financial pressures on ship owner's decisions – Financial performance and investment strategy – the cost of running ships – various revenue receipts – Voyage cash flow analysis and annual cash flow analysis- the internal rate of return. -14hrs

Module IV

The economic principles and global pattern of Maritime trade: Countries that trade by sea – Theories about the pattern of trade- Economic growth and sea trade – geographical distribution of seaborne trade- Bulk cargo and the economics of bulk shipping – The general cargo and the economics of liner shipping - India's overseas Trade and Economic Importance with reference to Economic zones. -14hrs

Module V

The economics of ships and ship designs: Relationship between cargo units and ship types –ships for liner trades, ships for dry bulk trades, liquid bulk trades, combined carriers- economic criteria for evaluating ship design.

The economics of ship building and recycling: The ship building market supply and demand model – The ship recycling industry – Economics of ship recycling industry.

Maritime forecasting and market research: Principles of forecasting – forecasting methodologies – market research methodology. -14hrs

References:

1. Martin Stopford, Maritime Economics, Routledge, (2008).
2. H. I. Larvey, Ship Board Operations, Butterworths and Henemann,(2008).
3. Armstrong, Malcom C, Practical Ship Handling, Brownson &Ferguson Ltd,(2007).
4. Cylil Hughes, Ship Board Operation Problems, Brownson &Ferguson Ltd,(2007).
5. Paul A. Samuelson, Economics, McGraw Hill Education, (2010).
6. James J. Berkley, The business of Shipping, Shiffer Publishing Ltd.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0504 MARINE AUXILIARY MACHINERY-II (77 hrs)

Course Outcomes:

On completion of the course the student would be able to :

1. Understand working of steering gears and shafting of ships.
2. Gain knowledge dry docking and different works associated with that.
3. Understand the working of different on board machinery, the source of noise and noise suppression.
4. Understand IMO regulations on the prevention of pollution by oil, oily water and sewage.
5. Explain the basic of lubrication and the testing of lub oil and fuel oil.

Module I **(16 Hrs)**

Steering gears: Operation and Constructional details of various types of steering machinery. Telemotor systems, transmitters and receivers. Variable Delivery Pumps used in steering gears- axial and radial displacement types. Hunting action of Steering gear. Emergency Steering arrangement. Safe Matic Steering Gear with redundancy concept as per SOLAS. Care and Maintenance of Steering Gear Plants. (10 Hrs.)

Shafting: Methods of shaft alignment, constructional details and working of Thrust blocks. Intermediate Shaft bearing and Stern tube bearing. Oil water lubricated Stern Tubes. Sealing Glands. Stresses in Tail End, Intermediate and Thrust Shafts. (6 Hrs.)

Module II **(16 Hrs)**

Dry Docking: Methods of dry docking of ships. Precautions for dry docking of vessels. Inspection and routine overhauling of underwater fittings. Inspection and maintenance of Hull. Maintenance of anchor and anchor chains. Painting scheme for the hull (8 Hrs)

Measurement of clearances and drops for the Propeller and Rudder. Removal and fitting of propellers (with and without Key). Maintenance of propeller and Rudder. (8 Hrs)

Module III **(15 Hrs)**

Other Ship board equipments: Engine room crane, chain blocks, shackles, Anchor chain, its testing and survey requirements. Different types of ship stabilizer, Bow Thrusters, Hull Protection arrangements, Overhauling procedure for various Aux. M/c, Bad weather precaution taken, Maintenance of E.R. Stores etc. (5 Hrs.)

Noise and Vibrations: Elements of aerodynamics and hydrodynamics sound, Noise Sources on Ships and noise suppression techniques, Noise level measurement. Requirements onboard related to Noise code. (4 Hrs.)

Various modes of vibration in a ship (i.e. free, forced, transverse, axial, torsional – Their sources and effects), Resonance and critical speed, Structure borne, and air borne vibration, Anti vibration mountings of machineries, De-tuners, Torsional vibration dampers, use of torsion graphs. (6 Hrs.)

Module IV **(14 Hrs)**

Pollution Prevention: Introduction of IMO Conventions, Regulatory control towards environmental pollution at sea. Marpol Convention and its annexes. (2 Hrs)

Prevention of pollution by oil & oily water: Use of coalescers, baffles, girds. STOKES Law; Static and turbo separators, Oily bilge separators their construction and operation, Oil content meter (OCM) and Oil level monitor (OLM). Incinerators. (8 Hrs)

Prevention of pollution by Sewage from ships: Sewage Treatment Plant – Regulatory requirements as per Marpol – Annex-IV. (4 Hrs)

Module V **(16 Hrs)**

Lubrication: Theories of Lubrication, Types of Lubricants and their Properties Suitability of Lubricants for various uses; solid and fluid lubricants. (2 Hrs.)

Additive Oils and their specific use. Terminology used in Lubrication systems. Loading pattern of various bearings in marine use and Lubrication system adopted. Different types of bearings used for marine machineries. (10 Hrs.)

Importance of LO/FO testing, Methods of testing etc. Use of oil mist detector. (2 Hrs.)

Monitoring of engine through L.O analysis report. (2 Hrs.)

Reference:

1. Smith D.W., Marin Auxiliary Machinery, Butter worth Publication, London
2. Khetagurov.M., Marine Auxiliary Machinery and Systems MIR Publishing House, Moscow.
3. Denharto, Mechanical Vibration, McGraw Hill
4. Kewel Pujra, Vibrations and Noise control
5. I. M. E., The Running and Maintenance of Marine Machinery, Institute of Marine engineers.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19- 208- 0505:MARINE INTERNAL COMBUSTON ENGINES-I (72hrs)

Course outcome: At the end of the course, the student will be able to:

1. Understand the basics of IC engines and on the IC engine components in detail.
2. Explain regarding scavenging and supercharging in Marine Diesel Engines.
3. Make a detailed study of combustion characteristics in I.C. Engines and control of exhaust emission.
4. Understand the cooling methods employed in I.C. Engines and to analyze the safety and prevention of incidents like crankcase explosion, scavenge fires, uptake fires and starting air line explosion.
5. Gain knowledge on balancing of engine and on the effects of vibration. To have a good understanding about the fuel injection system of a marine diesel engine.

Module I

Performance Characteristics of I.C. Engines: 4-stroke and 2-stroke cycles; Deviation from ideal condition in actual engines; Limitation in parameters, Timing diagrams of 2-stroke and 4-stroke engines. Comparative study of slow speed, medium speed and high speed diesel engines – suitability and requirements for various purposes. Mean Piston Speed, M.C.R & C.S.R ratings. Practical heat balance diagrams and thermal efficiency. **(10 hrs)**

Constructional Details of I.C. Engines: Principal Components: Jackets and Liners, Cylinder heads. Pistons, Cross heads, Connecting rods, Bed Plates, A-Frames, Welded construction for Bed Plates & Frames. Tie Rods, Exhaust valves. **(12hrs)**

Module II

General Description of I.C Engines: Marine Diesel Engines of MAN B&W and Sulzer (Wartzila), makes. **(4 hrs)**

Scavenging: Scavenging arrangements in 2-stroke engine; Air charging and exhausting in 4-stroke engines; Various types of Scavenging, their merits and demerits, Scavenge pumps for normally aspirated engines; under piston scavenging, Scavenge manifolds. **(4hrs)**

Supercharging Arrangements: Pulse and constant pressure type; Their relative merits and demerits in highly rated marine propulsion engines. Air movement inside the cylinder. Turbocharger and its details. Two stage, un-cooled, radial turbochargers. Hybrid turbochargers. **(6hrs)**

Module III

Combustion of Fuels in I.C Engines: Grades of suitable fuels. Preparation of fuels for efficient combustion. Fuel atomization, Ignition quality, Fuel injectors and its details. Ignition delay, after burning. Effect of sac volume in fuel injectors. Different fuels used in Marine Diesel Engines. **(4hrs)**

Compression pressure ratio and its effect on engines: Reasons for variation in compression pressure and peak pressure, Design aspects of combustion chamber. Control of NOx, SOx in Exhaust emission. Scrubber technology and catalytic reduction techniques. **(4hrs)**

Module IV

Cooling of I.C Engines: Various Cooling media used; their merits and demerits, cooling of Pistons, Cylinder jackets & cylinder heads, Bore cooling, coolant conveying mechanism and systems, Maintenance of coolant and cooling system. **(4hrs)**

Safety and Prevention of Mishaps in I.C Engines: Causes and prevention of crank-case explosions and scavenger fires. Detection of same and safety fittings provided to prevent damage, Uptake fire, Starting air line explosion. Thermal stresses in diesel engines. **(6hrs)**

Special features of I.C engines: Development of long-stroke engines, implication of stroke-bore ratio, Development in materials in construction & heat treatment of engine components. **(2hrs)**

Module V

Forces and Stresses: Balancing, Overloading, Different type of vibrations & its effects. **(4hrs)**

Fuel pumps and metering devices: Jerk and Common Rail Systems; Fuel injection systems, helical grove and spill valve type Fuel Pumps. System for burning heavy oil in slow and medium speed marine engine, V.I.T & Electronics injection system. **(6hrs)**

Effects of viscosity on liquid fuel combustion, Viscosity measuring equipment and its working principle, Necessity of variable fuel injection system, Procedure of application on a modern slow speed long stroke engine, Necessity for adoption of fuel quality setting system, Incorporation of FQSL along with the V.I.T system on the engine. **(6hrs)**

References:

1. Harrington, Marine Engineering,
2. A.Kane, Marine I.C.Engines, Shrof Publishers and Distributers.
3. John B. Woodward, Low Speed Marine Diesels, Krieger Publishing Co., (1998).
4. C.C.Pounder, Marine Diesel Engines, Butterworths and Heinemann,(2009).
5. D.K.Sanyal, Principles and Practice of Marine Diesel Engines, Bhandarkar Publications, (2013)
6. A. J. Wharton, Diesel Engines, Butterworths and Heinemann, (1991).
7. Dr. Denis Griffiths, Marine Low Speed Diesel Engine, Institute of Marine Engineers, (2001).
8. Deven Aranha, Marine Diesel Engines, Shrof publishers, (2018).
9. D A Tailer, Marine Diesel Engines, harcourt India P. Ltd.
9. John Haywood, Internal Combustion Engines Fundamentals, McGraw Hill Education, (2018).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0506 MARINE ENGG. DRAWING (108hrs)

Course Outcomes:

On completion of this course the student will be able to draw the assembly drawing of machine parts given the views of components.

Drawing : Advanced Marine Machinery assembly drawings.

Module – I (Auxiliary Machine)

Marine machinery components are assorted stop & sluice valves and auxiliary equipment dismantled; to be conceptualized in assembly and laid out as working & functional parts. Sectional views in elevation & plans executed. Part sectional views depiction.

Module – II (Main Engine)

Marine engine components dismantled. Assembled drawings of pistons, thrust blocks, liners, connecting rods, crossheads, injection valves, starting valves, Fuel pumps, Stern tube & Tail shaft, Rudder carrier bearing and all equipment with main machinery. Sectional / Outside and plan views of parts fitted / removed & in functional order.

References:

1. H.G. beck, Marine Engineering Drawing, Thomas Reed,(2006).
2. James G. Holburn, John J Seaton, MacGibbon,s Pictorial Drawing Book, James Munro & Co.
3. K C John, A Textbook of Machine Drawing, PHI, New Delhi, (2010).
4. N. D. Bhutt, Machine Drawing, Charotar Publishing House,(2014).
5. K R Hert, Engineering Drawing with Problems and Solutions, Arnold, (1975).
6. Ajeeth Sing, Machine Drawing, TMH, (2012).
7. N D Junarkar, Machine Drawing, Pearson Education India, (2007).
8. P S Gill, A Textbook of Machine Drawing, Kaston Publishing House, New delhi.
9. V Lakshminarayanan & M.L Mathur, Machine Drawing-jain Brothers, N.Delhi
10.

Note: Duration of the End Semester exam is 4 hours

Type of Questions for End Semester Exam.

Question Nos. I, II with sub sections (a), (b) if required -- -- (35 marks each with options to answer either I or II) from Module I.

Question Nos. III, IV with sub sections (a), (b) if required -- -- (40 marks each with options to answer either III or IV) from Module II.

The maximum marks that can be awarded for the Semester End Examination (SEE) will be only 60, even though the question are for 75 marks.

19-208-0507: NAVAL ARCHITECTURE – I (72 hrs)

Course objective: At the end of the course, the student will be able to:

1. Understand the functions of ship and types of ships.
2. Explain the geometry of ship and its hydrostatic calculations.
3. Understand transverse stability of ships and calculate of Metacentric height.
4. Explain longitudinal stability of ship and do trim corrections.
5. Gain knowledge on resistance and power calculations of ship.

Module I

Function of the ship: Design and integration of ship systems, General lay out of the ship. (6hrs)

Ship Types : Tankers, Bulk Carriers, Container Ships. LNG, LPG and Chemical Carriers, Lash Ships, Passenger Ships, Dredger, Tugs, etc. – Constructional details and requirements. (8hrs)

Module II

Geometry of Ship & Hydrostatic Calculations : Ships lines, Displacement Calculation, First and Second moment of area, Simpson's rules, application to area and volume, Trapezoidal rule, mean and mid-ordinate rule, Tchebycheff's rule and their applications, Tones per Cm. Immersion, Co-efficient of forms, Wetted surface area, Similar figures, Centre of gravity, effect of addition and removal of masses, Effect of suspended mass. (20hrs)

Module III

Transverse Stability of Ships : Static stability at small angles of heel, Calculation of B.M. Metacentric height, Inclining experiment, Free surface effect, Stability at large angles of heel, curves of static stability, dynamical stability, Different Characteristic curves of Dynamic stability. AITC formula. (10hrs)

Module IV

Longitudinal Stability and Trim : Longitudinal BM, MCT1, change of L.C.B. with change of trim, Change of trim due to adding or deducting weights, change in draft & trim because of filling/flooding several tanks with different densities, alteration of draft due to change in density, Flooding calculations, Floodable length curves, M.O.T. method for determination of floodable lengths, factors of subdivision, Loss of stability due to grounding, Docking stability, Pressure on Chocks.
(18hrs)

Module V

Resistance & Powering: Frictional, Residuary and total resistance, Froude's law of comparison, Effective power calculations, Ship's correlation Factor (SCF), Admiralty coefficient, Fuel coefficient, and fuel consumption, Effect of viscosity and application of ITTC formula.

(10hrs)

References:

1. Muckle W, Naval Architecture for Marine engineers.7th edition, Butterworths Heinemann(1987).
2. Tupper E.C., Introduction to Naval Architecture, Butterworths Heinemann(2013).
3. Comstock, Principles of Naval Architecture, Society of Naval Architects(1967).
4. Philip A Wilson, Basic Naval Architecture, Springer International Publishing(2017).
5. Harey Benford, Naval Architecture for non-Naval Architects, Society of Naval Architects(1991).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0508: FLUID MECHANICS AND MACHINERY LABORATORY (50 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Design the required experiments
2. Conduct different fluid flow experiments and conduct performance test on different hydraulic machinery using the theoretical knowledge.
3. Tabulate the data and use necessary theoretical knowledge to find out the results.
4. Interpret the results.

Study of pipe fittings and study of devices used for measurement of pressure, velocity, rate of flow.

Experiments :

1. Experimental verification of Bernoulli' theorem.
2. Steady flow through pipes – determination of friction factor and Reynold's number.
3. Determination of losses coefficients of pipe fittings.
4. Hydraulic coefficients of mouth pieces, nozzles and bend meters.
5. Determination of coefficient of discharge through various Notches.
6. Determination of Metacentric height and radius of gyration of floating bodies.
7. Calibration of Venturi meter and orifice meter.
8. Force due to impact of jets on vanes.
9. Performance characteristics of centrifugal pumps at constant speed.
10. Constant head characteristics of Francis Turbine.
11. Constant Head characteristics of Pelton Wheel.
12. Performance of Hydraulic Ram.

Board of impellers of pumps for practical demonstration specially required for Design Work.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0509 ELECTRONICS LABORATORY (54 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Design the required experiments
2. Conduct different electronic experiments using the theoretical knowledge.
3. Tabulate the data and use necessary theoretical knowledge to find out the results.
4. Interpret the results.

1. To study the charging and discharging action of a capacitor
2. To study the half wave and full wave rectification circuit without and with filter circuit
3. To study the volt-ampere characteristic of high current semiconductor diode
4. To study the volt-ampere characteristic of a diode and Zener diode
5. To study the characteristic of Junction Transistor
6. To study the volt- ampere characteristic of Field Effect Transistor.
7. To study the characteristics of Silicon Controlled Rectifier.
8. To study the Transistor Bias stability
9. To study the Transistor Feed Back Amplifier
10. To study the Integrated Circuit operational Amplifier
11. To study the Integrating, Differentiating Clamping and Clipping Circuit
12. To study the Logic Training Board
13. To study the Speed control of a D.C. motor by Thyristor.
14. Arithmetic operations using microprocessor 8085
15. Logical operations using 8085
16. Array operations using 8085
17. Speed and Direction control of stepper motor using 8085.

Note 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0601: MANAGEMENT SCIENCE (72 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand basics of management function, organizing organizational structures.
2. Gain knowledge production planning and control and operations research.
3. Understand resource allocation, work study, job evaluation and merit rating.
4. Explain the different aspects of finance management.
5. Understand the functions of human resource management.

Module I

Introduction to Management Principles & Practice: Definition and objectives of sound management. Need for Sound Management Principles and Practice & Growth of Modern management thought, Management functions, Process Planning, Corporation / Long term & tactical strategy, Policy distribution, SWOT Analyses, Organising – definition / illustrations, Staffing – manpower, planning, Directing – illustration, Controlling, parameters, application & Co-ordination; communication – efficient process model, communication barriers, inter-personnel communication skill. Principles of Locating a Plant & Developing Organization Structure, various types of organizational structures – Line / staff / matrix, centralization vs. decentralization of decision-making, distinction between authority / responsibility / accountability, Basic principles of delegation / empowerment of employees; Authority & Responsibility, Boundaries of Authority.

(16hrs)

Module II

Production / operation related uses: Distinction between products & services, Types of production system viz. Jobbing / Lot / Mass. Functions of Production Planning and Control, Product Development Principles, Standardization, Simplification & Specialization, Plant Layout, Product / Process, Logistics & supply chain / management. Integrated material management functions of material planning, inventory control, safety stock / cycle stock, purchase / stores performance, measurement parameters, standardization / codification, waste control. (14hrs)

Introduction to Operations Research: Linear Programming, Distribution Methods, Network Technique in Management – Critical Path Method (CPM), Program Evaluation & Review Technique (PERT). (4hrs)

Module III

Resources Allocation & Load smoothing: Operational Sales Forecasting; Inventory Control, Safety Stock, Determinational Introduction to Decision Theories in Management, Decision under Certainty, Right and uncertainty, Works Study, Job Evaluation & Merit Rating, Total Quality Management, Quality Control, ISO 9000 Series, Preventive/Condition based Maintenance and spare management. (14hrs)

Module IV

Finance Management: Methods of Capital formation & Control of Working Capital, How to read balance sheet / profit /loss, budgetary control &standard costing- Favorable/ adverse variances. Continuous & Discounted Cash Flow & Project Appraisal, Break even analysis, Cost Benefit Analysis, Methods of depreciation, Factory Costing, Estimating, Balance Sheet, Financial & Physical Ratios; Project & Budgetary control. (14hrs)

Module V

H.R.D. : The personnel Function, Requirement & Selection, Role of Psychological Tests in Recruitments, Training of employees, Performance Appraisal & counseling, Reward System, Legal Requirements and Regulation of Working Condition, Employer's Liabilities for Health and Safety, MBO, Leadership/Group Dynamics and Discipline, Motivation theories and Incentives, Maslow's hierarchy of contribution. Problems of Accident – Proveners, Fatigue etc. Relation with Trade, Union & Workers Participation in Management. (14hrs)

References:

1. Koont S. O. Donnel, Principles of Management, McGraw Hill, (1972). -
2. Bethel et. al, Industrial Organisation & Management, McGraw Hill, (1979).
3. Prasanna Chandra, Finance Management, TMH, (2015).
4. Hadley G , Linear Programming, Addision, Wesleys (1962).
5. Samuel Eilon, Production Planning & Control, Universal Book Traders. India.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0602 MARINE ELECTRICAL TECHNOLOGY (80 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand the electrical power generation, emergency power and associated controls.
2. Understand the electrical power distribution system on ship and protective devices for machines & motor controls.
3. Acquire knowledge about high voltage system.
4. Illustrate the maintenance & operation of electrical machines & equipments on a ship.
5. Identify various faults in electrical system on ship and acquire knowledge of instruments for fault finding & preventive maintenance.

Module I

Power Generation: Merits & Demerits board of A.C. & D.C. on board; Rules and Regulations governing electrical machineries on ships; Different alternator Excitations – Systems on board – (indirect, Direct 'static excitations, Brushless generator construction & operational diagram, Automatic Voltage Regulator. (8hrs)

Alternative Source of Power: Emergency Generator & Different Starting method including auto-start, emergency batteries construction and its different types & duties, Location of emergency power, Different Emergency loads, Rules & Regulation, emergency power, Maintenance of emergency power source on board. Shore Supply – Specifications as per Voltage / frequency, precautions while taking shore supply. (6hrs)

Module II

Distribution: Different electrical diagrams and their uses, electrical signals. Type of Distribution, Distribution network on board; Main & emergency switch board, construction, different switch gear & protective devices, Grounded and Insulated neutral systems, and precautions adopted in High Voltage distribution system, Cables & temperature classification. High Voltage systems onboard requirements as per STCW 2010 Convention. (10hrs)

Motor & Control Equipments: Types of marine motor, types of enclosures, protective devices on motors, motor characteristics curves, sequential starting (e.g. Refrigerating plants, automatic fired boiler). (4hrs)

Module III

Miscellaneous marine electrical equipment Alarm system: Engine Room Telegraph, Rudder Angle Indicator, R.P.M. & Revolution Counter, Centralised Salinity Indicator, Watertight door operation, Alarm system (types, supply) on board's oxygen analyzer, High & low level arms, Navigational lights, Emergency Radio Operation, Electrical Deck auxiliaries. (12hrs)

Module IV

Maintenance of Electrical Systems, Fault finding & Repair: Type of faults & indications on Generator, motor & distribution systems, Different Testing equipments & meters (multimeter / megger, clampmeter, etc.), Salvaging a motor Detection of faults on electronic circuits & cards – Indications & corrective arrangements, Necessary Precautions & care while fault finding and Repair, preventative maintenance, periodic surveys, spares requirement. (12hrs)

Safe Electrical Practice: Safe watch-keeping, points to check on electrical machineries, Switch gears & equipments, microprocessor control and maintenance electrical fire fighting, precautions against electric shock and related hazards. (8hrs)

Module V

Special Electrical Practice: Rules and Regulations & Operation of electro-hydraulic & Electric Steering gear, Diesel-electric and Turbo electric propulsion system, pod/Azipod drive unit, superconductivity applied in propulsion, Turbo alternator, special electrical practice for oil, gas and chemical Tankers (Tanker classification, Dangerous spaces, Hazardous zones, Temperature class), Flame proof Ex 'd' and intrinsic safety Ex 'i', Ex 'e' and Ex 'n' equipments and their application in zones, Maintenance of Ex-protected apparatus. (20hrs)

References:

1. G.O. Watson, Marine Electrical Practice, Butterworths-Haneimann, (2013).
2. W. Lows, Electricity Applied to Marine Engineering, International Specialised Book Services (1981).
3. D.A. Gillepie, Prime movers for generation of Electricity, Imprint Unknown, (1997).
4. Edmond G R, Advanced Electro Technology, Thomas Reeds, (2014).
5. Elstan Fernandez, Marine Electrical Technology, Shrof Publishers, (2017).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0603 SHIP FIRE PREVENTION & CONTROL (72 hrs)

Course Outcomes:

On completion of the course the student would be able to :

1. Understand the fire hazard aboard ships. Fire chemistry and control of A,B and C classes of fire.
2. Explain the fire protection built in ships and SOLAS conventions.
3. Acquire knowledge about fire detection and safety system on cargo ships and Tankers.
4. Illustrate the working of different fire extinguishers and other fighting equipments on a ship.
5. Identify various practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boiler rooms, Cargo holds, galley etc.

Module I

Fire hazard aboard ships: Fire triangle, tetrahedron, Fire Chemistry, Spontaneous Combustion. Limits of inflammability. Advantages of vapors fire extinguishing agents including vaporizing fluids and their suitability for ship's use. Control of class A,B and C fires. -14hrs

Module II

Fire protection built in the ships: SOLAS convention, requirements in respect of materials of construction and design of ships, fire detection and extinction systems, fire tests, escape means, electrical installations, ventilation system and venting system for tankers. Statutory requirements fire fighting systems and equipment on different vessels. Fire doors and fire zones. – 12hrs

Module III

Detection and Safety Systems: Fire safety precautions on cargo ships and tankers during working. Types of detectors, Selection of fire detectors and alarm systems and their operational limits. Commissioning and periodic testing sensors and detection system. Description of various systems fitted on ships.
- 12hrs

Module IV

Fire fighting Equipment: Fire pumps, hydrants and hoses, Couplings, nozzles and international shore connection, Construction, operation and merits of different types of portable and fixed fire extinguishers installations for ships. Properties of Chemical used. Bulk Carbon Di-Oxide and inert gas systems. Fireman's outfit its use and care. Maintenance, testing and recharging of appliances. Preparation, Fire appliance survey. Breathing apparatus- types, uses and principles. Water mist Lance. – 14hrs

Module V

Fire Control: Action required and practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boiler rooms, Cargo holds, galley etc. Fire fighting in port and dry dock. Procedure for re-entry after putting off fire, rescue operations from affected compartments. Fire aid, Fire organization on ships. Fire signal and muster. Fire drill. Leadership and duties, Fire control and plan, Human behavior, Special precautions for prevention/fighting fire in tankers, chemical carriers, Gas carriers, Chemical carriers, Safe working practice. – 20hrs

References:

1. E. Gordon B & Alan C Parnell, Designing for Fire Safety, John Wiley, (1983).
2. V K Jain, Fire Safety, New age International, (2006).
3. Keith Denton, Safety Management, McGraw Hill, (1982).
4. Krishnan N.V., Safety Management , Jaico Publishing House, (1996).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0604 MARINE REFRIGERATION AND AIR CONDITIONING (72 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand the different refrigeration cycles and different refrigeration systems.
2. Gain knowledge regarding marine refrigeration plant with multiple compression and evaporation and different refrigerants.
3. Explain the different components and maintenance of marine refrigeration plant and the refrigeration of cargo hold.
4. Understand about the properties of gas mixtures and air & water vapour mixtures.
5. Gain knowledge on basic principles of air conditioning and heat load calculation of AC plant.

Module I

Refrigeration : Reversed Carnot cycle, Vapour compression cycles, Refrigerating Effect, Co-efficient of performance, Cooling capacity, Rating of a Refrigerating Plant, Methods of improving C.O.P. Use of Vapour Tables, Applied Problems. Different refrigeration systems, classifications of refrigerators, uses of refrigeration at sea, cryogenic technology-definition, temperature range, insulation. – 10hrs

Module II

Marine Refrigeration Plants: Typical Marine Refrigerating Plants with multiple compression and Evaporator system. Heat pump cycles. Refrigeration in liquefied Gas carriers. -8hrs

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Different refrigerants: chemical formula, desired properties (general, physical, chemical, thermodynamic) comparison, effect on environment, Montreal protocol, new refrigerants. – 4hrs

Heat load calculation on refrigeration plant. – 2hrs

Module III

Design and construction of various components of refrigeration plants: compressor, condenser, evaporator, expansion valves, control and safety equipments. Operation and maintenance of refrigeration plants, control of temperature in different chambers, charging of refrigerant/oil, purging of air, defrosting methods, trouble shooting. - 12hrs

Refrigeration of cargo holds: brine system and it's operation & maintenance, methods of air circulation in holds, insulating materials, insulation, micro-organism, dead and live cargo, factors, affecting refrigerated cargo, container ship refrigeration, preparation for loading cargo, survey of refrigeration equipments.

- 6hrs

Module IV

Properties of Mixtures of Gas and Vapours: Dalton's Law of partial pressure, Amagat's Law of partial volume, volumetric and Gravimetric analysis of Gas Mixtures, Gibb-Dalton's Law, mean value of a Gas Constant. Equivalent molecular weight, Density, specific volume, specific heat and Molar Heat Capacity of gas mixtures. Advanced problems on Adiabatic mixing. - 8hrs

Air and Water Vapour Mixture: Specific humidity, Relative humidity, Dew point, unsaturated and saturated Air. Principle of Cooling Towers and Air Leakage Problem in surface condenser.

- 6hrs

Module V

Principle of Air conditioning: psychometric properties of air comfort conditions, control of humidity, Airflow and A.C. Capacity calculation for ship plants. - 8hrs

Air conditioning: necessity on board ships, different systems, control of room, air temperature, humidity, noise, dust and purity. Construction of duct & diffuser, fans, ventilation of accommodation, fire safety balancing of system. - 6hrs

Ventilation: Ventilation of engine room, pump room, CO2 and battery rooms, air change requirements, design considerations, maintenance. Heat load calculation of air conditioning plant. – 2hrs

Note: Refrigeration Data Books are permitted for examination

1. Domkundwar A. V., & Domkundwar, V. M., Refrigeration and Air conditioning Data Book, Dhanpat Rai & Co., Delhi, (2013).

References:

1. Roy J. Dossat, Thomas J. Horan, Principles of Refrigeration, 5th edition, Prentice Hall, (2001).
2. Stoecker W. F. and Jones J. W, Refrigeration and Air Conditioning, 2nd Ed., Tata McGraw Hill, (1982).
3. Jordan R. C. and Priester G. B., Refrigeration and Air Conditioning, 2nd Ed., Prentice Hall, (1969).
4. Arora, C. P., Refrigeration and Air Conditioning, Tata McGraw Hill, (2001).
5. Norman Harris, Modern Air Conditioning Practice, McGraw Hill, (1974).
6. Arora, R. C., Refrigeration and Air Conditioning, Prentice Hall, (2010).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0605 MARINE INTERNAL COMBUSTION ENGINES-II (80 hrs)

Course Outcomes:
On completion of the course the student would be able to:

1. To understand the main propulsion engine maneuvering system, power measurement and lubrication system in detail.
2. Gain knowledge regarding development of different types of engines and automation in marine diesel engines.
3. Explain the maintenance of components of marine diesel engines.
4. Understand about compressed air motors and centrifugal compressors.
5. Gain knowledge on gas turbine and plants.

Module I
Manoeuvring System : Starting and reversing systems of Marine Diesel engines with safety provisions. **(8hrs)**

Indicator diagrams and Power Calculation : Construction details of indicator instrument. Significance of diagram, Power calculations, fault detection, simple draw cards and out of Phase diagrams. Latest developments in measurement of performance of a diesel engine. Power Balancing, Performance Characteristic Curves, Test Bed trials and Sea trials of diesel engines.
(**10hrs**)

Lubrication Systems : Cylinder-Lubrication, Linear wear and preventive measures. (**2hrs**)

Module II
Medium Speed Engines : Different types of medium speed marine diesel engines, couplings and reduction gear used n conjunction with medium speed Engine, V-type engine details. Use of poor quality residual fuels and their consequences. Improvements in designs for higher power output. Fuels, combustion process – fundamentals. **(8hrs)**

Automation in modern diesel engine plants : Remote operation, Alarm and fail safe system, U.M.S. Operations of ships. **(2hrs)**

Governors and their basic functions Constant speed governors. Electronic Governor. Constructional details and hunting of governor. **(4hrs)**

Computerized monitoring and diagnostic applications in propulsion engines. The intelligent engine (camless concept) – various control systems. Improvement in designs for increased T.B.O. (Time Between Overhauls). **(6hrs)**

Module III
Maintenance of Diesel Engines : Inspection and Replacement of various component members such as Piston, Piston ring. Cylinder Head, Liner, Bearings Driving Chain and Gears etc. Crank shaft deflection and alignment, Engine holding down arrangements, Tightening of Tie bolts.
(8hrs)

Trouble Shooting in Diesel Engines : Hot & Cold Corrosion, Crank shaft web slip, X-head bearing problems, microbial degradation in fuel & lub oil. (**4hrs**)

Modern trends and developments : Significant developments in I.C. Engines by various engine makers – MAN B&W, Sulzer / Wartzila. (**4hrs**)

Module IV

Rotary positive Displacement Types of compressors: Compressed Air Motors. (**2hrs)**

Axial Flow Compressor: Principle of centrifugal compression and pressure rise in centrifugal compressor, change in Angular Momentum. Pre-whirl and pre-whirl vanes. Mach number at inlet to a centrifugal compressor, slip and slip factor, multi-stage centrifugal compressor. (**8hrs**)

Module V

Gas Turbines Plants : Constant volume or Explosion cycle Gas Turbine plant, constant pressure cycle or Joule – Brayton cycle Gas turbine plant simple C-B-T cycle, condition for maximum work output and thermal efficiency in simple cycle. Methods of improvement of Thermal Efficiency and work ratio of Gas Turbine plants. C-B-T-H cycle, complex cycles, closed cycle operation of Gas turbine plants, their merits and demerits. Total head or stagnation conditions. General Construction and Design features for marine plants, Materials of construction, Heat Exchangers and Reheat arrangements, Comparison of Free Piston engine gasifiers and conventional air-stream combustion chambers.

(**14hrs**)

References:

1. Harrington, Marine Engineering,
2. A.Kane, Marine I.C.Engines, Shrof Publishers and Distributers.
3. John B. Woodward, Low Speed Marine Diesels, Krieger Publishing Co., (1998).
4. C.C.Pounder, Marine Diesel Engines, Butterworths and Heinemann,(2009).
5. D.K.Sanyal, Principles and Practice of Marine Diesel Engines, Bhandarkar Publications, (2013)
6. A. J. Wharton, Diesel Engines, Butterworths and Heinemann, (1991).
7. Dr. Denis Griffiths, Marine Low Speed Diesel Engine, Institute of Marine Engineers, (2001).
8. Deven Aranha, Marine Diesel Engines, Shrof publishers, (2018).
9. D A Tailer, Marine Diesel Engines, harcourt India P. Ltd.
10. John Lamb, Running and Maintenance of Marine Diesel Engine.
11. B.G. Smith (IMARSET), Application of Automatic Machinery and Alarm Equipment in Ships

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0606 MACHINE DESIGN (80 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand the basic procedure in machine design, the standards used and the design for different load conditions.
2. Gain knowledge regarding fits and tolerances and design of fasteners, welded and revetted joints.
3. Do the design transmission elements like shaft, belt and chain.
4. Design clutches, bearings and brakes.
5. Design spur gear, bevel gear and helical gear.

Module I

Procedure in Machine Design : Concepts of Design, Procedure & Processes, Design Synthesis, Economic consideration in Design, Feasibility, Preliminary Design Alternative, Final Design Alternative, Preliminary & Final Plans & Drawings. (2hrs)

Use of Standards in Design: Selection of preferred sizes, common useful Materials and Manufacturing considerations in Design. Review of failure criteria in Mechanical Design, BIS System of Designation of Steels, Basis of Good Design, Deformation, Wear, Corrosion. Common useful Materials and Manufacturing considerations in Design. (4hrs)

Strength Consideration for Design : Strength of Materials, Reliability, Influence of size, Stress Concentration, Strength under combined stresses, Static loads, Impact loads, Repeated loads, Completely reversed loads, Static plus Alternating loads, Cyclic & combined loads, Fatigue Strength. Dynamic Stresses. Selection of Materials.

. (6hrs)

Module II

Specifications :- Fit, Tolerance, Finish-BIS (4hrs)

Design & Drawing to specifications for parts subjected to direct loads. (6hrs)

Fasteners : Bolts & Screws, Cotter & Knuckle joints, Keys & Couplings, Pipe joints.

Riveted & Welded joints: Design of riveted and welded machine parts. (6hrs)

Module III

Power Transmission : Shafts & Axles, Belt Drives, Chain Drives.

(16hrs)

Module IV

Bearings, Clutches & Brakes: Journal bearing, Ball bearing, roller bearing, plate clutche, cone clutch, pony brake, band brake, internal expanding brake. (16hrs)

Module V

Design of Tooth Gearing: Spur & Bevel Gears, Rack & Pinion, Worm & Worm Wheels, Helical Gears

(20hrs)

Data books allowed for Examination:

1. Mahadevan K. and Balaveera Reddy, Design data hand book, 4th Edn., CBS Publishers, (2013).
2. P.S.G.TECH, Design Data Hand Book, DPV Printers, (1993).
3. Linghaigh K.and Narayana Iyengar, B.R., Design Data Book, Vol. I & II, Mc. Graw Hill, (1994).
4. Bhandari, V. B., Machine Design Data Book, Tata Mc Graw Hill, (2014).

References:

1. Shigley, J.E., Mechanical engineering design, 5 th edition, McGraw Hill, (2009).
2. James G. Bralia, Handbook of product design for manufacturing, 2 nd Edn., McGraw Hill, (1998).

3. Bhandari, V. B., Design of machine elements, third edition, Tata Mc Graw Hill, (2010).
4. Doughtie, V. L., Design of machine members, McGraw Hill, (1964).
5. Siegel, Maleev, Machine design of machines, International and Hartman text book Co, (2007).
6. Donald J. Myatt, Machine design, McGraw Hill, (1962).
7. Sadhu Singh, Mechanical Machine Design - I, S. K. Kataria & Sons, (2011).
8. Pandya & Shah, Machine Design, 17th edition, Charotar Publishing House Pvt. Limited, (2009).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0607 NAVAL ARCHITECTURE - II (72 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand the basic concepts of strength of ship and calculate bending moment and deflection.
2. Gain knowledge regarding propellers and design propeller.
3. Calculate the forces acting on rudder and angle of heel while turning.
4. Explain how the ocean waves affect the rolling pitching and yawing.
5. Understand the different sources of ship vibration and the prevention of vibration..

Module I

Strength of Ships : Curves of buoyancy and weight, curves of load, Shearing force and bending moments. Alternate methods, Standard Conditions, Balancing ship on wave, Approximation for max. Shearing force and bending moment, method of estimating B.M. & Deflection. Longitudinal Strength, Moment of Inertia of Section, Section Modulus. - 16hrs

Module II

Propulsion & Propellers : Definitions, apparent and real ship wake, Thrust, relation between powers, relation between mean pressure and speed, measurement of pitch, Cavitation. - 8hrs

Propeller types, Fixed pitch, Variable Pitch, Ring propeller, Kort nozzles, Voith Schneider propeller, Propeller theory. - 6hrs

Blade element theory, Law of similitude and model tests with propellers, propulsion tests, Geometry and geometrical properties of screw propellers, ship model correlation ship trials. - 6hrs

Module III

Rudder Theory : Action of the Rudder in turning a ship, Force on Rudder, Torque on Stock, Calculation of force torque on non-rectangular rudder angle of heel due to force torque on rudder, Angle of heel when turning. Types of Rudder, Model experiments and turning trials, Area and shape of rudder, position of rudder, stern rudders, Bow rudders. -14hrs

Module IV

Motion of Ship on Waves : Theory of waves, Trochoidal waves, relationship between line of orbit centres and the undisturbed surface, Sinusoidal waves. Irregular wave pattern, Wave spectra, Wave amplitudes, Rolling in unresisting media, rolling in resisting media, practical aspects of rolling, Antirolling devices, Forces caused by rolling and pitching, Heaving and Yawing. - 12hrs

Module V

Ship Vibration: Types of vibration, flexural vibration, torsional vibration, coupling, approximate formulae for frequency of vibration of a ship- prevention of vibration. -10hrs

References:

1. Muckle W, Naval Architecture for Marine engineers.7th edition, Butterworths Heinemann(1987).
2. Tupper E.C., Introduction to Naval Architecture, Butterworths Heinemann(2013).
3. Comstock, Principles of Naval Architecture, Society of Naval Architects(1967).
4. Philip A Wilson, Basic Naval Architecture, Springer International Publishing(2017).
5. Harey Benford, Naval Architecture for non-Naval Architects, Society of Naval Architects(1991).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0608 FIRE CONTROL ENGINEERING LABORATORY (54 hrs)

Course outcome:
On completion of this course the student will be able to:

1 Test and operate jet and spray type nozzles and fire hoses.
2 Do operation, charging and maintenance of portable fire extinguishers.
3 Use fireman's outfit and breathing apparatus.

Fire Engineering Lab Experiments:

Operation, charging and maintenance of portable fire extinguishers
a. Soda acid type.
b. Foam type.
c. Dry powder type.

Operation, Use and function of breathing apparatus.
a. Self contained type.
b. Bellow Type.

Use of fireman's outfit.

Study of working of lifeboat and provisions for lifeboat. Use of life jackets.

Construction and operational details of life raft giving importance to manual and hydrostatic release device.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0609 MECHANICAL LABORATORY (52 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Design the required experiments
2. Conduct different mechanical and vibration experiments using the theoretical knowledge.
3. Tabulate the data and use necessary theoretical knowledge to find out the results.
4. Interpret the results.

Mechanics Experiments:

1. To measure circular and linear displacements of cam and follower in case of (i) Plate cam-Reciprocating follower (ii)Tangent cam-with roller oscillating follower and plot the displacement curves hence differentiate the velocity and accelerating curves.
2. To find the co-efficient of friction both for flat belt and V-Belt with Belt friction apparatus and hence find the slip.
3. Centrifugal clutch to demonstrate the process of Power parameters of the Hartnell Governor.
   i) Rotating masses
   ii) Spring Rate
   iii) Initial Spring compression.
4. Note the effects of varying the mass of the centre sleeve of the Porter Governor and Compare the same with that of Proell Governor.
5. To determine the characteristic curves of sleeve position against speed of rotation in case of :
   i) Hartnell Governor
   ii) Porter Governor and
   iii) Proell Governor
6. To determine the moment of inertia of different bodies by the Trifilar suspension by experiment and by calculation.

Vibrations Experiments:

1. The following experiments in vibrations are performed withVIBLAB apparatus:
   i) To verify the relation $T = 2\pi\sqrt{(l/g)}$ in case of a simple pendulum and to plot the graph T Vsl.
   ii) To verify the relation $T = 2\pi\sqrt{((K_2 + OG_2)/(g\,OG_2))}$ in case of a compound Pendulum and find the radius of gyration and equivalent length of compound pendulum.
2. To determine the method of Torsional Oscillation, the radius of gyration of a body, about the centre of gravity by using the relation, $T = 2\pi(K/a)\sqrt{(L/g)}$
3. To verify the relation, $T = 2\pi\sqrt{(W/Kg)}$ and plot a graph T Vs W.
4. Study of undamped natural vibrations of a beam pivoted at one end supported by tension spring at the other end.
5. To find out the natural frequency of a beam with and without load and to verify the Dunkerley's Rule.
6. Study of forced vibrations for various amounts of damping of beam pivoted at one end and supported by tension spring at the other end and top plot a graph of amplitude factor Vs frequency ratio. (LONG .VIB).
7. To study the forced vibrations for various amounts of damping and to plot a graph of amplitude factor Vs frequency ratio (Lat.Vib.)
8. Prove experimentally $T = 2\pi\sqrt{(1/Kt)}$ and study the relationship between the periodical time and shaft length.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0701 SHIP-IN-CAMPUS TRAINING-I

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the principles to be observed in keeping an engineering watch.
2. Gain knowledge handing over watch, safety and emergency procedures.
3. Be skilled in engine room resource management.
4. Gain hands on experience in using communication systems onboard

FUNCTION – Marine Engineering at the Operational Level.

COMPETENCE- 1: Maintain a Safe Engineering watch (Table A-III/I)

Principles to be observed in keeping an engineering watch: Duties undertaken during watch, maintenance of machinery space logs, handing over watch, safety and emergency procedures, change over of remote/automatic to local control of all system, safety precautions to be taken and immediate actions to be taken in the event of fire or accident..

- 70 hrs

Engine room resource management: Principles-allocation, assignment and prioritization of resources-effective communication-leadership and assertiveness- maintaining situational awareness-team building experience.

-10hrs

COMPETENCE -3: **Use of internal communication systems onboard.** -10hrs

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0702 SHIP-IN-CAMPUS TRAINING-II

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the principles of working of marine auxiliary machinery and their control systems.
2. Gain knowledge handling various deck machinery.
3. Be skilled in safety and emergency procedures for operation of propulsion plant machinery.
4. Gain hands on experience in staring up, running, shutting down of propulsion and auxiliary machinery and maintaining

COMPETENCE -4: Operate main and auxiliary machinery and associated control systems:
Basic construction and operation principles of:

Boilers, shafting installations, propeller. – 46hrs

Other auxiliaries such as pumps, air compressor, purifier, fresh water generator, heat exchangers, steering gear, automatic control systems. -26hrs

Various deck machinery -62hrs
Safety and emergency procedures for operation of propulsion plant machinery.- 48hrs
Operation of other auxiliaries including refrigeration, air conditioning and ventilation systems. -25hrs

Competency as per table A-III/2:

Practical knowledge for start up and shut down main propulsion and auxiliary machinery and maintaining safety of the above. - 25hrs

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0703 SHIP-IN-CAMPUS TRAINING-III

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the working of pumping systems used onboard and their control systems.
2. Gain knowledge in the operation of bilge, ballast and cargo pumping systems and oily water separators.
3. Gain hands on experience in managing fuel, lubrication and ballast operations.

COMPETENCE No-5: Operate fuel, lubrication, ballast and other pumping systems and associated control systems: (Table A-III/I)

Operation of various routine pumping systems. -40hrs
Operation of bilge, ballast and cargo pumping systems and oily water separators: -45hrs

Competency as per Table A-III/2: Manage fuel, lubrication and ballast operations: -5hrs

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0704 SHIP-IN-CAMPUS TRAINING-IV

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the principles of working of electrical, electronic, and control engineering.
2. Gain knowledge handling various electrical and electronic equipments.
3. Be skilled in safety and emergency procedures for operation of electrical and electronic equipments.
4. Gain hands on experience in staring up, running and maintenance of electrical machinery.

FUCTION: Electrical, electronic and control engineering at the operational and management level:

COMPETENCE No.-6: Operate electrical, electronic and control systems (Table A III/1):

Basic configuration and operation principles of:

Electrical equipment- generators and distribution systems, preparing, starting, paralleling and changing over of generators. -18hrs

Electrical motors including starting methodologies. -64hrs

COMPETENCE No.-7: Maintenance and repair of electrical and electronic equipments (Table A- III/1):

Safety requirements for working on shipboard electrical systems, including safe isolation of electrical equipment required before personnel are permitted to work on such equipment, maintenance and repair of electrical system equipment, switchboards, electric motors, generator and DC electrical systems and equipment, detection of electric malfunction, location of faults and measures to prevent damage. -52hrs

Operation of electrical testing and measuring equipment. -10hrs

Function and performance tests of the following equipment and their configuration:

Monitoring systems, automatic control devices, protective devices. – 8 hrs

Competency as per Table A-III/ 2:

Manage trouble-shooting, restoration of electrical and electronic control equipment to operating condition.

Troubleshooting of electrical and electronic control equipment & monitoring systems. Function test of electrical, electronic control equipment and safety devices. -14hrs

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0705 SHIP-IN-CAMPUS TRAINING-V

Course Outcomes:

On completion of this course the student will be able to:

1. Gain knowledge handling various hand tools machine tools and measuring instruments.
2. Be skilled in safety measures to be taken for safe working.
3. Gain hands on experience in using various hand tools machine tools and measuring instruments.

FUNCTION: Maintenance & repair at the operational and management level:
COMPETENCE No.-8 Appropriate use of hand tools, machine tools and measuring instruments for fabrication and repair onboard (Table A-III/I).

Methods for carrying out safe emergency/temporary repairs- Safety measures to be taken to ensure a safe working environment and for using hand tools- machine tools and measuring instruments- Use of hand tools, machine tools and measuring instruments- Use of various types of sealants and packings. - 305hrs

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0706 SHIP-IN-CAMPUS TRAINING-VI

Course Outcomes:

On completion of this course the student will be able to:

1. Gain knowledge Maintenance and repair of shipboard machinery and equipment.
2. Be skilled in Safety measures to be taken for repair and maintenance.
3. Gain hands on experience in overhauling, repairing propulsion and auxiliary machinery and maintaining.
4. Understand planning maintenance and repairs including statutory and class verifications.

COMPETENCE No. 9 : Maintenance and repair of shipboard machinery and equipment (Table A-III/ 1).

Safety measures to be taken for repair and maintenance, including the safe isolation of shipboard machinery and equipment required before personnel are permitted to work on such machinery or equipment- The use of appropriate specialized tools and measuring instruments. - 50hrs

Maintenance and repair, such as dismantling, adjustment and reassembling of machinery and equipment. - 120hrs

The interpretation of piping, hydraulic and pneumatic diagrams. - 25hrs

Competency as per Table A-III/ 2:

Manage safe and effective maintenance and repair procedures.
Detect and identify the cause of machinery malfunctions and correct faults.
Ensure safe working practices.

Planning maintenance & repairs including statutory and class verifications- Detection of machinery malfunction, location of faults and action to prevent damage

Inspection and adjustment of equipment. Non-destructive examination. - 13hrs.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0707 SHIP-IN-CAMPUS TRAINING-VII

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the Controlling the operation of the ship and care for persons on board.
2. Gain knowledge Ensure compliance with pollution prevention requirements.
3. Understand how to Maintain seaworthiness of the ship**.**
4. Familiarize how to Prevent, control and fight fires on board gain knowledge on how to Maintain the conditions set forth in a ship security plan.

FUNCTION : Controlling the operation of the ship and care for persons on board at the operational and management level.

COMPETENCE No. 10: Ensure compliance with pollution prevention requirements (Table A-III/ 1).

Precautions to be taken to prevent pollution of the marine environment- Anti-pollution procedures and all associated equipment- Proactive measures to protect the marine environment.

- 24hrs

COMPETENCE No. 11 : Maintain seaworthiness of the ship (Table A-III/ 1):

General knowledge of the principal structural members of a ship and the proper names for the various parts. - 10hrs

COMPETENCE No. 12 : Prevent, control and fight fires on board (Table A-III/ 1):

Ability to organize fire drills- Knowledge of classes and chemistry of fire- Knowledge of fire-fighting systems- Action to be taken in the event of fire, including fires involving oil systems.

- 24hrs

COMPETENCE No. 18 : Maintain the conditions set forth in a ship security plan; Recognition of security risks and threats; Undertake regular security inspections of the ship; and proper usage of security equipment if any. - 3hrs

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.

19-208-0801 SAFE WATCHKEEPING & ENGINE ROOM RESOURCE MANAGEMENT
(72 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand the standards of training certification and watch keeping for sea farers and criteria for engine room watch.
2. Gain knowledge regarding minimum requirements of engine room watch and engineering watch under way.
3. Explain the details of engineering watch and ship beard applications.
4. Understand the principles of leadership and team working skills required on board.
5. Gain knowledge on basic principles of managerial skills required on board.

Module I

Standards of training, certification and watch keeping for sea farers-International Conference of 1978 and modifications under STCW 1995 and 2010. Basic principles to be observed in keeping an engineering watch requirements, -6 hrs

Criteria for composing the engine room watch. Fitness for duty, Protection for marine environment, Requirement for certification, minimum knowledge requirement for certification, theoretical, practical duties and responsibilities concerning safety and protection and environment requirement for watch keeping duties. Physical training and experience in watch-keeping routine; main and aux machines, pumping systems generating plant. Safety and emergency procedures, First aid. -8 hrs

Module II

Minimum requirement for Rating of Engine room watch. Special requirement for engineer officers for oil tankers, Chemical tanker, gas tankers, Details of operational guidance for in-charge of an engineering watch. -6 hrs

Engineering watch underway – general taking over watch, periodic checks of machinery, engine room Log, preventive repairs and maintenance, bridge notification. Navigation in congested water and during restricted visibility, calling the attention of the Chief Engineer officer, watch keeping personnel.

-8 hrs

Module III

Engineering watch (unsheltered anchorage) - condition to be ensured. Watch-keeping in port watch arrangements- Taking over and handing over a watch- Oil, Chemical and Gas tankers-principles, characteristics of cargo- toxicity hazards- safety equipments, protection of personnel pollution.

-6 hrs

Shipboard Applications-Regulation and codes of practice for Chemical and Gas tankers, safe watch keeping – safety precautions to be taken on board those ships during ship operation, repair and maintenance, emergency operations; training of officers and other personnel- Requirement of continued updating of proficiency. - 8 hrs

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ModuleIV

Leadership and team working skills:

Introduction to Management, Related Conventions and National Legislations, applies task and workload management, applies effective resource management and decision making.

Engine room resource management, effective corrections, allocation of resources. Planning and coordination, work load management, time and resource constraints. Personal relationship on board ship, working in multi cultural environment. -14hrs

Module V

Leadership and Managerial Skills:

Knowledge of Shipboard Personnel Management and Training - Engineer and Manager, Human Resource Management, Training and Development, Maintenance Management.

Ability to Apply Task and workload management – Communication, Team building, Planning and co-ordination, Personal assignments, Time and resource constraints, Prioritization.

Knowledge and ability to apply effective Resource Management - Allocation, assignment and prioritization of resources, Effective communication on board and ashore, Decisions reflect consideration of team experience.

Knowledge and ability to apply Decision-Making Techniques - Management processes and functions, Negotiating skills, Situation and risk assessment, Identify and generate options, Select course of action, Evaluation of outcome effectiveness.

Development, Implementation, and Oversight of Standard Operating Procedures - Project planning and controlling. -14 hrs

References:

1. STCW Convention Proceedings 1978 and 2010 Amendments.
2. Marchant Shipping Notices

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0802 SHIP OPERATION AND MANAGEMENT (74 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand the brief history of shipping, the conference systems and the bills of lading.
2. Gain knowledge regarding marine insurance and the organizational structure of shipping companies.
3. Explain capitalization and finance, shipping operations and commercial shipping practice.
4. Understand the different provisions of merchant shipping act.
5. Gain knowledge of maritime declaration of health, marine fraud and present scenario of Indian shipping.

Module I

Brief history shipping: Modern shipping practice, Marine vehicles and cargoes, Development in shipping and cargo handling, multi model transportation, factors affecting universal adoption, liner and tram shipping services. -4 hrs

Conference systems. Organization & concerns shippers council, Chartering, chatter parties, Theory of freight rates and fares. Rate fixation machinery and government control. Responsibility of ship owners and charters, Tanker chartering, freight rates and fares- various times influencing factors market pricing,

-4 hrs

Bills of lading-function & uniqueness and related problems, Carriage of goods by sea act, Cargo surveys and protests. -6 hrs

Module II

Marine insurance: underwriting and loss adjusting principles applied to Marine cargo insurance. Hull/machinery policy, particular average, General average, P and I Clubs, making claims.

-10 hrs

Shipping companies-organization structure, Restructuring on the basis of functional coherence, ship management companies. Turn around strategy for sick shipping companies, Ownerships of vessels, Shipping Company and its administration. -10 hrs

Module III

Capitalization and finance, characteristics, cost ratios & allied definition. Sources, Financing package, Lender security, Relation between Insurance Premium, & non-conformity / condition of class. Economics of new and second hand tonnage, Subsides, procedure & implication of buying & selling new/old vessels.

-8 hrs

Ship Operations: planning sailing schedules, Voyage estimates. Economic factors.

-6 hrs

Commercial Shipping practice: Manning of ships, Engagement and discharge of crew, D.L.B Seaman's welfare. -4 hrs

Module IV

Merchant shipping act: Registration of ship, ship's papers, Port Procedures, Pilotage, flags of convenience, flags of discrimination, and their effects on shipping, duties regarding pollution, Collision, Explosion, fire etc., Vessels in distress, Shipping causalities penalties under merchant Shipping Act.

-12 hrs

Maritime Declarations of Health and the requirements of the International Health regulations including WHO's guidelines for drinking water quality. -3hrs

Marine fraud: Genesis and prevention. -3 hrs

Indian shipping: current scenario and few case studies. Cabotage Law -4 hrs

References:

1. G.Raghuram, Shipping Management- Cases and concepts, Macmillan India Ltd.,(1998).
2. Larvey H.I., Ship Board Operation, Routledge, (2012).
3. Amstrong Malcom.C.,Practical Ship Handling, Brown Sons & Fergusan Ltd. (2007).
4. E|dward F Stevens, Shipping Practice, Financial Time Prentice Hall, (1981)
5. John M. Downard ,Managing Ships, Fair Play Publication, (1984).
6. Capt.Dara E. Driver , Advanced Shipboard Management, Rumer Publication, (1985).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0803 MARITIME STATUTORY REGULATIONS (72Hrs.)

Course Outcomes:
On completion of the course the student would be able to:

1. Gain knowledge regarding IMO and its structure, UNCLOSE, SOLAS and other conventions regarding ship's safety.
2. Understand different provisions of ISM code and ISPS code.
3. Explain the pollutions related conventions, Acts and Regulations.
4. Understand about ILO's Maritime Labour Conventions.
5. Gain knowledge on National Legislations, Flag State and Port State Control.

Module I
IMO and its structure and functions- IMO conventions and Recommendations-how above instruments are adopted under Explicit/Tacit acceptance procedures.
UNCLOS: knowledge of the international maritime law embodied in UNCLOS.
SOLAS: Basic safety concept on board a merchant vessel, understanding the contents, and having the operational knowledge of them.
Understanding the importance and having the operational knowledge of LOADLINE Convention, 1966, TONNAGE Convention, 1969, COLREG, 1972 with respect to ship's safety.
-16hrs

Module II
ISM Code: Introduction-background-objectives-implementation-Mandatory applications of SMS-Various requirements of ISM code- Documentation- Maintenance of ship equipments as per the code- company's verification, review and evaluations –Certification, verification and control- internal and external audits- issue of DOC/SMC certificates and maintenance of them.

ISPS Code: Security awareness – identification of security threats – security related duties – ISPS Code and its requirements- ship's security plan – levels of security – controlling measures – drills and exercises – documentation – audits and certification. -14hrs

Module III
Pollution related Conventions, acts and regulations:-Precautions to be taken to prevent pollution of the marine environment during bunkering, loading/discharging oil cargo, tank cleaning, pumping out bilges.
MARPOL 73/78: Responsibilities under the relevant requirements of the International Convention for the prevention of Pollution from Ships – Annex I, Annex II, Annex III, Annex IV, Annex V and Annex VI of MARPOL- Various equipments requirements, their operations, documentation, including necessary record books to be maintained under each of the said Annexes.
Requirements of the International Convention for the Control and Management of Ship's Ballast Water and Sediments,2004, international Convention for the Control of Harmful Anti-Fouling Systems on Ships,2001, Regulation on Noise, Oil Pollution Act, 1990.
Concept of Liability and Compensation as related to Marine Pollution. -18hrs

Module IV
ILO's Maritime Labour Convention,2006 (MLC 2006): Need for this- requirements of the convention- Documentation – Certification- Maintenance of certificates issued under MLC. -8hrs

Module V
National Legislation: How national legislations are made from international conventions-Merchant Shipping Act, 1956 and its amendments- Role of Maritime Administration (Directorate General of Shipping)- and its functions, DGS Rules, MS Notices. Verification of Compliance of various

international conventions and national legislations- Flag State Inspections- Port State Control Inspections- Non conformities – Detention of ships.
Statutory and Classification surveys- related conventions for the certificates- Surveys special/intermediate/annual to be conducted on ocean going ships-period of validity and maintenance of them.
RPS rules and their requirements. -16hrs

References:

IMO and ILO publications on the above said conventions, DGS regulations, Class Rules.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0804: MARINE MACHINERY SYSTEM DESIGN (90 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand design considerations of marine systems.
2. Gain knowledge regarding marine machinery component design.
3. Explain the design of power transmition systems and the cooling systems.
4. Understand the designing of Lub Oil system, Steering gear system and Air starting system.
5. Gain knowledge on design of fuel systems, steam and gas turbine plants, davits and fire fighting systems.

Module I

Design Considerations: Manufacturing methods, Castings, Forgings, Fabrication & Plastic moulding, Machine tolerances, surface finish. Application to basic design principles in respect of fuction, available materials, production methods, economics, aesthetic appeal. Initial and servicing cost, analysis of force, flow through an assembly and its effect on the design. Design with respect to repairs and reconditioning specifically 'at sea' work with its normal limitations and restrictions.

-18 hrs

Module II

Marine Machinery Component Designs :-

Design and Drawing of marine machinery components subject to combined bending, twisting and direct loading like Crank shafts, Propeller shafts etc., Design and Drawing of Flywheel, Piston, connecting rod, Safety valves, Reducing valves, Compression & Torsion springs, Journal Bearings, Thrust bearings etc. Design of lifting equipment e.g. Engine room overhead crane, globe & other valves Mechanical Pilot etc.

-15 hrs

Module III

Advanced Design of Marine Systems Design:-

Power Transmission system including thrust blocks, intermediate shaft and tail-End Shaft. Water cooling systems including pumps, filters, heat exchangers for Diesel and Steam engine plants.

-16 hrs

Module IV

Advanced Design of Marine Systems Design:-

Lubricating Oil systems including pumps, purifiers pressure by-pass valves.

Electro-hydraulic Steering gear system including Rudder, Rudder stock, Tiller arm, Ram &Cylinder Marine Diesel Engine Air starting systems including Air receivers, Compressors and Air starting valves.

- 16 hrs

Module V

Advanced Design of Marine Systems Design:-

Marine Diesel Engine Scavenge and Exhaust system. Marine Diesel Engine Fuel Injection system including Fuel pumps and Fuel injectors.

Design of Steam Turbine Plants. Design of Gas Turbine Plants.

Life boat and it's launching device. Refrigeration Plant. Bulk CO_2 system.

Fire filling system including emergency fire pump. -16 hrs

Note :- Latest developments and IMO requirements are to be considered in each design project.

Computer Aided Design :

Analysis of stress, strain, vibration, thermal stress, deflection through method of Finite Element Analysis by use of various software like MSC, NASTRAN, I-DEAS, AUTO-CAD, Pro-engineer (Practice only).

-9 hrs

References:

1. Shigley, J.E., Mechanical engineering design, 5 th edition, McGraw Hill, (2009).
2. James G. Bralia, Handbook of product design for manufacturing, 2 nd Edn., McGraw Hill, (1998).
3. Bhandari, V. B., Design of machine elements, third edition, Tata Mc Graw Hill, (2010).
4. Doughtie, V. L., Design of machine members, McGraw Hill, (1964).
5. Siegel, Maleev, Machine design of machines, International and Hartman text book Co, (2007).
6. J N Reddy, Finite Element Method, MacGraw Hill.
7. Segarlind, Finite Element Method,

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0805 MARINE CONTROL ENGG. & AUTOMATION (75 hrs)

Course Outcomes:

On completion of the course the student would be able to:

1. Understand the different measuring devices and signal transmitting devices.
2. Gain knowledge regarding control theory and different types of controllers.
3. Understand details of correcting units, system analysis and mathematical models.
4. Understand about the stability and performance of control system.
5. Gain knowledge on applications of control system on ships.

Module I

Measuring Devices: Pressure, Temperature, Level and Flow measuring devices. Miscellaneous Instruments; Shaft Power meters, Unbonded Strain Gauges, Bonded Strain Gauges, Troductor Tachometers (Electric and Mechanical), Water Purity Meters: Salinity Indicator, P H Meters, Oil in Water Monitor: Photo Electric Cells, Photo Conductive Cells, Photo Voltaic Cells, Viscosity Sensors, Oil Most Detector -8 hrs

Signal Transmitting Devices: Flapper Nozzle, Electro Pneumatic signal converter, Electrical signal transmission. Pneumatic, Types of Controllers: hydraulic, electric and electronic controllers for generation of control action, Variable Inductance and capacitance transducer, Force Balance Transducer, Synchros. -8 hrs

Module II

Automatic Control Theory: Process Control, Feed Back, Closed Loop and Open Loop Control, Two Step (On-Off) Control, Modulating Control, Off Set or Droop, Desired Value, Set Value, Proportional, Integral and Derivative Control, Split Range, Ratio and Cascade Control, System Response: Distance Velocity, Measurement and Transfer Lags. -8 hrs

Automatic Controllers: Functions of a Proportional, Integral and Derivative Action Controllers, Stacked Type, Electronic, and Pulse type Controllers, Controller Adjustments Relays On-Off Cut Off Switches. -8 hrs

Module III

Correcting Units: Diaphragm actuators, Valve-positioners, piston actuators, Electro-pneumatic transducers. Electro-hydraulic actuators and Electric actuator control valves. -8 hrs

System analysis: Examination of system behaviour as a result of different inputs with respect to time or frequency response. -3 hrs

Mathematical Models: System behaviour considered in a mathematical sense using Differential Equation. System description using mathematical terms for Mechanical, Electrical, Thermal and Liquid Level system. Laplace Transforms, Transfer Functions and Block Diagrams. -10 hrs

Module IV

.**Stability and Performance:** Concept of stability, Routh & Hurtwiz stability criteria. Analysis of System Performance under dynamic or transient operating condition using Laplace Transforms. Performance characteristics, Nyquist stability criterion. -12 hrs

Module V

Application of Controls on ships: Marine Boiler-Automatic Combustion control, Air/fuel ratio control, feed water control two and three element type, steam pressure control, combustion chamber pressure control, fuel oil temperature control, Control in Main Machinery units for Temperature of lubricating oil, jacket cooling water, fuel valve cooling water, piston cooling water and scavenge air, fuel oil viscosity control, working of control system during Manoeuvring of Direct Reversing Diesel Engine Bridge control of main machinery. Instrument for UMS classification. -10 hrs

References:

1. G.J. Joy and I.D. Gardner, Instrumentation and Control, Chilton Company, (1967).
2. Werner Deport & Kurt Stoll, Pneumatic Control, Vogel Verlag, (1986).
3. Werner Deport & Kurt Stoll , Pneumatic Control Application, Vogel Verlag, (1986).
4. Application of Automatic machine and alarm equipment on ships part-iv Vol. I, IME.
5. Leslie Jackson, Instrumentation and Control systems, Thomas Reed, (1975).
6. L.F.Adams, Engineering Instrumentation and Control, Hodder Publishers, (1981).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0806 DOUBLE HULL TANK VESSELS (72 hrs)

Course Outcomes:
On completion of the course the student would be able to:

1. Understand the IMO requirements and the need for double hull.
2. Design considerations of double hull tank vessels.
3. Explain the different aspects of structural design of double hull tankers.
4. Understand different cargo handling systems.
5. Gain knowledge on basic economic aspects of double hull tank vessels.

Module I

Origin of double hull ships, their usefulness and superiority over conventional single skin ships, use of double hull tank ships for transport of different types of commodities, prevention of oil-spill and pollution of sea, IMO requirements, schedule for phasing out single hull tank vessels of different sizes.

Module II

Design considerations, main dimension, hull-weight estimate, double hull requirements, minimum depth of double bottom tank, wing tank width, clearance for inspection, etc. maximum cargo tank size, capacity, effect of free surface, damage stability, hydrostatically balanced loading, sloshing loads, its elimination or minimization.

Module III

Structural design, non-uniform and uniform stress distribution, unidirectional (longitudinal) structural members, elimination of transverse structural members (except transverse bulkheads), minimization of structural discontinuities and stress concentration zones, use of steel of higher strength, resistance to grounding and collision, classification society requirements, access to inside and bottom spaces.

Module IV

Cargo handling system, use of submerged pumps, ordinary pumps or new independent pumps, cargo transfer system, assurance of different grades of oil, concealed pipe-lines, easy maintenance, inspection and cleaning, elimination of explosion risks.

Module V

Economic aspects, fast loading discharging of oil cargo, quicker and cleaning, ballasting and deballasting, larger number of trips per year.

References:

1. D.J. Eyres , Ship construction, Butterworth-Heinemann, (1972).
2. Robert Taggart, Ship Design and Construction, Society of Naval Architects, (1980).
3. W. Muckle, Strength of Ship Structures, Hodder and Stoughton Educational, (1967).
4. D.A. Taylor, Merchant Ship Construction, Butterworth-Heinemann, (1985). -
5. Ed. Lewis,Principles of Naval Architecture Vol. 1, 2, & 3, Society of Naval Architects, (1980).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19- 208- 0807: CRYOGENIC ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Understand about the low temperature properties of engineering materials .
2. Learn about the critical components of the gas liquefaction systems .
3. Study cryogenic fluid storage and transfer systems.
4. Get insight on the insulation and transportation of cryogenic storage vessels.
5. Learn the details of LNG carriers regarding construction, inspection and operation.

Module I

Introduction to Cryogenic Systems, Historical development, Low Temperature properties of engineering materials, Mechanical properties - Thermal properties - Electr ic and magnetic properties –Cryogenic fluids and their properties. Applications of Cryogenics: Applications in space, Food Processing, sup er Conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry.

Module II

Liquefaction systems: ideal system, Joule Thomson expansion, Adiabatic expansion, Linde Hampson Cycle, Claude & Cascaded System, Magnetic Cooling, Stirling Cycle Cryo Coolers.
Gas liquefaction systems: Introduction - Production of low temperatures - General Liquefaction systems- Liquefaction systems for Neon. Hydrogen and Helium – Critical components of Liquefaction systems.

Module III

Cryogenic Refrigeration systems: Ideal Refrigeration systems - Refrigeration using liquids and gases as refrigerant - Refrigerators using sol ids as working media, cryogenic fluid storage and transfer systems.

Module IV

Cryogenic Storage vessels and Transportation, Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryogenic fluid transfer systems, Pressure flow - level and temperature measurements – Types of heat exchangers used in cryogenic systems. Cryo pumping Applications.

Module V

Liquified Natural Gas Carriers: Introduction – IGC Code – Design and Construction – Selection of hull form, containment and propulsion – LNG cargo operation procedure – LNG Carrier hazards – Fire fighting on LNG Carriers – Inspection of LNG Carriers during construction, while in service and during drydocking.

References

1. Klaus D. Timmerhaus, Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, (1989).
2. Randal F. Barron, Cryogenic systems, McGraw Hill, (1986).
3. Scott, R. B., Cryogenic Engineering, VanNostrand Co., (1962).
4. Flynn T. M., Cryogenic Engineering , Taylor and Francis Inc., (2005) .
5. Mamata Mukhopadhyay, Fundamentals of Cryogenic Engineering, Prentice Hall, (2010).
6. Thipse, S. S., Cryogenics – A Text book, Narosa Publishing House, (2013).
7. D J Eyres, Ship Construction, Elsevier, 2007.
8. IGC Code:20016 Edition.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0808 FLUID CIRCUITS & CONTROL (72 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Understand about different system components and their function, and symbols used.
2. Learn about the different control systems, hydraulic and pneumatic systems and the fluids used..
3. Study the fluid power unit and the different pumps used.
4. Get insight on the system circuits, open and closed loop control systems and their application.
5. Learn the details of the stability of the system and different hydraulic systems.

Module I

Introduction – Historical background

System components and functions: Valves, Tank, Flexible hose, piping and fittings. Seal and packing, actuators, pipe couplings, Assembly of different hydraulic components without using piping, e.g. Vertical/Horizontal stacking, manifold block etc. Different types of filters, instruments and control elements, e.g. Float switch, thermostat, pressure switch, etc. Different valves for pressure control, velocity and discharge control direction control, etc. Symbols of components along with various hydraulic terms.

Module II

Different control systems, Hydraulic and Pneumatic systems, Typical circuit for a pump set, Advantages of fluid circuit.

Fluid for hydraulic and pneumatic control; properties of liquids for hydraulic control, hydraulic reservoir, properties of air for pneumatic control, reservoir for compressed gases and compressed air, Compressibility and Inertia loading, Hydraulic stiffness, System natural frequency and allied problems.

Module III

Fluid power units:- Pumps, compressors and blowers, Positive displacement pumps: reciprocating pump, gear pump, vane pump screw pump, rotary piston pump: Pressure accumulators and intensifiers.

Module IV

System Circuits – Linear circuits, regenerative, circuits, accumulator circuits, intensifier circuits. Open loop and Closed loop systems, block diagram, application of Laplace transform, transfer function, Characteristic equation different physical systems of first order and second order, spring-mass damper systems Liquid level systems, thermal systems etc. systems of nth order.

Module V

Stability of a system – Root locus methods, Rouths criterion, Fluid logic and control systems. Application of hydraulic control in machine tools and other devices.

Hydraulic Systems – Hydraulic press, Hydraulic crane, hydraulic lift, hydraulic riveter etc. Hydraulic systems – Fluid coupling and fluid torque converter.

References:

1. John Pippenger and Tyler Hicks “Industrial Hydraulics” Mc Graw Hill Ltd.
2. S.R.Majunder “Pneumatic Systems- Principles and Maintenance “Tata McGraw Hill Publishing company Ltd”.
3. Andrw Parr “Hydraulics and Pneumatics” – Jaico Publishing Hose
4. James F.Thorpe – “Mechanical System Components” Hyn and Bacon Publishers, Boston.
5. Bruce E.Mccord “Designing pneumatic control circuits” Marcel Dekker Inc New York.
6. Pelter Rohner “Industrial Hydraulic Control” John Wiley Brisbone.
7. Harry.L. Stewart “Practical Guide to Fluid Power”

8. Herbert E. Marrit, John Wilery “Hydraulic Control System”
9. Anthony Esposito PHI “Fluid Power with applications”
10. Stinger J.D. Macmillan, “Hydraulic Systems”

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19- 208- 0809: HYDRAULIC AND PNEUMATIC DRIVES (72 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Describe the operation of hydraulic and pneumatic system components such as actuators and control valves
2. Identify various components of Pneumatic and Hydraulic control systems
3. Develop simple circuits for hydraulic and pneumatic applications.
4. Design and troubleshoot hydraulic and pneumatic systems

Module I

Introduction to oil hydraulics and pneumatics, their advantages and limitations, ISO symbols and standards in Oil Hydraulics and pneumatics, Recent developments, applications, Basic types and constructions of Hydraulic pumps and motors, Ideal pump and motor analysis, Practical pump and motor analysis, Performance curves and parameters. (14 hrs)

Module II

Hydraulic Actuators, Hydraulic control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves, Series and parallel pressure compensation flow control valves, Flapper valve Analysis and Design, Analysis of valve controlled and pump controlled motor, Electro-hydraulic servo valves-specifications, selection and use of servo valves. (14 hrs)

Module III

Electro hydraulic servomechanisms – Electro hydraulic position control servos and velocity control servos, Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Basic configurations of hydraulic power supplies – Bypass Regulated and Stroke Regulated Hydraulic Power Supplies, Heat generation and dissipation in hydraulic systems

(14 hrs)

Module IV

Design and analysis of typical hydraulic circuits, Use of Displacement – Time and Travels- Step diagrams: Synchronization circuits and accumulator sizing. Meter - in, Meter - out and Bleed-off circuits: Fail Safe and Counter balancing circuits.

Module V

Components of pneumatic systems: Direction, flow and pressure control valves in pneumatic systems, Development of single and multiple actuator circuits, Valves for logic functions: Time delay valve, Exhaust and supply air throttling, Examples of typical circuits using Displacement – Time and Travel- Step diagrams, Will - dependent control, Travel - dependent control and Time dependent control, combined control, Program Control, Electro - pneumatic control and air

hydraulic control, Applications in Assembly, Feeding, Metalworking, materials handling and plastics working. (14hrs)

References:

1. Joji P., Pneumatic controls, Wiley India Pvt. Ltd., (2008).
2. Anthony Esposito, Fluid Power with applications, 7 th Edition, Prentice Hall, (2009).
3. Ernst W., Oil Hydraulic Po wer and its Industrial Applications, 2 nd Ed., McGraw Hill, (1960).
4. Lewis E. E. and Stern H., Design of Hydraulic Control Systems, McGraw Hill, (1962).
5. Morse A. C., Electrohydraulic servomechanisms, McGraw Hill, (1963).
6. Pippenger J. J. and Koff, R. M., Flui d Power Control systems, McGraw Hill, (1959).
7. Fitch Jr. E. C., Fluid Power Control Systems, McGraw Hill, (1966).
8. Khaimovitch, Hydraulic and Pneumatic Control of Machine Tools, Pergamon Press, (1965).
9. John Watton., Fluid Power Systems: modeling, simulation and microcomputer control, Prentice Hall, (1989).
10. Herbert, E., Merritt, Hydraulic control systems, John Wilely and Sons Inc., (1991).
11. Thoma Jean U., Hydrostatic Power Transmission, Trade and Technical Press, England, (1964).

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0810 RENEWABLE ENERGY SOURCES & APPLICATIONS (72 hrs)

Course Outcome:

On completion of this course the student will be able to:

1. Understand the basics of renewable energy technology and fundamentals about solar energy, energy storage, design, performance and applications.
2. Identify Wind energy as alternate form of energy and to know how it can be tapped.
3. Understand about the Tidal energy & Geothermal energy, its mechanism of production and various methods of energy storage and distribution.
4. Enable students to understand how to convert energy from biomass, conversion of biomass into fuels, design and operation, properties and characteristics of biogas.

Module I

Principles of Renewable Energy: Introduction, Fundamentals, Scientific Principles of Renewable Energy. Technical Implications, Social Implications.

Solar Radiation: Introduction, Extra terrestrial Solar Radiation, Components f Radiation, Geometry of Earth & Sun, Geometry of the Collector, Solar Beam.

Effects of Eastern Atmosphere, Measurement. Estimation of Solar Radiation, Problems.

Solar Water Heating: Introduction: Heat Balance, Unsheltered & Sheltered Heaters, Systems with Separate storage. Selective Surfaces, Evacuated collectors, Uses of Solar Heat, Air Heater, Space Heating & Cooling, Water desalination, Solar Ponds, Solar concentrators Electrical Power systems, Problems.

Module II

Photo Voltaic Generation: Silicon P-N Junction, Photo absorption, Solar Radiation Input, Photo Voltaic Circuit Properties & Lads, Limit to Cell efficiency. Solar Cell Construction, Types & adaptation of Photo voltaic. Other types of Photo voltaic & thermoelectric Generation, Problems.

Module III

Wind Power: Introduction: Turbine Types & Terms, Linear Momentum & Basic Theory, Dynamic Matching, Stream Tube Theory, Characteristics of the Wind, Power Extraction by a Turbine, Electricity Generation, Mechanical Power, Total systems, Problems.

Module IV

Wave Energy: Tidal Power: Introduction, The cause of Tides, Enhancement of Tides, Tidal Flow Power, Tidal Range Power, World Range Power sites, Problems.

Ocean Thermal Energy Conversion:

Principles, Heat Exchangers, Pumping Requirements, Other practical considerations, Problems, Hydro Power & Geothermal Energy. Brief Review & Description

Energy storage & Distribution: Importance of Energy Storage & Distribution, Biological Storage, Chemical Storage, Heat Storage, Electrical Storage, Fuel Cells, Mechanical Storage, Distribution of Energy Problems.

Module V

Biomass: Principles of using Biomass, Availability

Economics Biofuels Introduction Biofuel Classification, Thermo chemical, Biochemical, Agrochemical Biomass Production for energy farming. Energy farming-advantages & disadvantages, Geographical Distribution, Crop yield, Energy analysis, Direct combustion for heat, Domestic cooling & heating, Crop drying, Process heat & electricity. Pyrolysis, Solid, Liquid, Gases Hydrogen Reduction, Acid & enzyme hydrolysis, Conversion of oil (coco) to Ester, Methanol liquid Alcoholic fermentation, Directly from sugar cane sugar Beet, Starch crops, Cellulose, Ethanol fuel use. Ethanol production.

Anaerobic Digestion for Biogas-Basic process & energetics Digester sizing. Working Digesters, Agrochemical fuel Extraction-advantages & disadvantages.

References:

1. Non Conventional Energy Sources, G.D. Rai Khanna publications
2. Solar energy, H.P. Garg & Jaiprakash TMH.
3. Principles of energy conservation, CULP, TMH.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

19-208-0811 TRIBOLOGY (72 hrs.)

Corse Outcome:

On completion of this course the student will be able to:

1. Understand the nature of engineering surfaces, their topography and the theories/laws of dry friction.
2. Get basic idea on consequences of wear, wear mechanisms, wear theories and wear measurement.
3. Get knowledge on fundamentals of viscosity and flow, principles of hydrostatic lubrication.
4. Get an exposure to theories of hydrodynamic lubrication, design of hydrodynamic journal bearings, brief idea of lubrication systems and different bearing materials.
5. Gain an overview of lubricants types, properties, testing and the basic principles of predictive maintenance and instrumentation.

Module I

Dry Friction – topography of surfaces – contact between surfaces – sliding friction – energy dissipation. Theory of molecular attraction – fretting corrosion and prevention – variables in dry friction – present concept of friction – boundary friction – oiliness – variables of boundary friction – friction characteristics of metals and non-metal – rolling friction – sources of measurement of friction. -14hrs

Module II

Wear – types – mechanism – factors affecting wear – Adhesive wear – abrasive wear – fatigue wear – corrosive wear – brittle fracture wear – Delamination – Wear measurement. -14hrs

Module III

Viscosity and flow; Fundamentals of viscosity and flow – Petroff's equation – friction torque – viscosity measurement – factors affecting viscosity – Principle of hydrostatic lubrication – hydrostatic step bearing – multi recess bearing – design problems – different types of compensation and their effect on bearing, parameters – hydrostatic lift, simple problems – hydrostatic journal bearing, simple problems – hydrostatic squeeze films. -14hrs

Module –IV

Hydrodynamic Lubrication: solution of Reynolds equation – application to tilting pad thrust bearing – design of hydrodynamic journal bearings – force feed on oil flow with various type of grooves – dynamic bearings and rotor systems – brief discussion, lubrication systems, bearing materials – gas bearings – brief discussion – elasto-hydro dynamic lubrication – brief discussion.

-14hrs

Module–V

Lubricants and Maintenance: Lubricants – types – solid and liquid – properties - additives – testing – reclamation of lubricants, surface treatment – phosphating of metal surface, Teflon coating, - Predictive maintenance – signature analysis and condition monitoring – basic principles – instrumentation. -14hrs

Text books:

1. Cameron, A. "Basic Lubrication Theory", 3rd Edition, Wiley Eastern, 1988.
2. Majumdar, "Introduction of Tribology of bearings"1st Edition, Prentice – Hall international.
3. Hutchings. M.Tribology, "Friction and wear of Engg.", 1st Edition, Edward Arnold, Great Britain, 1992.
4. Bharat Bhusan & B.K.Gupta, handbook of tribology.

Type of Questions for Semester End Exam.

Two questions A and B of 12 marks each from each module with options to answer either A or B (5x15=75). Both A and B shall have a minimum of two subdivisions. The maximum marks that can be awarded for Semester End Examination (SEE) will be only 60, Even though questions are for 75 marks.

MRE 8012 SIMULATION & CONTROL LABORATORY (54 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Design the required experiments
2. Conduct different control experiments using the theoretical knowledge.
3. Tabulate the data and use necessary theoretical knowledge to find out the results.
4. Interpret the results.

Simulator Lab Experiments

Description of basic engine functions and their simulation introduced in Auto-Chief-II system of Nor-Control.
Manual method of engine operation from engine room station.
Engine Operation from Remote stations i.e. control room and Navigation bridge. Safety and interlocks in UMS-ships an effect of malfunction of main engine auxiliaries.
Electronic logic circuits in remote control stations.
Simulation of engine functions in logic circuits.
Study and adjustments of logic circuits for remote control operation of main engine and trouble shooting.
Interfacing Input/Output interfacing and pneumatic Interfacing in the system.
Role of classification societies with reference to UMS-Ships.

Control Lab. Experiments.

Operation of automatic Viscosity Controller and maintaining a specific viscosity of a given fuel.
Operation of an Automatic flow controller and measuring the flow from in a given pipe.
Operation and utility of a 3 Term (P + I + D) Pneumatic controller.
To study the functioning of a Mist Detector and checking the alarm when the Pre-set value is exceeded.
Study the operation of fire detection unit using lonization chamber type detector.
CNC&VMC machines, microprocessor controlled DC & Ac machines, SCADA.

Note: *50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners, one not below the rank of Associate Professor. A candidate shall secure a minimum of 50 % marks in the aggregate and 40 % minimum in the end semester examination for a pass.*

19-208-0813 SEMINAR (54 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and reference identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. Develop skills like time management, leadership quality and rapport with an audience.

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Mechanical Engineering. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks and technical reports. The references shall be incorporated in the report following International standards reflecting the state - of- the-art in the topic selected. Each student shall present a seminar for about 30 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

19-28-0814 PROJECT WORK (180 hrs)

Course Outcomes:

On completion of this course the student will be able to:

1. Realize various steps involved in conducting a project work, like literature survey, methodology adopted – field study / survey / experiments / numerical work, analysis of the data to arrive at final results and conclusions, etc.
2. Initiate a habit of proper report writing with all of its major components, proper style of writing and preparation of a distinct abstract and carved out conclusions.
3. Conceive the pros and cons of working in a team and the wonderful results which could evol ve through team-work.
4. Present and defend self-prepared and corrected report (with the help of project guide) of a self - created work to a peer audience.

Each batch comprising of 4 to 6 students shall identify a project related to the curriculum of study and submit a project synopsis comprising of the following.

- Application and feasibility of the project
- Complete and detailed design specifications.
- Block level design documentation
- Detailed design documentation including block/line diagrams and algorithms
- Project implementation action plan using standard presentation tools

Each batch of students shall develop the project designed during the VIII semester. The implementation phase shall proceed as follows:

- A detailed project report in the prescribed format shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report.
- The work shall be reviewed and evaluated periodically

A committee consisting of the Project Coordinator (appointed by the Head of the Department / Division), project guide and at least one senior faculty member will carry out the assessment based on at least one interim re view and a final review just before the submission of the project report.

The final evaluation of the project shall include the following.

Presentation of the work Oral examination Demonstration of the project against design specifications Quality and content of the project report .

Guidelines for evaluation :

1.	Regularity and progress of work	20
2.	Work knowledge and Involvement	50
3.	Semester End presentation and oral examination	50
4.	Level of completion & demonstration of Functionality / Specifications	50
5.	Project Report – Presentation style and content	30
Total		**200** marks

Note: Points (i) and (ii) to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (iii) - (v) to be evaluated by the final evaluation team.

19-208-0815 VIVA-VOCE

Course Outcomes:

The student will be able to:

1. Refresh all the subjects covered during the programme
2. Gain good knowledge of theory and practice
3. Develop oral communication skills and positive attitude
4. Face technical interviews with confidence

Each student is required to appear for a comprehensive viva - voce examination at the end of the complete course work. The examination panel shall comprise of a minimum of one internal examiner and one external examiner, both appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the entire course of study and practical/analysis skills in the field.