## REGULATIONS: AVIATION OPERATIONS MANAGEMENT (LATERAL)

1. **Programme No**  
   4304

2. **Programme Name**  
   M. Sc (Aviation Operations Management)

3. **Programme Code**  
   Observer(LATERAL ENTRY)

4. **Approving Authority**  
   Naval Headquarters

5. **Eligibility Criteria for Admission**  
   (a) Qualified Observer Course  
   (b) A B.Sc.or B.E. or B.Tech degree in any discipline from any recognised university.

6. **Duration**  
   (a) Semester I & II would consist of cadet phase and SLt technical Course (32 weeks (192 working days); 36 Credits).  
   (b) Semester III & IV will be Air Operations Management course (44 weeks (200 working days); 48 Credits).

7. **Attendance Required**  
   80 % Minimum

8. **Nature**  
   (a) Selected candidates are to formally register at the beginning of IV Semester of MSc (Air Operations Management) and join with the regular batch.  
   (b) Selected candidates are to qualify the IV semester examinations along with the regular batch.

9. **Approved intake capacity**  
   As Approved by Naval Headquarters( Maximum 30)

10. **Examination Pattern**  
    Exam Paper setter would be other than Subject Instructor as nominated by CI  
    (a) 11 Written Papers  
    (b) 06 Flying training exams  
    (c) Dissertation  
    1200  
    1100  
    100

11. **Minimum Qualifying**  
    60%
Marks

(a) Aggregate Marks 60%

(b) Written Examination 50% (Except Airmanship (80 %) due to Flight Safety Management)

(c) Flying 60%

(d) Dissertation 55%

12. Grading:

(a) Grades. The following are the grades for performance in individual subject:

<table>
<thead>
<tr>
<th>Ser</th>
<th>Range of Marks</th>
<th>Grades</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>90% and above</td>
<td>S Outstanding</td>
<td>10</td>
</tr>
<tr>
<td>(ii)</td>
<td>80 - 90 %</td>
<td>A Excellent</td>
<td>9</td>
</tr>
<tr>
<td>(iii)</td>
<td>70 - 80 %</td>
<td>B Very Good</td>
<td>8</td>
</tr>
<tr>
<td>(iv)</td>
<td>60 - 70 %</td>
<td>C Good</td>
<td>7</td>
</tr>
<tr>
<td>(v)</td>
<td>50 - 60 %</td>
<td>D Satisfactory</td>
<td>6</td>
</tr>
<tr>
<td>(vi)</td>
<td>Below 50 %</td>
<td>F Failure</td>
<td>0</td>
</tr>
</tbody>
</table>

(b) Cumulative Grade Point Average. Over all performance at the end of the course is indicated by Cumulative Grade point Average (CGPA) calculated as for the subjects:

\[
\text{CGPA} = \frac{G_1C_1 + G_2C_2 + G_3C_3 + \ldots + G_nC_n}{C_1 + C_2 + C_3 + \ldots + C_n}
\]

Where G = Grade Weightage
C= Corresponding Subject Credit

(c) The classification on degree would be as follows:

<table>
<thead>
<tr>
<th>Ser</th>
<th>Classification</th>
<th>CGPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>First class with distinction</td>
<td>8 and above</td>
</tr>
<tr>
<td>(ii)</td>
<td>First Class</td>
<td>7 and above</td>
</tr>
<tr>
<td>(iii)</td>
<td>Second and above</td>
<td>6 and above</td>
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</table>
13. Details of course and credit points are as follows:

**SEMESTER III**

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>SUBJECTS/FLYING</th>
<th>C/E</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.01</td>
<td>Anti Submarine Warfare - I</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>23.02</td>
<td>Naval Oceanology &amp; Meteorology</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>23.03</td>
<td>Aeronautical Science and technology</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>23.04</td>
<td>Electronic warfare &amp; Submarine Tactics</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>23.05</td>
<td>Gunnery &amp; Photography</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>23.06</td>
<td>Radio aids</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>23.07</td>
<td>Basic stage flying &amp; preparation - I</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>23.08</td>
<td>Basic stage flying &amp; preparation - II</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>23.09</td>
<td>Basic stage flying &amp; preparation - III</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
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**SEMESTER IV**

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>SUBJECTS/FLYING</th>
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<tbody>
<tr>
<td>24.01</td>
<td>Air Navigation - I</td>
<td>C</td>
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<tr>
<td>24.02</td>
<td>Air Navigation - II</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>24.03</td>
<td>Airmanship</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>24.04</td>
<td>Instruments &amp; Magnetism</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>24.05</td>
<td>Air Operations and Tactics</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>24.06</td>
<td>Advance stage flying &amp; preparation - I</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>24.07</td>
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<tr>
<td>24.09</td>
<td>Dissertation</td>
<td>C</td>
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<tr>
<td><strong>TOTAL</strong></td>
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</tbody>
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Note:

(a) Marks for Subjects from 23.01 to 23.09 would be from Observer school examination marks list of candidates.

(b) Exams for Subjects from 24.01 to 24.08 would be conducted at school. All officers enrolled for lateral entry have to appear in all exams.
(c) Subject 24.09 would be for preparation and presentation of dissertation and would be evaluated out of 250 marks.

14. **Failure in Examination.** The candidate failing to get the necessary grade in exams shall be deemed to have failed in the examination.
### Scheme of Instruction and Examination

**MSc in Aviation Operations Management (Lateral)**

**Programme No. 4302**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Subject/Flying</th>
<th>Total Hours</th>
<th>Credits</th>
<th>Scheme of Teaching</th>
<th>Scheme of Examination Marks</th>
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<td></td>
<td>L</td>
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<tr>
<td>23.01</td>
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<td>120</td>
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<td>70</td>
<td>2</td>
<td>60</td>
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<tr>
<td>23.03</td>
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<td>2</td>
<td>70</td>
<td>40</td>
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<tr>
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<td></td>
<td>L</td>
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<td>60</td>
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<td>630</td>
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MSc IN AVIATION OPERATIONS MANAGEMENT

PROGRAMME NO. 4302 (LATERAL)

SEMESTER III

23.01 ANTI SUBMARINE WARFARE

1. Lecture per week: 7 Hr
2. Practical per week: 00 Hr 40 Min
3. Max marks per theory paper: 100
4. Duration per paper: 04 Hr
5. Total number of Modules: 04
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

MODULE 1


MODULE 2

9. LOFAR: Low Frequency Analysis and Recording principles, Broad band and narrow band analysis, noise generated by submarine and various types of power plants, Noise ranging LOFAR signature analysis and Introduction to Towed Array system.

MODULE 3

10. ANTI SUBMARINE WARFARE TACTICS I: Basic ASW definitions, types of ASW aircrafts their control and operations, Coordinated ASW operations,
11. **ANTI SUBMARINE WARFARE TACTICS II**: Coordinated ASW attack and search plans, ASW screen and their construction, merits and demerits of ASW screens, introduction to basic and advanced anti submarine exercise, evasive measures and counter measures in ASW.

**BOOKS OF REFERENCE:**

(a) Training Docket- Anti Submarine Warfare  
(b) Training Docket- Underwater Acoustics  
(c) INMI  
(d) Principles of Underwater sound by Robert Urick  

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**23.02 NAVAL OCEANOLOGY & METEOROLOGY**

1. Lecture per week: 04 Hr  
2. Practical per week: 00 Hr 40 Min  
3. Max marks per theory paper: 100  
4. Duration per paper: 03 Hr  
5. Total number of Modules: 04  
6. Number of questions from each Module: EQUAL  
7. Total number of questions to be answered: All  

**MODULE 1**

8. **OBSERVE WEATHER DURING FLYING**: Brief description about Met Instruments, Structure of atmosphere, Atmospheric pressure, Change of temperature and pressure with height, Visibility, Lapse rate, Stability conditions of atmosphere, Clouds, Thunderstorms, Jet streams, Tornado, Water sprouts, Winds, Buy Ballots law and mountain waves.
MODULE 2

9. **USE OF MET INFORMATION FOR AIR NAVIGATION:** Synoptic hours of Observations, Instruments and non instruments observations, Coding procedures for aviation weather reports, METAR, SPECI & Landing reports.

MODULE 3

10. **USE OF MET INFORMATION FOR AIR OPERATION:** Synoptic metrology, Climatology of India, High altitude meteorology, Radar and satellite information and aviation forecasts.

MODULE 4

10. **EXPLOIT EFFECT OF OCEAN WATER PROPERTIES IN UNDERWATER OPERATIONS:** Continental Shelf, Sea mounts, Oceanic Ridge, Coral reef Atolls, Hydrosphere, Geography of Oceans, Water Mass, Salinity, Factors affecting salinity and its effect on sound propagation.

**BOOKS OF REFERENCE:**

(a) Training Docket- Oceanology

(b) Training Docket- Aviation Meteorology

(c) Aviation weather handbook by Terry T Lankford

23.03 **AERONAUTICAL SCIENCE AND TECHNOLOGY**

1. Lecture per week: 4 Hr 40 Min
2. Practical per week: 02 Hr 40 Min
3. Max marks per theory paper: 100
4. Duration per paper: 03 Hr
5. Total number of Modules: 04
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All
MODULE 1

8. **RADIO/RADAR THEORY:** Principle of radar operation, factors affecting radar range, Types of tracking radars, methods used in tracking radars, Radar echo and types of distortion in radar echoes, technical specification and details of naval aviation radars, basic radio theory, aerial parameters and radiation mechanisms, principle of communication using satellites.

MODULE 2

9. **AIRFRAMES AND AERO ENGINES:** Aerodynamics and principles of flight, advantage/disadvantage of aircraft over helicopter, aircraft construction and function of each part, Control surfaces, Aircraft systems, Classification of airframe, Cabin and cockpit layouts, types of aero engines and their imitations, aircraft performance under various conditions, aircraft maintenance procedures and documentations.

MODULE 3

10. **UNDER WATER WEAPONS & SENSORS:** Functional and operational characteristics of SONAR, Sonobuoys and monitoring system, introduction to air under water weapons, limitation and capabilities of air under water weapons, loading/unloading procedures of air weapons and Sonobuoys and safety precautions related to it.

MODULE 4

11. **SHORT AIRCRAFT MAINTENANCE COURSE:** Functioning and capabilities of various systems and sensors fitted on the aircraft on which flying is to be conducted. The systems would include avionics system, navigation system, hydraulic system, fuel system etc.

**BOOKS OF REFERENCE:**

(a) Training Docket- Naval Institute of Aviation Technology
(b) Training Docket- Aircraft Engines
(c) Naval Aircraft Maintenance Manual
(d) Introduction to Radar systems by Merrill I. Skolnik
(e) Mechanics of Flight by A.C Kermode
23.04 ELECTRONIC WARFARE & SUBMARINE TACTICS

1. Lecture per week: 04Hr
2. Practical per week: 00Hr 40 Min
3. Max marks per theory paper: 100
4. Duration per paper: 04
5. Total number of Modules: 05
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

MODULE 1

8. ELECTRONIC WARFARE APPLICATION & ELECTRONIC WARFARE ACTIVITIES: History and growth of Electronic Warfare, Scope of Electronic Warfare, Electronic Support Measure tree, organize Electronic Support Measure search and direction finding task within a force, exploitation of Electronic Warfare system in tactical scenario and correlation of data with other sensors. ORPAS operation and its exploitation, modern trend in Electronic Warfare.

MODULE 2

9. CONVERSANT WITH ALL ASPECTS OF INFORMATION WARFARE: Concept of information warfare, subsets of information warfare, IW initiatives of Indian Navy and its offensive and defensive measures, network centric operations.

MODULE 3

10. TACTICS EMPLOYED BY SUBMARINE AGAINST SURFACE AND AIR ASW UNITS: Peculiarities of submarine warfare and types of submarine missions, technical and tactical consideration for choosing a patrol operational deployment and tactics of nuclear submarine of radar operation, Passage planning by submarine, attack tactics used by submarine, submarine evasion tactics, classification technique used by submarine, submarine communication.

MODULE 4

11. CAPABILITIES/LIMITATIONS OF OWN AND ENEMY SUBMARINES: General machinery layout in conventional submarines, various regimes of operation of machineries and its impact on LOFAR signatures, weapon capabilities of own and enemy submarines, limitation of conventional submarine,
sonar and ESM capabilities of own and enemy submarines and its exploitation, future development and trends.

**MODULE 5**

12. **PRACTICAL ASPECTS OF SUBMARINE TACTICS:** Consolidate the theoretical knowledge gained with practical experience at sea.

**BOOKS OF REFERENCE:**

- (a) Training Docket- Airborne Electronic warfare
- (b) Training Docket- Submarine Tactics
- (c) INMI/ SMOTIS
- (d) EW 101 by David Adamy

**23.05 GUNNERY & PHOTOGRAPHY**

1. Lecture per week: 02 Hr 20 Min
2. Practical per week: Nil
3. Max marks per theory paper: 100
4. Duration per paper: 04Hr
5. Total number of Modules: 04
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

**MODULE 1**

8. **GUNNERY TACTICS AND PROCEDURES:** Basic principles of anti missile defence, air defence formation and Avanguard procedures. Hard kill and soft kill measures, OTHT procedures, Combat air patrol and its tactical employment.

**MODULE 2**

9. **WORKING OF VARIOUS TYPES OF MISSILES:** Introduction to various missiles, their capabilities, limitation, tactical and technical data.
MODULE 3

10. TYPES OF MISSILES, CAPABILITIES AND THEIR EXPLOITATION: Flight profile of missiles after launch, search patterns, target acquisition, type of guidance, weapon danger zone.

MODULE 4

11. PHOTOGRAPHY: Theories of photography, Installation of camera manually & by remote control, operation of hand held camera, Radarscope and Digital Camera, calculations of camera operation for mosaic construction and analysis of photographs taken during sortie.

BOOKS OF REFERENCE:

(a) Training Docket - Aviation Gunnery
(b) Training Docket - Aviation Photography

23.06 RADIO AIDS

1. Lecture per week: 04 Hr
2. Practical per week: Nil
3. Max marks per theory paper: 100
4. Duration per paper: 03 Hr
5. Total number of Modules: 04
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

MODULE 1

8. THEORY OF RADIO WAVE PROPAGATION, FREQUENCY BAND & THEIR USES: Introduction to radio aids, relationship between frequency and wavelength, sky wave propagation, space wave propagation, different frequency bands and their advantages and disadvantages.
MODULE 2

9. READ, INTERPRET AND USAGE OF VARIOUS RADIO AIDS FOR NAVIGATION: Understand loop theory, non-directional beacon (NDB), Automatic direction finder (ADF), VOR, DVOR, instrument landing system (ILS), primary and secondary radars, airborne weather radar, Ground control approach radar (GCA), precision approach radar (PAR), Doppler navigation system, radio altimeter, radar altimeter, Distance measuring equipment (DME), IFF/SSR, Global positioning system (GPS).

MODULE 3

10. PRACTICAL USAGE OF RADIO AIDS FOR NAVIGATION: Non directional beacons (NDB), Automatic direction finder (ADF), VOR, DVOR, instrument landing system (ILS), primary and secondary radars, airborne weather radar, Ground control approach radar (GCA), precision approach radar (PAR), Doppler navigation system, radio altimeter, radar altimeter, Distance measuring equipment (DME), IFF/SSR, Global positioning system (GPS).

MODULE 4

11. MODERN DEVELOPMENT IN AVIONICS: Understand modern development, TACAS, Concepts of FANS, Pulse modulation technique, optical fiber generation and its use, multiplexing its principles and its use.

BOOKS OF REFERENCE:

(a) Training Docket- Avionics
(b) Training Docket- Air Navigation
(c) Pilots radio communications handbook by Paul E Illman

23.07 BASIC STAGE FLYING & PREPARATION - I

1. Lecture per week: 04 Hr
2. Practical per week: 00 Hr 40 Min
3. Max marks per theory paper: 150
4. Duration per paper: 04 Hr
5. Total number of Modules: 5
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

**MODULE 1**

8. **AIR EXPERIENCE AND INTRODUCTION TO AIR PLOT:** Aircraft familiarisation, air experience, initiation to map reading, map reading by day, introduction to air plot navigation, RT monitoring.

**MODULE 2**

9. **AIR PLOT:** Air plot navigation, use of radio position lines, simultaneous fixing by two position line, range by VOR DME, introduction to three position line running fix.

**MODULE 3**

10. **FIXING METHODS USING RADIO AID POSITION LINES:** Fixing using bearing, visual & radio, use of three radio position lines, running fixes, calculation of vectored wind velocity, alter heading parallel track, alter heading D/R.

**MODULE 4**

11. **INTRODUCTION TO NIGHT FLYING:** Introduction to night flying over land, map reading by night over land, logging procedures, D/R alteration of heading, Introduction to radar.

**MODULE 5**

12. **AIR PLOT NAVIGATION BY NIGHT:** Air plot navigation by night, map reading, use of single radio position lines and construction of 3 position line fix, precautions while taking radio fix at night.

**BOOKS OF REFERENCE:**

(a) Training Docket- Air Navigation
(b) Training Docket- Ground Basics
(c) Air Navigation by Trevor Thom
23.08 BASIC STAGE FLYING & PREPARATION - II

1. Lecture per week: 04 Hr
2. Practical per week: 00 Hr 40 Min
3. Max marks per theory paper: 150
4. Duration per paper: 04 Hr
5. Total number of Modules: 4
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

MODULE 1

8. INTRODUCTION TO MARITIME RECONNAISSANCE TECHNIQUE: Introduction to navigation over sea, importance of maintaining air plot over sea, calculation of wind using air plot method, Maritime Reconnaissance technique, creeping line ahead search (CLA search).

MODULE 2

9. INTRODUCTION TO OVER THE HORIZON TARGETING: Over the horizon targeting, types of over the horizon targeting, passing of reports of over the horizon targeting from air, rectangular search with non parallel tracks.

MODULE 3

10. INTRODUCTION TO NIGHT MARITIME RECONNAISSANCE: Introduction to night navigation over sea, square search to investigate a datum, Maritime Reconnaissance technique at night. Introduction to target vision devices.

MODULE 4

11. INTRODUCTION TO STRIKE HOMING: Introduction to strike homing, passing of report of target to maritime operation centre, guiding strike aircraft to target, Battle damage assessment.

BOOKS OF REFERENCE:

(a) Training Docket- Air Navigation
(b) Training Docket- Ground Basics
<p>| | |</p>
<table>
<thead>
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<th></th>
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<tr>
<td>1.</td>
<td>Lecture per week: 04 Hr</td>
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<tr>
<td>2.</td>
<td>Practical per week: 01 Hr</td>
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<td>3.</td>
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<td>Duration per paper: 04 Hr</td>
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<td>6.</td>
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<tr>
<td>7.</td>
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**MODULE 1**

8. **LETDOWN PROCEDURES**: Let down using Very High Frequency Omni range, Non directional beacon, Instrument landing system.

**MODULE 2**

9. **DATUM SEARCH, SEA LINES OF COMMUNICATION MONITORING**: Square search to investigate a datum, monitoring shipping traffic in sea lines of communication, analysis of SLOC traffic to observe enemy ships, tactical problems.

**MODULE 3**

10. **CROSSOVER PATROL**: Planning a cross over patrol & advantage of cross over patrol with respect to other patrol, patrolling over a choke point to prevent enemy unit passing undetected.

**MODULE 4**

11. **CONSOLIDATION**: Consolidation sortie by day and night, position fixing during dusk hours, navigation over land followed by navigation over sea using all aids, navigation during day as well as during night.
MODULE 5

12. **END OF TERM SORTIE:** Sortie by day and night. Pupil will be assessed for their knowledge and procedures before progressing to advanced stage (Semester IV).

**BOOKS OF REFERENCE:**

(a) Training Docket- Air Navigation  
(b) Training Docket- Ground Basics  
(c) Air Navigation by Wg Cdr R.K. Bali (Retd)

SEMESTER IV

24.01 AIR NAVIGATION - I

1. Lecture per week: 04 Hr 40 Min  
2. Practical per week: 2 Hr  
3. Max marks per theory paper: 100  
4. Duration per paper: 04 Hr 30 Min  
5. Total number of Modules: 04  
6. Number of questions from each Module: EQUAL  
7. Total number of questions to be answered: All

**MODULE 1**

8. **MEDIUM LEVEL NAVIGATION AND FLYING PROCEDURES:** Introduction to air navigation, identification of direction, distance and position on the earth and chart and correlation between two, use of navigation equipments, use of map for medium level navigation, compute wind accurately in air, aspects of flight planning, maintenance of accurate log in air.
MODULE 2

9. **TACTICAL PROBLEMS**: Critical points, Point of no return, last point of diversion, Radius of action, air to air interception, air to ground interception, maintaining last track, not maintaining last track, timing action by speed adjustment, timing action by distance.

MODULE 3

10. **DR PLOTS & SIMULATOR EXERCISE**: DR Plots, SIMEX at appropriate flying stages.

MODULE 4

11. **FUEL PLANNING AND LOGGING**: Phases of flight and track keeping rules, fuel planning, track plot, air plot, mental DR, position line and fixes, most probable position, range by navigation aids and maintenance of accurate log in air.

**BOOKS OF REFERENCE**:

(a) Training Docket- Air Navigation

(b) Training Docket- Advanced Air Navigation

(c) Air Navigation by Wg Cdr R.K. Bali (Retd)

**24.02 AIR NAVIGATION - II**

1. Lecture per week: 04 Hr
2. Practical per week: Nil
3. Max marks per theory paper: 100
4. Duration per paper: 03 Hr
5. Total number of Modules: 04
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All
8. **LOW LEVEL NAVIGATION** low level navigation map preparation, timing action and track keeping for low level navigation, safety check during low level navigation.

**MODULE 2**

9. **MAPS & CHARTS**: Basic principles of map projection, principle and characteristics of all conic all projections, characteristics of cylindrical projections, Gnomonic projections, polar stereographic projection, plotting position lines on all projections.

**MODULE 3**

10. **MARITIME RECONNAISSANCE NAVIGATION**: Maritime reconnaissance techniques over sea, plotting procedures over sea, radio position lines, navigation procedures for search and patrol, SAR – Dinghy and PLB search.

**MODULE 4**

11. **MARITIME RECONNAISSANCE**: Maritime reconnaissance, gambit tactics, planning an SAR sortie profile, Maintenance of Log in an SAR sortie, Calculations of search area with respect to time available and fuel balance. ROA, CP, PNR calculations.

**BOOKS OF REFERENCE**:

(a) Training Docket- Maps and Charts
(b) Training Docket- Low level Navigation

**24.03 AIR MANSHP**

1. Lecture per week: 04 Hr
2. Practical per week: Nil
3. Max marks per theory paper: 100
4. Duration per paper: 03 Hr
5. Total number of Modules: 04
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All
MODULE 1

8. **OPERATIONS MANAGEMENT:** Air space management during regular flying, disaster management in the event of natural calamities, aid to civil aviation for emergencies arising out of hijacking and other terrorist activities.

MODULE 2

9. **RULES/REGULATIONS OF AIRFIELD & AIRSPACE MANAGEMENT:** Standard operating procedures, Air traffic organisation, FIR, ADIZ, flight rules, ICAO publications, NOTAM, Jeppessen Charts, ground handing of aircraft, Safety procedures during climb and descent, let down procedures, Standard communication procedures. Understand various conventions, rules, operations, provision and responsibility of airspace.

MODULE 3

10. **SURVIVAL TECHNIQUES:** Use of safety equipments, maintenance and their use in emergency, SAR organisation and functions, GMDSS. Understand the best means of survival technique under adverse conditions. Survival techniques over Sea, desert and snow. Aviation medicine- understands the physical and psychological effects of flying. First aid techniques.

MODULE 4

11. **SAR MANAGEMENT:** Disaster management for aircraft crash over land/sea, SAR management, planning for search of survivors, fishing boat, casualty evacuation etc from sea. Dispersal management. Aircraft movement / parking on ground, hangar evacuation plan, aircraft emergencies on ground, post-accident plan management.

**BOOKS OF REFERENCE:**

(a) Training Docket- Air Regulations

(b) Training Docket- Airfield and Air Space Management

(c) Air Regulations by Wg Cdr R.K. Bali (Retd)
24.04 INSTRUMENTS & MAGNETISM

1. Lecture per week: 4 Hr
2. Practical per week: Nil
3. Max marks per theory paper: 100
4. Duration per paper: 04 Hr
5. Total number of Modules: 04
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

MODULE 1

8. AIRCRAFT PRESSURE INSTRUMENTS: Requirement and standard of aircraft instruments, standardization of the pressure instruments, principle and usage of temperature measuring gauges, Altimeter, Air speed indicator, Vertical speed indicator, Mach meter.

MODULE 2

9. READ, INTERPRET AND USAGE OF VARIOUS RADIO AIDS FOR NAVIGATION: Data transmission system, its principle, errors limitations and uses. Gyroscope, laws of gyro dynamics, properties of gyroscope and their application in various aircraft instruments, Directional gyro, Attitude indicator, Turn slip indicator, Rate gyro, Ring laser gyro, Artificial horizon, Integrating gyro etc.

MODULE 3

10. MAGNETISM & DEVIATION: Concept of direction, methods of expressing direction, earths magnetism & how it is used for direction finding, deviation & its causes, Hard and soft iron magnetism, deviation coefficient A,B,C,D,E and total deviation formula, vertical component of aircraft magnetism.

MODULE 4

11. COMPASS: Direct indicating compass and its errors, Watt datum compass, Remote indicating compass, principle and working of gyro magnetic compass, difference in various types of gyro magnetic compass, procedure of compass swing.
BOOKS OF REFERENCE:

(a) Training Docket- Aviation Instruments
(b) Training Docket- Compass and Magnetism
(c) Magnetism and Magnetic Material by J. M. D Coey

24.05 AIR OPERATIONS & TACTICS

1. Lecture per week: 4 Hr
2. Practical per week: Nil
3. Max marks per theory paper: 100
4. Duration per paper: 03 Hr
5. Total number of Modules: 04
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

MODULE 1

8. SEARCH & PATROL MANAGEMENT: Capabilities & limitations of various equipments fitted on naval aircraft and induction plan of future aircraft. Search and patrol, Calculation and planning for visual and radar searches, tactics involved in surface and air antisubmarine operations.

MODULE 2


MODULE 3

10. INDIVIDUAL MISSIONS / OPERATIONS:

(a) Search and rescue Sortie.
(b) Range Clearance Sortie.
Module 4

11. **Individual Missions / Operations / Tactics Management:**

   (a) Maritime Recce and anti-submarine warfare search.
   
   (b) Tactical deployment of sonobuoys.
   
   (c) Magnetic anomaly detection, principle & Limitations.
   
   (d) Unmanned Aerial Vehicle Principle & tactical utility.
   
   (e) Gambit Tactics.
   
   (f) Rules of engagement - with respect to surface, sub surface and aircraft.
   
   (g) International Maritime law and its implications.

**Books of Reference:**

   (a) Training Docket- Tactics

   (b) INMI

   (c) SAR Convention 1979 manual: Maritime search and rescue

24.06 Advanced Stage Flying and Preparation - I

1. Lecture per week: 04 Hr

2. Practical per week: 00 Hr 40 Min

3. Max marks per theory paper: 150
4. Duration per paper: 04 Hr
5. Total number of Modules: 4
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

**MODULE 1**

8. **INTERNATIONAL AIRFIED PROCEDURES**: procedure from international airfield, radius of action interception, Air plot tactical navigation, maintaining timing action by air plot method.

**MODULE 2**

9. **INTRODUCTION TO ELTA RADAR**: ELTA radar familiarisation, switching on/off procedure, display area familiarisation, soft key operation and tactical area analysis, tactical area symbology.

**MODULE 3**


**MODULE 4**

11. **CONSOLIDATION ON ELTA**: Functions of all keys, State s of ELTA radar, modes of ELTA, magnification of radar picture, measurement of target dimensions.

**BOOKS OF REFERENCE**:

(a) Training Docket- Air field and Airspace management
(b) ELTA operations Manual

**24.07 ADVANCED STAGE FLYING AND PREPARATION - I**

1. Lecture per week: 04 Hr
2. Practical per week: 00 Hr 40 Min
3. Max marks per theory paper: 150
4. Duration per paper: 04 Hr
5. Total number of Modules: 4
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

**MODULE 1**

8. **INTERNATIONAL AIRFIELD PROCEDURES:** procedure from international airfield, radius of action interception, Air plot tactical navigation, maintaining timing action by air plot method.

**MODULE 2**

9. **INTRODUCTION TO ELTA RADAR:** ELTA radar familiarisation, switching on/off procedure, display area familiarisation, soft key operation and tactical area analysis, tactical area symbology.

**MODULE 3**

10. **ELTA OPERATIONS & MANAGEMENT:** Navigation over sea using ELTA radar, modes of operation of ELTA and target classification, observation of sea lines of communication using ELTA radar, tactical area analysis.

**MODULE 4**

11. **CONSOLIDATION ON ELTA:** Functions of all keys, States of ELTA radar, modes of ELTA, magnification of radar picture, measurement of target dimensions.

**BOOKS OF REFERENCE:**

(a) Training Docket- Air field and Airspace management
(b) ELTA operations Manual

**24.08 ADVANCED STAGE FLYING AND PREPARATION - III**

1. Lecture per week: 04 Hr
2. Practical per week: 01 Hr
3. Max marks per theory paper: 200
4. Duration per paper: 04 Hr
5. Total number of Modules: 4
6. Number of questions from each Module: EQUAL
7. Total number of questions to be answered: All

MODULE 1

8. **INTRODUCTION TO LOW LEVEL NAVIGATION:** Planning and execution of low level navigation for identification & bombing of target. Precautions to be taken while planning a low level sortie.

MODULE 2

9. **LOW LEVEL NAVIGATION:** Navigation technique for navigation of aircraft at low level maintaining aircraft on track and use of timing action to reach target on time i.e. all track keeping and timing action rules.

MODULE 3

10. **CONSOLIDATION:** Consolidation by day and night, use of all aid for navigation, revision of all the procedures, navigation over land flowed by navigation over sea, use of ELTA for aiding various maritime operations at sea.

MODULE 4

11. **END OF TERM SORTIE:** Day and night sortie to check proficiency of pupil on all aspects of navigation before passing out of observer school.

**BOOKS OF REFERENCE:**

(a) Training Docket- Air field and Airspace management

(b) ELTA operations Manual

24.09 DISSERTATION

1. Lecture per week: 04 Hr
2. Practical per week: 01 Hr
3. Max marks per theory paper: 250
4. Duration per paper: 04 Hr
5. Total number of Modules: 01
6. Number of questions from each Module: Equal
7. Total number of questions to be answered: All

**MODULE 1**

8. **DISSERTATION:** The officer would be required to carry out a dissertation on aviation related topic or emerging technology affecting aviation industry.

**BOOKS OF REFERENCE:**

Observer school Standing Orders
DIVING SCHOOL

REGULATIONS – PO CD I 'Q' (8103)

DIPLOMA IN
DIVING TECHNOLOGY
REGULATIONS

1. Programme No. : 8103
2. Programme Name Civil Equal : Diploma in Diving Technology
3. Programme Code Naval Equal : Petty officer (Clearance Diver) Course
4. Approving authority : Naval Headquarters/CABS
5. Eligibility criteria for admission :
   (a) Higher Secondary (10+2) in PCM (Physics, Chemistry and Maths) with minimum 55% marks.
   (b) Successful completion of ab-initio course at INS Chilka with 50% aggregate marks.
   (c) Successful completion of Basic ‘Q’ course at Diving School (Part II of Basic ‘Q’ training) with minimum duration of 20.5 weeks including 05 weeks at Seamanship School (Part I of Basic ‘Q’ training).
   (d) Minimum 20 weeks of work experience after Basic ‘Q’ course at Diving School.
   (e) Successful completion of LS ‘Q’ course at Diving School (Part II of Leading ‘Q’ training) with minimum 60% aggregate for duration of 12 weeks including 02 weeks at Seamanship School (Part I of Leading ‘Q’ training).
   (f) Should have minimum Six years of service experience. This is to be certified by the head of the school after verifying from Service Documents.
6. Duration:
   PO ‘Q’ Professional Course for Diploma : 18 weeks
REGULATIONS

7. Attendance requirement: 80% minimum


9. Approved intake capacity: As approved by HQSNC/CABS

(If the trainees strength of trainees is more than 15, the course will be split into two classes to maintain optimum instructor – trainee ratio of 1:15)

10. Examination Pattern: Question paper setter and evaluator will be other than the subject instructor as nominated by the school. The teaching staff of this school will evaluate 100% of the answer sheets and results will be forwarded to the university on completion of the course. Examination pattern will be as follows:

   (a) 06 Theory exams - 500 Marks
   (b) 11 Practical exams - 650 Marks
   Total - 1150 Mark

11. Minimum qualifying marks:
   (a) Aggregate Marks - 60%
   (b) Written examination - 55%
   (c) Practical - 55%

12. Grading: The grading of the students is based on the final result, which is as follows:

   (a) 80 % and above O - Outstanding
   (b) 75 – 79.9 % A - Distinguished
   (c) 70 – 74.9 % B - Above Average
   (d) 65 – 69.9 % C - High Average
   (e) 60-64.9 % D - Average
   (f) Below 60 % F - Failure

13. Failure in Examinations:

   (a) Failure in one subject will result in warning by Chief Instructor and re-examination.
(b) Failure in two subjects or in one subject more than once will result in warning by Officer-in-Charge and re-examination.

(c) Failure in three or more subjects or in re-examination will be considered as failure in the whole course and trainee will be required to undergo the course again.

(d) Cases of failures in one or two subjects, absence on medical grounds, may be retained in the establishment by two weeks for additional coaching and re-examination, subject to approval by HQSNC.

14. **Synopsis** of subjects PO 'Q' CD I is appended below:-

**PO 'Q' CD I Course.**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Marks</th>
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<tr>
<td>0901</td>
<td>Diving Theory</td>
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<tr>
<td>0902</td>
<td>Marine Salvage</td>
<td>100</td>
</tr>
<tr>
<td>0903</td>
<td>Demolition Theory</td>
<td>100</td>
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<tr>
<td>0904</td>
<td>Equipment</td>
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<td>0905</td>
<td>Mine Clearance</td>
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<tr>
<td>0906</td>
<td>Clearance Diving General</td>
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<td>0907</td>
<td>Task Book recording</td>
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<tr>
<td>0908</td>
<td>Practical supervision of Recompression Chamber</td>
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<tr>
<td>0909</td>
<td>Practical Clandestine Operations</td>
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<td>0910</td>
<td>Personal Physical conditioning</td>
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<td>0911</td>
<td>Diving at high altitudes</td>
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<tr>
<td>0912</td>
<td>Open Water Diving</td>
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<tr>
<td>0913</td>
<td>Search &amp; Rescue diving &amp; Combat Beach Reconnaissance</td>
<td>50</td>
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<tr>
<td>0914</td>
<td>Evaluation of Supervisory skills by carrying out Power Point presentations and other diving emergencies</td>
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SCHEME OF INSTRUCTION
AND EXAMINATION
FOR
DIPLOMA
(DIVING TECHNOLOGY)
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**03.01.01 DIVING THEORY**

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<td>Total no of questions to be answered</td>
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**MODULE 1**

**PHYSICS OF DIVING**

- Introduction, Force, Pressure, Density, Liquids and Gases, Water Pressure, Atmospheric pressure, Absolute pressure and Gauge Pressure.

**MODULE 2**

**ARCHIMEDES'S PRINCIPLE AND BUOYANCY**

- Displaced liquids and Upthrust, Buoyancy, Effects on divers, Emergency ascent.

**MODULE 3**

**BOYLE'S LAW AND THE EFFECTS OF PRESSURE**

- Boyle's law, Effects of pressure on immersed objects, Effects of pressure on the body, Sinuses, Ears, Lungs, Facemask Squeeze.
MODULE 4

PHYSIOLOGY OF DIVING

Respiration, Heart, Circulation of the blood, Blood, Lungs, Oxygen Requirements of the body.

MODULE 5

DALTON'S LAW OF PARTIAL PRESSURE AND GAS POISONINGS

Partial Pressures, Dalton's Law of Partial Pressure, Partial pressure and Gas Poisonings (Oxygen poisoning, Carbon dioxide poisoning, Carbon monoxide poisoning, Hyperventilation, Other Gases, Nitrogen)

MODULE 6

PROBLEMS OF NITROGEN

Introduction, Nitrogen Narcosis, Decompression, Solution of Nitrogen in the body, Saturation, Physical effects of decompression, Super Saturation, Decompression stops and decompression tables, Diving at altitudes, Symptoms and treatment of decompression sickness, Aseptic Necrosis of Bone.

MODULE 7

MISCELLANEOUS PHYSICAL PHENOMENA

Introduction, Underwater Vision, Underwater sound and Heat transfer underwater.

BOOKS OF REFERENCE

BR 2806
Training Docket – Diving Theory
03.01.02 MARINE SALVAGE

Lecture per week : 5 + 5 Hrs
Max marks per theory paper : 50
Duration per paper : 3 Hrs
Total no of modules : 7
No of question from each module : 10
Total no of question to be answered : All

MODULE 1

DIVER SHIP MAINTENANCE

Underwater tasks, briefing, preliminary inspection, rigging, outer bottom scrubbing of surface ships, clearing or examining valves, clearing propellers, cleaning of propellers, dressing of propellers, propellers changing, cleaning or 2.5m and 4m Sonar Domes, dome exchange and submarine transducer exchange, magnets.

MODULE 2

WRECK SURVEY AND DIVING REQUIREMENTS

Buoying a wreck during survey, types of material used in ship construction - nomenclature, types of material used in ships construction – nomenclature, details of ship construction, typical cargo ship layout and construction terminology, layout of bulk cargo carrier, Isherwood system of framing for cargo ship and tanker.
MODULE 3

PREPARATION FOR PASSING LIFTING WIRES

Methods used, sweeping method, tunnelling method, reaction jet, air lift, air supply, tunnelling procedure.

MODULE 4

COFFERDAMS BULK HEAD SHOARING AND PATCHING


MODULE 5

UNDERWATER PNEUMATIC & HYDRAULIC TOOLS

General – Tools available, principle of operation, supply and exhaust hoses, operation, repairs to tools, Grinder – General, changing chisels, applications, Chipper – General, changing chisels, applications, Drilling machine(small – General, applications, Drilling machine(large) – General, applications, Brushing machine – General, applications, Ratchet spanner - general, Attachments - availability

MODULE 6

UNDERWATER WELDING AND CUTTING

Principles of welding, equipment required, specifications, direct current welding generator, knife switch, electrode holder, supply lead, return current or earth clamp, generator earth lead, electrodes, tools, rubber gloves or neoprene mitts, welding mask, welding visor, technique of welding, methods employed, patching, Cutting - equipment in use, oxy-arc cutting, principle of oxy-arc cutting, equipment required, specifications, direct current generator, knife switch, solenoid valve, oxygen supply arrangements, oxygen regulator, oxygen supply to torch, type of DC3 cutting torch, electrodes, electrical supply and return leads, methods of cutting, oxy-hydrogen cutting, advantages, principle of oxy-hydrogen cutting.
MODULE 7

COX SUBMERGED BOLT DRIVING AND PATCHING GUN

Introduction, description, main components, barrel holder, construction, firing catch, gun sling, barrels, nose, arrester blocks, stabilizer, extension bolt, wooden ferrules, 'T' adaptor, wooden registers, protective flange, ammunition, ammunition marking,

TEXT BOOK REFERENCE

- BR 2808
- Training Docket – Marine Salvage
03.01.03 UNDERWATER DEMOLITION

Lecture per week : 2 + 3 Hrs
Max marks per theory paper : 50
Duration per paper : 4 Hrs
Total no of modules : 7
No of question from each module : 20
Total no of question to be answered : All

MODULE 1

DEMOLITION THEORY

Types of explosive, types of detonator, types of safety fuze, the initiation train, types of demolition, tamping, direction of the detonation wave, shaped or cavity charges.

MODULE 2

DEMOLITION CHARGES IN THE NAVY, STORES AND MATERIAL, DESCRIPTION, FITTING AND PREPARATION

To unfit charges, comparison of firing methods, dual initiation, fuze, safety fuze, No. 11MK2 and 18MK1, Igniters, igniters, safety fuze, watertight, MK1, igniter, safety fuze MK3, to ignite safety fuze, detonators, percussion, No5, Electric No 79 MK1N, Detonator safety fuze no 80MK1N, to fit a length of safety fuze to a detonator no. 80 MK1N, cordtex, cordtex accessories, sleeve, fuze sealing, watertight demolition MK1, to fit cordtex to detonators, Disposal of fitted detonators, to fit the scare charges, demolition, 1 lb, throwing the charge, to fit the charge for demolition use, to fit the charge for firing by safety fuze
MODULE 3
INITIATION AND FIRING OF CHARGES

Multiple charges, methods of using cordtex, initiation by cordtex, electrically wired circuits, electrical data for firing circuits, dynamo exploder MK7, firing circuits, connecting up, to test detonators and circuits, to test ohmmeters, safety, to test detonators, electric, to test firing cables, to test dynamo exploder or firing battery, to test circuits of multiple charges, prcker tests to find a break in a circuit, misfires, dual system of initiation.

MODULE 4
HANDLING AND FIRING OF EXPLOSIVES - PRECAUTIONS

General safety precautions, before firing, misfires, precautions during preparation of charges, additional safety precautions during instruction and training, handling and stowage of explosives, handling detonators, stowage of detonators, radio and lightening hazards, precautions in wartime.

MODULE 5
TYPES OF CHARGES – PLACING AND CALCULATION OF SIZE

Classification of charges, cutting or shattering charges, Cutting steel girders, Breaching charges, Borehole charges, Pneumatic drilling, Boring with beehives, Boreholes in timber, Pressure charges, Mined charges, Concussion charges, Specific targets, Quays, Jetties and piers, Boom defences, wires and chin cables, Docks, caissons and lock gates, Beach obstacles, Block ships and scuttling charges, Bridges, Railways, Destruction of airfield runways, Industrial targets, Oil, gas and petrol installations, electric installations and power stations, Destruction of common machinery, Rectifiers, Guns, Armoured fighting and other vehicles, Munitions – mines, bombs, projectiles, torpedoes, ammunition and depth charges, Precautions, countermining charge size and safe distances, Underwater demolitions, Gas and incendiary missiles, Stacks of munitions, Other targets.
MODULE 6

EXECUTION OF DEMOLITION TASK

Demolition operations, preliminary demolitions, tactical or reserved demolition, role of the Naval demolition platoon, demolition schedule, reconnaissance, reporting, organizing the reconnaissance, making the reconnaissance, points to look for on demolition reconnaissance, preparing the demolition, long-standing demolitions, firing points, initiation points, firing the charges, NATO procedure, duties of the firing arty on reserved demolitions.

MODULE 7

ORGANISATION AND TRAINING OF DEMOLITION PARTIES

Individual ship demolition party, support of demolition operations: the demolition guard, demolition platoon as part of a fleet or squadron company or battalion, stores to be carried, landing on active service, notes and explanation of the example, training Army responsibility, NATO procedure, orders to the demolition guard commander.

TEXT BOOK REFERENCE

- BR 338(1)
- Training Docket— DEMOLITION
03.01.04 EQUIPMENT

Lecture per week : 5 Hrs
Max marks per theory paper : 100
Duration per paper : 3 Hrs
Total no of modules : 07
No of question from each module : 20
Total no of question to be answered : All

MODULE 1

BASCCA, DIVATOR, SUPERLITE HELMET 17- B

Introduction, the apparatus, main components, cylinder cradle, cylinder assemblies, cylinder valves, manifold, first stage reduction valve, pressure gauge, intermediate pressure hose connection, second stage demand valve, breathing circuit, operation and endurance, technical description, models and duration, air supply, harness, regulator unit, reserve air unit, breathing valve, facemask, usage, cleaning, storage, diving at low water and or air temperature

MODULE 2

DC 55, OXYGER 57 SET & BOOSTER PUMP

Principle of operation, description, preparation of the unit, operation, maintenance, accessories and consumable matter, oxygen cylinder, demand valve assembly, breathing bag, the harness, Working principle, performance, characteristics, description, preparation of the unit. Booster pump - general, description, technical characteristics, installation—commissioning, utilization mode, calculation note, maintenance.
MODULE 3

TYPES OF RE-COMPRESSION CHAMBER AND ASSOCIATED SYSTEM DESIGN AND CONSTRUCTION

Different types of re-compression chambers, design and construction, acceptance trials, proof test periodicity, procedure of hydraulic and pneumatic test, oxygen system, communication system.

MODULE 4

INFLATABLE CRAFT

Construction, design and fabrication, Pressure testing, pressure test of buoyancy chambers, bulkhead test, safety-topping-up valve test, flotation test and deployment.

MODULE 5

OUT BOARD MOTOR

Different types of OBMs, Maintenance, weekly, monthly, half yearly, yearly Maintenance schedule and routine.

MODULE 6

DIVING COMPRESSORS AND GAS ANALYSIS

Different types of compressors, operating procedure, charging procedure and their maintenance. Gas purity and analysis as per BS 4001.

MODULE 7

UNDERWATER TV CAMERA & DUKANE LOCATOR SYSTEM

The principle, parts of camera, preparation, basic operation, camera care and maintenance. Dukane – Introduction, general description, physical characters, beacon mounting, beacon signal, environmental test, theory of operation, installation, operation, testing and adjustments, beacon off-current consideration, battery off-current test, beacon maintenance.
TEXT BOOK REFERENCE

- BR 2807
- Training Dockets – Diving Equipment
- Equipment exploitation and maintenance manuals
03.01.05 MINE CLEARANCE

Lecture per week : 5 + 5 Hrs
Max marks per theory paper / practical : 100
Duration per paper : 4 Hrs
Total no of modules : 5
No of question from each module : 15
Total no of question to be answered : All

MODULE 1

SHAPED CHARGE CUTTING OUTFIT AND RENDER SAFE PROCEDURE TOOLS

Purpose of equipment, brief description of equipment, description of SCCO (E) equipment, use of equipment, forming of charge liner and base sector, preparation of sections for assembly, filling the line charges, fitting detonators, ancillary equipment, diameter gauge, Jablex and adhesive, brass strip, fastening ring, liner tensing tool, clip hook, crimping tool, portable generator.

MODULE 2

MINE RADIOGRAPHIC OUTFIT CAMERA

Introduction, Principles of radiography, radiation hazards, description of equipment, Team personnel, MRO, the shutter mechanism, controls, clamps, cassette container, screens, processing solutions, detection equipment, handling road, transit and storage of source, source calculation, loading of source, using the equipment, removing the exposed film, replacement of the source, dose and dose rate, source strength, half life.
MODULE-3

LIMPET MINE DISPOSAL EQUIPMENT

Introduction and description, the injector, associated firing equipment, buoyancy aid, safety custody and use of cartridge, damage control, RADHAZ safety precautions, electrostatic energy, firing angle and stand of distance, disposal officer, LMDE handler, operating procedure, deployment and firing, before firing and after firing and maintenance.

MODULE-4

MINE LIFTING BAG

Purpose, principle, brief description, use, venting valves, air used, draught, description of components, time delay mechanism, preparation of used mine lifting bag, testing of equipment underwater.

MODULE-5

MODERN DAY MINE — CONSTRUCTION AND CHARACTERISTICS AND THEIR DISPOSAL

Types & Classification of mines, floating mine disposal exercise, moored mine disposal exercise, floating, towing and disposing a mine in safe place, practical exercise, planning a mine hunting/disposal operation

TEXT BOOK REFERENCE

- BR 2809
- BR 8622
- Training Docket – EOD/MID, LMDE and Dukane
- Training Docket – Mix Gas
03.01.06 CLEARANCE DIVING GENERAL

Lecture per week : 5 Hrs
Max marks per theory paper : 100
Duration per paper : 3 Hrs
Total no of modules : 4
No of question from each module : 20
Total no of question to be answered : All

MODULE 1

DIVING & SAFETY REGULATION

Diving regulations, diving responsibilities, safety regulations, selection and qualification, pay, medical and records, accidents, usual incidents and material failures.

MODULE 2

DECOMPRESSION & THERAPEUTIC DECOMPRESSION

General, decompression in the water, operation of compression chambers, decompression in water, surface decompression, therapeutic decompression, and diving tables.

MODULE 3

PLANNING AND CONDUCT OF DIVING OPERATION

Planning an operation, dressing and undressing the diver, diving accessories-preparation and operation, diving communication, general diving instructions, underwater searches and operations, diving boats, deep diving.
MODULE 4

UNDERWATER COMPASS SWIMMING

Placing the mine under ships hull, placing the mine under jetty, underwater compass swimming.

TEXT BOOK REFERENCE

- BR 2806
- Training Docket – Combat Diving
### LIST OF PRACTICALS FOR CD-I (8103)

<table>
<thead>
<tr>
<th>SER</th>
<th>SUBJECT CODE</th>
<th>PRACTICALS</th>
<th>DURATION HRS/WEEK</th>
<th>TOTAL MARKS</th>
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<tr>
<td>1</td>
<td>03.01.02</td>
<td>U/W hydraulic and pneumatic tools, U/W Welding, Oxy-Arc cutting, Oxy-hydro cutting and Cox gun firing</td>
<td>5</td>
<td>50</td>
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<td>2</td>
<td>03.01.03</td>
<td>Surface demolition at NAD Aluva and U/W demolition at Tuticorin.</td>
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<td>3</td>
<td>03.01.05</td>
<td>Operation of SCCO (E) machine, operation of MRO, loading of source in MRO, radiography of ground mine, MLB and LMDE practical</td>
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<td>03.01.07</td>
<td>Preparation and recording of Task Book covering entire syllabus of the course</td>
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<td>5</td>
<td>03.01.08</td>
<td>Practical supervision of Recompression Chamber</td>
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<td>6</td>
<td>03.01.09</td>
<td>Clandestine Operations - Placing the mine underwater compress swimming.</td>
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<td>7</td>
<td>03.01.10</td>
<td>Physical conditioning – Conduct of Personnel Physical Efficiency Tests and Physical Training</td>
<td>4</td>
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<td>8</td>
<td>03.01.11</td>
<td>Planning and conduct of Clandestine operation training and open water dives at various high altitudes.</td>
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<td>Planning and conduct of Open Water dives at various depths of Sea at different weather conditions</td>
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<td>10</td>
<td>03.01.13</td>
<td>Planning and conduct of Search and Rescue helicopter jumps and Combat Beach Reconnaissance</td>
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<td>11</td>
<td>03.01.14</td>
<td>Evaluation of Supervisory skills by carrying out Power Point presentations and other diving emergencies</td>
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NUCLEAR, BIOLOGICAL, CHEMICAL DEFENCE AND DAMAGE CONTROL
INCLUDING FIRE FIGHTING SCHOOL

REGULATIONS JSSO CBRN COURSE - 61:03

CERTIFICATION IN NUCLEAR, BIOLOGICAL CHEMICAL (NBC)
DEFENCE/SAFETY, DISASTER CONTROL
# REGULATIONS JSSO CBRN COURSE

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<table>
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<tr>
<td>1</td>
<td>Programme Number : 61:03</td>
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<tr>
<td>2</td>
<td>Programme Name : Certification in Nuclear, Biological Chemical (NBC) Defence/Safety, Disaster Control and Ship Fire Fighting Management</td>
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<td>3</td>
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<td>4</td>
<td>Approving Authority : Service Headquarters (Indian Army/Indian Navy/Indian Airforce)</td>
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<td>Eligibility Criteria for Admission:</td>
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<td>Basic Qualifications for all:-</td>
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<td></td>
<td>(I) Commissioned Officer nominated by respective Service Headquarters (Indian Army/Indian Navy/Indian Airforce).</td>
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<tr>
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<td>(II) A Degree (BTECH/BE/BSC/BCOM/BBA/BA) from a recognized Institute with minimum 50% Marks agg.</td>
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<td>(III) Should have completed Basic Service training at IMA/INA/AFA/OTA/NDA</td>
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<td>(IV) Officer having experience of more than 02 years in Administration, Security, Engineering and Electrical fields.</td>
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<td>Duration : 04 Weeks</td>
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<td>Minimum Attendance Required : 85% (If the individual is hospitalized for a duration exceeding 15 % duration the candidate is Relegated to Next Course)</td>
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<td>Nature : 04 Weeks Full Time</td>
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<td>9</td>
<td>Approved Intake Capacity : As approved by Headquarters Integrated Defence Staff</td>
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<tr>
<td>10</td>
<td>Examination Pattern : End of each Semester, Semester Exam Paper will be set by TDEC. The all Answer Sheets will be evaluated by Staff of this Establishment (300 Marks for 13 Written Papers).</td>
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<td>11</td>
<td>Minimum Marks Qualifying : 50 % in Written Examination and 55 % aggregate (760/1400).</td>
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<td>Grading : The grading of the Student is based on the Final Result, which is as follows:-</td>
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<td>(a) 80 % and above O Outstanding</td>
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<tr>
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<td>(b) 75 – 79 % A Distinguished</td>
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<tr>
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<td>(c) 70 – 74.9 % B Above Average</td>
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TRAINING ATTACHMENT OTHER THAN CLASSROOM INSTRUCTIONS

1. Training Attachments/ Visits. The training attachment for two weeks is conducted on one of the frontline warships of Indian Navy to acquaint the trainees with various practical aspects of NBC onboard ships. Visits to following reputed institutes are also conducted:

   (a) Faculty of Chemical Biological radiological and Nuclear wing CME, Pune.
   (b) Bhaba Atomic Research center (BARC), Trombay.
   (c) National Disaster Response Force (NDRF), Talegaon.
   (d) National Institute of Virology, Pune.
   (e) CQAE, Aundh.
   (f) Naval Dockyard, Mumbai.
| (d) 65 – 69.9 % | C | High Average |
| (e) 60 – 64.9 % | D | Average |
| (f) 55 – 59.9 % | E | Below Average |
| (g) Below 55 % | F | Failure |

13 Failure in Examinations : Penalty Awarded *
(a) Failure in one or Two Subjects : The candidate will be Re-examined. As it is Qualifying Examination, Penalty for the Failure is not applicable.
(b) Failure in more than Two Subjects or failure to obtain 55% Marks in Aggregate : Students failing in examination will be dealt as per the current orders of NBCD School.
# SCHEME OF INSTRUCTIONS AND EXAMINATIONS

**JSSO CBRN COURSE No. 61.03**

<table>
<thead>
<tr>
<th>Sub Code</th>
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<th>Total Period (Hrs)</th>
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<th>Scheme Of Examination</th>
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<td>03.01.02</td>
<td>CBD</td>
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<td>HAZARD PREDICTION</td>
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<td>1.5</td>
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<td>03.01.04</td>
<td>DISASTER MANAGEMENT</td>
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<td>03.01.05</td>
<td>NBC DRILL</td>
<td>24</td>
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<td>03.01.06</td>
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SYLLABUS FOR
CERTIFICATION IN NUCLEAR, BIOLOGICAL
CHEMICAL (NBC) DEFENCE/ SAFETY AND
DISASTER CONTROL
JSSO CBRN COURSE
03.01.01 - NBC TRAINING PROGRAMME CODE - 61:03

Total hours : 92
Max marks : 75
Duration of paper : 1½
Total no of modules : 14
Total no of questions to be answered : All

(MODULE I)
TO KNOW THE NBC CAPABILITIES OF NEIGHBORING COUNTRIES & GENERAL ISSUES CONCERNING NBC WARFARE

To understand various issues concerning NBC warfare. NBCD Organization at NHQ, Command & Ships, NBC Stores and CNAL items, NBC Trials of new construction ships, Future Trends in NBC warfare

(MODULE II)
TO KNOW THE BASIC NUCLEAR PHYSICS AND PRINCIPLES OF NUCLEAR WEAPONS


(MODULE III)
TO DESCRIBE THE PHENOMENA OF NUCLEAR EXPLOSION AND THEIR EFFECTS

To acquaint the trainees with different types of nuclear explosion and energy partition. To acquaint the trainees with different effects of blast & shock. To acquaint the trainees with different effects of thermal radiation. Characteristics of explosion, energy partition – air, surface and underground burst, weapon yield and types of burst. Under water burst, chronological development of underwater burst, scientific aspects of nuclear explosion phenomena. Blast and shock effect development, variation of blast overpressure with time, the dynamic pressure arrival time and duration, incident and reflected wave the mach effects, interaction of blast wave with structures. Characteristics of under ground burst, crater formation, crater dimension, under water explosion technical aspects, effective ranges of over pressure, effects on material, effects on personnel, scaling law. Thermal radiation effect – characteristics attenuation of thermal radiation, effects of atmosphere smoke, fog and shielding, effective ranges of thermal radiation. Absorption
of thermal radiation on material effect on human, effects of thermal radiation in Japan, scaling law, protective measures. Survivability and Communication in Nuclear Environment, Nuc Hardening.

**MODULE IV**

**TO KNOW THE EFFECTS OF NUCLEAR RADIATION AND DELIVERY SYSTEM OF NUCLEAR WEAPONS**

The trainees will describe the effects of nuclear radiation. To acquaint the trainees with the various delivery systems in use for nuclear weapons: Comparison of nuclear bomb radiation, sources of $\gamma$-rays & neutrons units of radiation shielding against $\gamma$-rays & neutrons. Residual nuclear radiation and shielding. Deposition of contaminants, radioactive decay. Effect of neutron & dose distance relationship. Effects of ionizing radiation on personnel effects on body tissue, genetic effects & Radiation Hazards. To acquaint the trainees with the various delivery systems in use for nuclear weapons.

**MODULE V**

**TO KNOW THE OPERATION AND USE OF RADIOLOGICAL DETECTION EQUIPMENT**

To acquaint the trainees with the units of nuclear radiation for calculating radiation dose. The trainees will know the use of Radiac calculator. Nuclear radiation units – Activity, Exposure, Dose rate & Dose Quality factor, Effects of large doses over a prolonged period, Radiological Hazards. Radiac calculators - Radiac slide rule.

**MODULE VI**

**TO FAMILIARIZE WITH VARIOUS METHODS FOR PREDICTING THE NUCLEAR HAZARD & NUCLEAR BURST AND YIELD ESTIMATION**

To acquaint the trainees with various theories used in nuclear, chemical and biological hazard prediction. To acquaint the trainees with yield estimation from simulated exercises. Hazard Prediction, Predictor software, Vector Plotting for hazard prediction.

**MODULE VII**

**TO FAMILIARIZE WITH RECCE AND MONITORING, RADIATION EXPOSURE STATUS & COMMANDER'S GUIDE**

To acquaint the trainees with various methods used in reece and monitoring of contaminated areas. To make the trainees understand the term radiation exposure status and Operational Exposure Guidance. Recce and monitoring techniques. RES and OEG. Guidelines for Commanders based on radiation levels inside and outside the citadel.

**MODULE VIII**

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TO KNOW THE SURVIVABILITY OF COMMUNICATION IN NUCLEAR ENVIRONMENT AND NUCLEAR HARDENING

To outline the chances of communication taking place in a nuclear environment. To acquaint the trainees with nuclear hardening. To acquaint the trainees with Case Studies. EMP, TREE and its effect on electronics, Nuclear hardening techniques, FUKUSHIMA and CHERNOBYL.

(MODULE IX)
TO UNDERSTAND THE DUTIES OF VARIOUS NBC PARTIES AND NBC DRILLS

To explain the various drills during NBC attack. Role of Pre Shelter Parties, Monitoring, Decontamination and Cleansing Station Parties, NBC Drills including duties of every individual. Duties of Internal monitoring party, Shelter station, Close Down Organization, Take Cover and Immediate Action Drill, Citadel, pressurized & non Pressurized Citadel, Pre-wetting. Duties of NBCPO.

(MODULE X)
TO ACQUAINT THE TRAINEES WITH HISTORY OF CHEMICAL WARFARE & DIFFERENT CHEMICAL AGENTS USED AS WEAPONS OF WAR AND TO ACQUAINT THE METEOROLOGICAL EFFECTS ON CW AGENTS

To familiarize the class with the general history of chemical warfare. To know various classifications of chemical warfare agents. To acquaint the trainees with various meteorological effects on chemical agents. To acquaint the trainees with Case Study. Familiarization with Chemical Detectors and Equipment. Historical background of chemical warfare and their known/alleged use in warfare/sabotage. Classification of chemical agents from the point of tactical use Pre-requisite of chemical agents. Different types of nerve agents and their effects on human, Blood agents, Choking agents, blistering agents, Incapacitating agent, Anti-plant agent, Meteorological problems of chemical warfare, Bhopal Gas Tragedy, Details of NBC Detectors, Ship Installed Chemical Agent Detection System (SICADS), Chemical Agent Monitor (CAM), RVD, Water Poison Detection Kit, etc.

(MODULE XI)
TO ACQUAINT THE TRAINEES WITH HISTORY OF BIOLOGICAL WARFARE & DIFFERENT BIOLOGICAL AGENTS USED AS WEAPONS OF WAR AND TO ACQUAINT THE MEANS OF DELIVERY & DISSEMINATION TECHNIQUES OF BW AGENTS

To familiarize the class with the general history and concepts of biological warfare. To familiarize the class with various biological agents and their effects on human body. To know about the detection of biological agents. To acquaint the trainees with various means of delivery of biological weapons and dissemination techniques. To introduce to TIC/TIM. Historical background of biological warfare and their known/alleged use in warfare/sabotage. classification of biological agents, Potential biological agents and diseases caused. Toxins as biological agents, Detection, sampling and identification of biological agents. Modes of delivery like aircraft spray, aircraft
dispensers, spores etc. Definition of Toxic Chemical materials, Material Safety Data Sheet (MSDS), Hazchem Code, HAZMAT.

(MODULE XII)
TO KNOW THE MEDICAL ASPECTS OF NBC WARFARE AND POSSIBLE FIRST AID FOR THE INJURIES CAUSED

To acquaint the class regarding the medical aspects of nuclear, biological and chemical warfare agents on human beings. To familiarize with various First Aid techniques that can be adopted for the management of injuries caused by the NBC weapons. Medical effects of nuclear weapons, Medical effects of chemical weapons, Medical effects of biological weapons, Psychological effects of NBC weapons. management of contaminated casualties, First Aid to blast, burn and radiation casualties, First Aid to chemical casualties, Resuscitation techniques, First Aid kit and its use, CPR, fractures, burns, wounds, water testing kit.

(MODULE XIII)
TO KNOW THE PROTECTION METHODS AGAINST NBC WEAPONS

To explain the various constituents of Individual Protection Gear and their characteristics. To explain the various personal drills during NBC attack, To understand the various aspects of collective protection. To undertake donning/ undonning of NBC Suits and their maintenance. To carry out radiological and chemical monitoring. To carry out radiological and chemical decontamination. To enter/ exit citadel. Various constituents of IPE and their characteristics, Take cover drill, immediate action drill, immediate personal cleansing. Collective Protection - Basic concepts of Citadel, prewetting, pressurization, AFU— design and operation. Closing down procedure, shelter station, special problems in machinery spaces and habitability in closed down conditions. Donning/ un-donning of NBC Suits, change of canister, maintenance and cleansing after use. Radiological monitoring – Organization, monitoring techniques, monitoring teams, route card, marking of hot spots. Chemical monitoring/detection. Radiological decontamination – practical procedures, devices and substances used, portable decontamination apparatus – decontamination of clothing, equipment, machinery spaces, disposal of contaminated waste. Entry into citadel through cleansing stations/ exit from citadel. Various collective protection methods available in case of NBC attack.

(MODULE XIV)
TO KNOW ABOUT CONTAMINATION CONTROL AND DECONTAMINATION ORGANIZATION AT HARBOUR

To acquaint the trainees with the various methods/ procedures for contamination control and organisation. Contamination control and handling of contaminated ship at sea/harbour. Control of Contaminated ships at Naval Bases.

References:
1. INBR 1835 Vol –III.
2. Navy Orders (str) 22/02 issued from time to time.
3. FF Dockets for the Navy.
4. Various international conventions like CWC and NPT.
5. NDMA Act.

03.01.02 - Chemical TRAINING PROGRAMME CODE - 61:03

| Total hours  | 44 |
| Max marks    | 50 |
| Duration     | 1½ |
| Total no of modules | 3 |
| Total no of questions to be answered | All |

(MODULE I)
CHEMICAL DEFENCE DRILLS

To be conversant with various types of chemical defence in vogue in all three services of armed forces. To study chemical defence drills. To study various international protocols in chemical defence and various conventions in vogue. Various equipments used in chemical detection.

(MODULE II)
BIOLOGICAL DEFENCE DRILLS

To be conversant with various types of biological defence in vogue in all three services of armed forces. To study Biological defence drills. To study various international protocols in biological defence and various conventions in vogue. Various equipments used in biological detection.

(MODULE III)
CHEMICAL AND BIOLOGICAL EQIPMENTS HELD WITH INDIAN NAVY

To study various chemical and biological defence equipments in use in Indian Navy. To know various collective and individual equipment used in chemical and biological defence.

References :
1. IN 1920 (A) – Indian Navy Disaster Management hand book
2. CWC
3. NDRF Visit

03.01.03 – HAZARD PREDICTION - 61:03

Total hours : 320
(MODULE I)
BASICS OF HAZARD PREDICTION

The requirement of carrying out hazard predictions. Various instruments/equipments required for hazard predictions. Study units of hazard predictions. Various NBC reports developed by hazard predictions.

(MODULE II)
PLOTTING OF NBC/HAZARD PREDICTION AREA

To use various drawing equipment like drawing board, parallel ruler, set squares, charts of various scale etc. to plot a hazard prediction area. To draw hazard area by use of the same and define primary zone and secondary zone.

(MODULE III)
TO GENERATE NBC REPORT

To generate various NBC report by use of hazard plot area.

References:
1. CWC.
2. NDRF Visit.

03.01.04 - DISASTER MANAGEMENT PROGRAMME CODE:- 61:03
To be conversant with various types of disaster and classification of the same. To know disaster cycle and various subheads in the same. To know damages done during disaster. To be conversant with disaster management policy of India. To study the disaster management act (NDMA) and various clauses covered in the same.

(MODULE II)

ROLE OF ARMED FORCES IN DISASTER AND CONCEPT OF QRT AND QRMT

To be study the role of armed forces during disaster. Steps involved in requisition of armed forces in disaster. Various types of nuclear accident and disaster. The role of NBC quick reaction team and quick reaction medical team during NBC disaster.

(MODULE III)

NATION DISASTER RESPONSE FORCE (NDRF)

To be conversant with role of NDRF. Concept of SDRF and DDRF. Various types of disaster handled by NDRF. Location of various NDRFs.

References:
1. IN 1920 (A) – Indian Navy Disaster Management hand book
2. NDMA Act
3. NDRF Visit

105 - NBC DRILL CODE - 61:3

| Total hours | 24 |
| Max marks   | 50 |
| Duration    | 1  |
| Total no of modules | 5 |

(MODULE I)

TO PLOT HAZARD PREDICTION DURING NBC ATTACK

To acquaint the trainees with various theories used in nuclear, chemical and biological hazard prediction. To acquaint the trainees with yield estimation from simulated exercises. Hazard Prediction, Predictor software, Vector Plotting for hazard prediction.

(MODULE II)

TO CARRY OUT DUTIES OF VARIOUS NBC PARTIES
To familiarize the class with duties carried out by NBC parties and carry out drill of various NBC parties in vogue onboard Ship. To also carry out maintenance of various NBC equipments.

(MODULE III)
TO CARRY OUT NBC DRILLS

To carry out various drills during NBC attack. Role of Pre Shelter Parties, Monitoring, Decontamination and Cleansing Station Parties, NBC Drills including duties of every individual, Duties of Internal monitoring party, Shelter station, Close Down Organization, Take Cover and Immediate Action Drill, Citadel, pressurized & non Pressurized Citadel, Pre-wetting. Duties of NBCPO.

(MODULE IV)
TO CARRY OUT INDIVIDUAL PROTECTION AND COLLECTIVE PROTECTION DRILL

To explain various Individual Protection Gear and don the same. To carry out individual protection drill. To acquaint with collective protection drill and carry out the same. To undertake donning/undonning of NBC Suits and their maintenance. To carry out radiological and chemical monitoring. To carry out radiological and chemical decontamination. To enter/exit citadel. Various constituents of IPE and their characteristics. Carry out Citadel, prewetting, pressurization, AFU-design and operation. Closing down procedure, shelter station, special problems in machinery spaces and habitability in closed down conditions. Donning/un-donning of NBC Suits,

(MODULE V)
TO CARRY OUT CONTAMINATION CONTROL AND DECONTAMINATION ORGANIZATION AT SEA AND HARBOUR

To acquaint the trainees with the various methods/procedures for contamination control and organization. Contamination control and handling of contaminated ship at sea/harbour. Control of Contaminated ships at Naval Bases.

References:
1. INBR 1835 Vol –III.
2. Navy Orders (str) 22/02 issued from time to time.
3. NBC Dockets for the Navy.
4. Various international conventions like CWC and NPT.
5. NDMA Act.

106 – PROJECT AND SYNDICATE PRESENTATION
PROGRAMME CODE - 61:3

Total hours : 2
Max marks : 50
Duration : 1½
Total no of modules : 2

(MODULE I)
PROJECT

The trainees are required to make a practical project in the field of NBC/DC/FF and also make a detailed project report as required as per standards laid down. The project should be of use to the Tri-services.

(MODULE II)
SYNDICATE PRESENTATION

Trainees are divided into syndicates of 2 to 3 and are required to give a presentation related to NBC.

References:-
1. INBR 1835.
2. Navy Orders.
3. FF Dockets for the Navy.
4. Various international standards like NFPA and SOLAS.
5. Open Net.
# REGULATIONS NBCD (I) Course 61.02

<p>| | | |</p>
<table>
<thead>
<tr>
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<tr>
<td><strong>Programme Number</strong></td>
<td>61:02</td>
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<tr>
<td><strong>Programme Name</strong></td>
<td>Diploma in Nuclear, Biological Chemical (NBC) Defence/Safety, Disaster Control and Ship Fire Fighting Management</td>
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<td><strong>Programme Code</strong></td>
<td>NBCD (I) Course</td>
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<tr>
<td><strong>Approving Authority</strong></td>
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**Eligibility Criteria for Admission:**

**BASIC QUALIFICATIONS:-**

(I) Successful completion of basic training at INS Chilka and professional schools.

(II) Senior Secondary Certificate/10 + 2 from CBSE/Any recognized Board.

(III) Sailors having experience of more than 06 years and successfully qualified in NBCD 'key course'.

**SEMESTER-I**

(I) 02 weeks of NIETT phase.

(II) 01 weeks of ITW Attachment.

(III) 03 week of Projects/Syndicate presentation/ Attachments to various Defence labs.

**SEMESTER-II**

(I) 10 weeks of Nuclear, Biological, Chemical (NBC) Defence/Safety, Disaster control and Ship Fire Fighting Management course at NBCD School, INS Shivaji and Qualify Examination at the end of Each Course.

**Duration**: 16 (06 + 10) Weeks

**Minimum Attendance Required**: 85% (If the individual is hospitalized for a duration exceeding 15% duration the candidate is Relegated to Next Course)

**Nature**: 16 Weeks Full Time

**Approved Intake Capacity**: As approved by IHQ MoD (Navy) and HQSNC

**Examination Pattern**: End of each Semester, Semester Exam Paper will be set by TDEC. The all Answer Sheets will be evaluated by Staff of this Establishment (1400 Marks for 12 Written Papers).

**Minimum Qualifying**: 50 % in Written Examination and 55 % aggregate (760/1400).
Marks

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<th>Grade</th>
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<td>A</td>
<td>75 - 79 %</td>
<td>Distinguished</td>
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<td>B</td>
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<td>C</td>
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<td>E</td>
<td>55 - 59.9 %</td>
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<tr>
<td>F</td>
<td>Below 55 %</td>
<td>Failure</td>
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12 Grading: The grading of the Student is based on the Final Result, which is as follows:

(a) Failure in one or Two Subjects: The candidate will be Re-examined. As it is Qualifying Examination, Penalty for the Failure is not applicable.

(b) Failure in more than Two Subjects or failure to obtain 55% Marks in Aggregate: Students failing in examination will be dealt as per the current orders of NBCD School. The candidate will be disqualified from the course and sent back to his parent unit.

13 Failure in Examinations: Penalty Awarded *
### SCHEME OF INSTRUCTIONS AND EXAMINATIONS

**NBCD (I) COURSE No. 61.02**

**SEMESTER - I (06 Weeks)**

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<td>Practical (week)</td>
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<td>02</td>
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- **Duration Of Theory (Hr):**
  - 250
  - 100
  - 150

- **Total of Marks:**
  - 250
  - 100
  - 150
  - 500

- **Total:**
  - 250
  - 100
  - 150
  - 500
### SEMESTER-II (10 Weeks)

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### TABLE FOR CALCULATION OF FINAL PERCENTAGE

Pass Percentage 50 %, Aggregate 55 %

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<td>Total Aggregate</td>
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SHIP FIRE FIGHTING MANAGEMENT

(Diploma of Nuclear, Biological, Chemical
SYLLABUS FOR

(NBC) DEFENCE/SAFETY, DISASTER CONTROL AND COURSE)
02.01.01 NIETT PHASE – NIETT

Total hours : 54
Max marks : 250
Duration : 2 weeks
Total no of modules : Modules covered at NIETT and marks forwarded for inclusion in overall results
Total no of questions to be answered : All

02.01.02 ITW PHASE – INS Shivaji

Total hours : 27
Max marks : 100
Duration : 2 weeks
Total no of modules : 03 (modules covered at INS Shivaji and marks forwarded for inclusion in overall results)
Total no of questions to be answered : All

02.01.03 – PROJECT AND SYNDICATE PRESENTATION

PROGRAMME CODE - 61:2

Total hours : 71
Max marks : 150
Duration : 1.5 hrs
Total no of modules : 2

(MODULE I)

PROJECT

The trainees are required to make a practical project in the field of NBC/DC/FF and also make a detailed project report as required as per standards laid down. The project should be of use in the Indian Navy and should be implementable as part of advancement in the Indian Navy NBCD Field. To be conversant with all portable fire fighting extinguishers in use in Indian Navy.

(MODULE II)

SYNDICATE PRESENTATION

Trainees are divided into syndicates of 2-3 and required to give a presentation in the field of NBCD.
02.02.01 - NBC TRAINING PROGRAMME CODE - 61:02

<table>
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**MODULE I**

TO KNOW THE NBC CAPABILITIES OF NEIGHBORING COUNTRIES & GENERAL ISSUES CONCERNING NBC WARFARE

To understand various issues concerning NBC warfare, NBC organization at IHQ MoD (Navy), Commands and Ships, NBC stores and CNAL items, NBC trials of new construction ships, future trends in NBC warfare.

**MODULE II**

TO KNOW THE BASIC NUCLEAR PHYSICS AND PRINCIPLES OF NUCLEAR WEAPONS


**MODULE III**

TO DESCRIBE THE PHENOMENA OF NUCLEAR EXPLOSION AND THEIR EFFECTS

To acquaint the trainees with different types of nuclear explosion and energy partition. To acquaint the trainees with different effects of blast & shock. To acquaint the trainees with different effects of thermal radiation. Characteristics of explosion, energy partition – air, surface and underground burst, weapon yield and types of burst. Under water burst, chronological development of underwater burst, scientific aspects of nuclear explosion phenomena. Blast and shock effect development, variation of blast overpressure with time, the dynamic pressure arrival time and duration, incident and reflected wave the mach effects, interaction of blast wave with structures. Characteristics of under ground burst, crater formation, crater dimension, under water...
explosion technical aspects, effective ranges of over pressure, effects on material, effects on personnel, scaling law. Thermal radiation effect – characteristics attenuation of thermal radiation, effects of atmosphere smoke, fog and shielding, effective ranges of thermal radiation. Absorption of thermal radiation on material effect on human, effects of thermal radiation in Japan, scaling law, protective measures. Survivability and Communication in Nuclear Environment, Nuclear Hardening.

(MODULE IV)
TO KNOW THE EFFECTS OF NUCLEAR RADIATION AND DELIVERY SYSTEM OF NUCLEAR WEAPONS

The trainees will describe the effects of nuclear radiation. To acquaint the trainees with the various delivery systems in use for nuclear weapons. Comparison of nuclear bomb radiation, sources of -rays & neutrons units of radiation shielding against -rays & neutrons. Residual nuclear radiation and shielding. Deposition of contaminants, radioactive decay. Effects of neutron & dose distance relationship. Effects of ionizing radiation on personnel effects on body tissue, genetic effects & Radiation Hazards. To acquaint the trainees with the various delivery systems in use for nuclear weapons.

(MODULE V)
TO KNOW THE OPERATION AND USE OF RADIOLOGICAL DETECTION EQUIPMENT

To acquaint the trainees with the units of nuclear radiation for calculating radiation dose. The trainees will know the use of Radiac calculator. Nuclear radiation units – Activity, Exposure, Dose rate & Dose Quality factor, Effects of large doses over a prolonged period, Radiological Hazards. Radiac calculators - Radiac slide rule.

References:-
1. INBR 1835 Vol –III.
2. Navy Orders (str) 22/02 issued from time to time.
3. FF Dockets for the Navy.
4. Various international conventions like CWC and NPT.
5. NDMA Act.

02.02.02 - DC TRAINING PROGRAMME CODE - 61:2

| Total hours | 118 |
| Max marks | 200 |
| Duration | 4½ |
| Total no of modules | 8 |
| Total no of questions to be answered | All |
(MODULE I)
TO BE FAMILIAR WITH VARIOUS DESIGN FEATURES OF THE WARSHIPS AND THE PUMPING AND FLOODING ARRANGEMENTS

To be conversant with ships strength members, WT and GT integrity requirements. To be conversant with pumping flooding and drainage arrangements of ships. Basic ship construction / design features of warship, strains/stress experienced by the ship, loads acting on ship, Hogging, Sagging, Torsion, Raking, Panting, Pounding & Stresses during Docking/Launching. GT/WT subdivisions in a ship, limitations of subdivisions and air escapes. GA Plan and reading, Watertight and gastight openings-doors, hatches, manholes, scuttles, trunks, slide valves and flaps in ventilation system. Use of PFD arrangement, typical pumping out arrangement in ships, Ballasting and De-ballasting. Use of Fixed and Portable Pumps, Precautions during their operation, Types of Drains. Counter flooding and its principles. Action Stripping Plan, Jettison bill and responsibility for counter flooding, CNAL.

(MODULE II)

TO IDENTIFY VARIOUS STABILITY CONDITIONS, EFFECTS OF FLOODING, SHIFT OF WEIGHTS AND CARRYOUT STABILITY CALCULATIONS

To be able conversant with laws of flotation and elements of stability. To be conversant with effects of free surface and change of weights. Laws of flotation, centre of gravity buoyancy, forces and moments, metacentre, metacentric height, righting lever, states of equilibrium, heel, list, loll and trimming and loll, effects of loading (list, ballast and top weight), correction of list, loll, effects of free surface of liquids on stability significance of TPC, MCT 1CM, Inclining experiment and calculations of BM = I/V, stability information supplied to the ships and data available in hydrostatic curves. Effect of ships characteristics on stability, effects of loading on intact ship and movement of weight in the pontoon. Effects of free surface on heel, trim, adding/removing weights. Introduction to basic of damaged stability, added weight and lost buoyancy method.

(MODULE III)

TO BE ABLE TO IDENTIFY AND ASSESS VARIOUS TYPES OF DAMAGE AND TAKE CORRECTIVE ACTION USING SUITABLE DEVICES

To be conversant with various types of leak stopping devices. To be conversant with various types of damage and be able to take necessary counter measures. To be familiar with procedure for demarcation of zones of damage and take corrective actions. Leak stopping devices, stopper plate, splinter box, GRP Dome, shoring materials, wedges & plugs. Shoring - Principles, General Rules, Types and Methods of shoring. Damage to underwater hull, damage to pipes, shell plating cracks, methods of shoring, use of suitable leak stopping devices for various types of damages. Cold repair compounds. Types of shoring – DRY EXERCISES, Damage Control Simulator exercise. CASE STUDY To be familiar with procedure for demarcation of zones of damage and take corrective actions and case study of incident happened in past.
(MODULE IV)

TO IDENTIFY VARIOUS COMPARTMENTS, SYSTEMS AND OPENINGS BY THE USE OF LOCATION MARKINGS AND SHOULD ALSO BE ABLE TO UTILIZE VARIOUS WATERTIGHT AND GASTIGHT RISK AND CONTROL MARKINGS

To be conversant with layout of compartment/ systems and various location markings used onboard ships. To be conversant with water tight & Gas tight risk and control markings and their importance/ implications. Application of location markings, location markings of doors/hatches/manhole /trunks and ventilation systems, various sizes used for markings, method of marking. OS Marking, station number, FAP, Content Circle, Compartment below marking, traffic routes, color code for pipes Red Zone, Watertight risk markings, application of red openings, Water tight control markings, various water tight conditions, color and size of various water tight risk and control markings. Gas tight risk marking, gastight control markings, various gas tight conditions, color and size of various gas tight risk and control markings.

(MODULE V)

TO BE CONVERSANT WITH VARIOUS NBCD STATES OF READINESS AND THEIR APPLICATION

To be familiar with purpose of assuming various NBCD states of readiness and actions to be taken. To be able to handle emergency situation onboard. Various NBCD States, arrangements governed by NBCD states, material conditions in various NBCD States, Super -imposition of GT condition over WT condition. Relationship Between NBCD States, Responsibility for setting state, Special Sea Duty Men, Assuming State 2, Control of openings in lower state of readiness. Emergency procedures at harbour/ sea, men and material, purpose & control of emergency procedure.

References :-
1. INBR 1835 Vol –II and IV.
2. Navy Orders (str) 22/02 issued from time to time.
3. DC Dockets for the Navy.
4. Various international standards like NFPA and SOLAS.

02.02.03 – FIRE FIGHTING TRAINING
PROGRAMME CODE -61:2

Total hours : 118
Max marks : 200
Duration : 4 ½
(MODULE I)
TO KNOW THE PRINCIPLES OF FIRE CHEMISTRY


(MODULE II)
THE TRAINEE WILL BE CONVERSANT WITH DIFFERENT EXTINGUISHING AGENTS AND IDENTIFY THEIR USE AGAINST EACH CLASS OF FIRE

The trainees will state the properties of different extinguishing agents and identify their use against each class of fire including percentage required for extinguishing the fire and their advantages and disadvantages. Application methods - Jet Spray, Spray Jet, Fine Water Spray system. CO₂, Halon, AFFF as smothering agents, DCP as Free radical quenching agent. Introduction to Halon alternatives.

(MODULE III)
TO CARRY OUT THE DUTIES OF OFFICER-IN-CHARGE AS REGARDS TO FIRE FIGHTING ASPECTS

1. To know the principle of operation of all first aid F/F appliances, use and maintenance. To know the principles use and maintenance of major fire fighting equipment of Eastern and Western origin ships. Details and General Specification of CNAL items, Content of NBCD Locker (Initial Introduction and General Specification). General specification, Constructional details, operation, safety devices, precautions while using, re-charging and maintenance of 9 ltr AFFF Extinguisher, 2 kg CO₂ extinguisher and 10 Kg DCP extinguisher. Types of hoses, specifications and various couplings adopters, nozzles – spray/jet and jet/spray nozzles. Y pieces, methods of stowage and care of hoses. Practicals at Hose Training Gallery for handling of nozzles fire hoses and entry through door with charged hoses. Fireman & Accessories, Rising Mains, Emergency Rising Mains, Hydrants, Foam Making Branch Pipes at Helo deck of FFTF (FB 5X, FB 10 X), Foam Inlet Tubes. Helo Hanger Foam Sprinkling System and Magazine Sprinkling System, Portable inline inductors, Emergency Bulkhead Connections. Practicals at FFTF. Precautions to be taken before & after operating major FF systems.

2. Constructional and Operational details of
(a) KARAT-M System
(b) Inhibitor System
(c) Steam Drenching System.
(d) APZ 028.
(e) Flooding Systems
(f) Fixed Foam Installations
(g) Basic of Electro pneumatic operated solenoid valve (AUDCO) fitted in SNM class
(h) Procedure and periodicity of sprinkling system
(i) Constructional & Operational details of
(j) CO2 smothering system
(k) SO IV foam generating equipment.
(l) Introduction of Major Fire Fighting System installed in all class of ships and also
(m) submarines
(n) PD 150 & Trolley mounted CO2 extinguishers for protection of Helo deck.
(p) Operation & maintenance of all Fixed and Portable fire fighting equipment, DD
Pumps etc.

(MODULE IV)
TO KNOW THE PRINCIPLES OF FIRE DETECTION

To know the principles of operation of fire detection and alarm system. Principles and
Operation of Automatic Fire Detection System (Fire Alarm System). Types of Detectors and
Constructional Features. Selection of detectors for compartments. Procedure and Frequency of
testing/calibration of Fire Alarm Detection System.

(MODULE V)
FAMILIARIZATION WITH FIRE PROTECTION GEARS AND EQUIPMENT

1. The trainee will be able to use BA sets for fire fighting operations. The trainee will be able to
differentiate FF suits and the correct drills for donning. The trainee will be able to operate TIC in
smoke filled compartments. The trainee will be able to understand the latest trends, induction
procedure of new equipment in the Navy.

2. General requirements of Breathing Air Apparatus for fire fighting, BASSCA. Importance
and use of Life Line, Guide Line and Personal Line. Duties of BA controller. Use of ELSA.
Protective clothings against fire. Description. Donning, Type, Specification, Purpose, Stowage and
Maintenance of Fearnought Suit, Aluminized Fire Proximity Suit, Nomex Based Suits (Bristol
Suits), Latest Flame Retardant Textile. Constructional details. purpose, salient features. principles
of operation and use of Thermal Imaging Camera. Practicals inside burn rooms of FFTF. Details
of new equipment inducted / being inducted / likely to be inducted in the Navy.

(MODULE VI)
TO ADVISE THE COMMAND NBCDO AS NBCDO REGARDING FIGHTING A FIRE ONBOARD
1. The trainees will be able to understand fighting fire on small & large ship. Fire fighting Organization in harbour (FEP), at Sea (SSFP) and Action organization, in small and large ships. Reduced Fire Fighting organization. Details of Fire Fighting Operations and Exercises. Practical to be conducted as FEP/SSFP/Action organization etc as a group. Fire Fighting Procedures – Saavdhhan Procedure, Fire Alarm Reaction Guide. Ventilation control, Search & Rescue operations.

2. First report & Action for:-
   (a) Closed door/hatch fire.
   (b) Open door/hatch fire.

3. Practical for small pit fires in fire hard. Entry, exit and fire fighting in confined spaces.

4. Sequence of Operations are as follows:-
   (a) when opening a hatch to approach a fire
   (b) when opening a door to approach a fire
   (c) Details and use of Kill Card at DCHQ of FFTF
   (d) Details of E-Kill Cards
   (e) Mass casualty evacuation at FFTF
   (f) Practical in burn rooms of FFTF on escape through smoke filled compartment.

5. Organization of DCHQ and duties and responsibilities of OOD/OOW/ NBCDO for FEP/SSFP/Action Organization / Helo crash. Action by Heads of Deptt. , NBCDO boards (Incident Board only) including marking and control. Emergency procedures in harbour and at Sea. Boundary cooling, Methodology and Precautions to be observed whilst Boundary cooling, Pumping out of water used for boundary cooling. Importance of establishing a smoke boundary, smoke clearance, smoke curtains. Important aspects of Fire Fighting operations in Important Compartments Viz, Galley, Machinery Spaces, AVCAT Compartment and Magazines. Containment group procedures at FFTF. Causality evacuation procedure during crash on deck. Fire Fighting Exercises, Fire Exercises with the Dockyard/Local Fire Brigade for ships in refit/prior to entering refit. Organisation of Dockyard Fire Service, Requisitioning of Fire brigade and its role for Firefighting, Chain of command and Methodology to be followed, Boundary Cooling, Pumping and Flooding arrangements. Overview of De-watering arrangement during Fire Fighting. Practical on complete Action Station drills including multiple scene of fire and procedure of operating major fire fighting system on board.

(MODULE VII)

TO ADVISE THE COMMAND REGARDING PREVENTIVE MEASURES AGAINST FIRE

1. The trainee will be able to localise the fire and prevent the fire onboard. Fire Prevention and Extinction, General Precautions to Prevent Fire, Reasons for serious damage through fire, Details of Hot Work organisation as per the existing NO (NO 09/12). Precautions before commencement of hot work, hot work log book, duties of fire sentry, duties of OOD, NBCDO and Dept. Officer.

2. Organisation of Welding sentries Key Organisation, Safe to weld Certificate and importance of ‘Hot Work Clearance’ prior to commencement of Hot Work. hot work in confined spaces, in fuel.
tanks, magazines and pipe systems containing fuel and gas. Additional safety measures to be adopted for commencement of Hot Work during refit.

**MODULE VIII**

**TO ACQUAINT THE TRAINEES ABOUT THE INCIDENTS OF FIRE IN INDIAN NAVY**

The trainee will be able to advise the ships duty watch and fire fighting organization in case of fire on board ships especially during hot work in refits. The trainee will be able to advise the Command on the Organisation, Shore Support case of concurrent Major Fire and Major Flooding on board ships. Case studies of fires onboard INS Amba, INS Tir & INS Taragiri and any Case study of fire on board ships during hot work. Movies on cases of fires. Case Studies of INS Taragiri and INS Vindhyagiri to understand the complexity of Organization, Shore Support in case of concurrent Major Fire and Major Flooding.

**References:-**

1. INBR 1835 Vol -I
2. Navy Orders (str) 22/02 issued from time to time
3. FF Dockets for the Navy
4. Various international standards like NFPA and SOLAS

**02.02.04 - NO/NI TRAINING PROGRAMME CODE - 61:2**

| Total hours | : 4 |
| Max marks   | : 50 |
| Duration    | : 1 |
| Total no of modules | : 5 |
| Total no of questions to be answered | : All |

**MODULE I**

INBR 1835 Vol –V and BR 312

To be conversant with various organizations of fire fighting, damage control teams as per ship size and displacement. Various parties to be employed for FF, DC and NBC during various states of readiness. State of emergency onboard ship and actions to be taken. NBCD points to be borne in mind while designing new constructions ships including major firefighting system to be installed, various cables and cable glands

**MODULE II**

NAVY ORDER (STR) 22/02 (NBCD POLICY OF INDIAN NAVY)
To be able conversant with responsibilities of various departments towards NBCD and functioning of NBCD onboard. To know various stakeholders in Indian Navy in the field of NBCD. The various allowance of NBCD in various Ships.

**MODULE III**

NAVY ORDER 09/12 (HOTWORK AND WELDING)

To be conversant with welding and hotwork onboard ship’s. Study the responsibility of various department during hot work. Responsibility of shore organization during hotwork. Rules and regulations regarding carrying of hot work.

**MODULE IV**

NAVY ORDER 01/10 (NBCD TRIALS OF NEW CONSTRUCTION SHIPS AND TRIALS OF SHIPS IN COMMISSION)

To know how to carry out trials of new construction ships. Various types of NBCD trials to be carried out. To study trials to be carried during pre and post refit of ship. Various agencies involved in trials. Various types of NBCD trials carried out.

**MODULE V**

NAVY ORDER 54/03 (NBCD BOOKS AND RECORDS)

To be familiar with various NBCD Books and records. The various actions taken while preparing the books and records. various stakeholders involved in making books and records.

References :-

1. INBR 1835 Vol II.
2. Navy Orders (Str) 22/02 issued from time to time.

02.02.05 - DISASTER MANAGEMENT PROGRAMME CODE - 61:2

| Total hours | 3 |
| Max marks | 50 |
| Duration | 1 |
| Total No of modules | 3 |
| Total No of questions to be answered | All |

**MODULE I**

TYPES OF DISASTER AND NDMA ACT
To be conversant with various types of disaster and classification of the same. To know disaster cycle and various subheads in the same. To know damages done during disaster. To be conversant with disaster management policy of India. To study the disaster management act (NDMA) and various clauses covered in the same.

(MODULE II)

ROLE OF ARMED FORCES IN DISASTER AND CONCEPT OF QRT AND QRMT

To be study the role of armed forces during disaster. Steps involved in requisition of armed forces in disaster. Various types of nuclear accident and disaster. The role of NBC quick reaction team and quick reaction medical team during NBC disaster.

(MODULE III)

NATION DISASTER RESPONSE FORCE (NDRF)

To be conversant with role of NDRF. Concept of SDRF and DDRF. Various types of disaster handled by NDRF. Location of various NDRFs.

References :-
1. IN 1920 (A) – Indian Navy Disaster Management hand book.
2. NDMA Act.
3. NDRF Visit.

02.02.06 - NBC DRILL CODE - 61:2

Total hours : 108
Max marks : 50
Duration : 1
Total no of modules : 3

(MODULE I)

TO PLOT HAZARD PREDICTION DURING NBC ATTACK

To acquaint the trainees with various theories used in nuclear, chemical and biological hazard prediction. To acquaint the trainees with yield estimation from simulated exercises. Hazard Prediction, Predictor software, Vector Plotting for hazard prediction.

(MODULE II)

TO CARRY OUT DUTIES OF VARIOUS NBC PARTIES
To familiarize the class with duties carried out by NBC parties and carry out drill of various NBC parties in vogue onboard Ship. To also carry out maintenance of various NBC equipments.

(MODULE III)

TO CARRY OUT NBC DRILLS

To carry out various drills during NBC attack. Role of Pre Shelter Parties, Monitoring, Decontamination and Cleansing Station Parties, NBC Drills including duties of every individual, Duties of Internal monitoring party, Shelter station, Close Down Organization, Take Cover and Immediate Action Drill, Citadel, pressurized & non Pressurized Citadel, Pre-wetting. Duties of NBCPO.

References:

1. INBR 1835 Vol - III.
2. Navy Orders (str) 22/02 issued from time to time.
3. NBC Dockets for the Navy.
4. Various international conventions like CWC and NPT.
5. NDMA Act.

02.02.07 - DC DRILL CODE - 61:2

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(MODULE I)

TO PRACTICALLY CARRY OUT PUMPING AND FLOODING DRILL

Use of PFD arrangement, typical pumping out arrangement in ships, Ballasting and De-ballasting, Use of Fixed and Portable Pumps, Precautions during their operation, Types of Drains. Counter flooding and its principles. Action Stripping Plan, Jettison bill and responsibility for counter flooding, CNAL.

(MODULE II)

TO BE ABLE TO IDENTIFY AND ASSESS VARIOUS TYPES OF DAMAGE CONTROL DEVICES AND TAKE CORRECTIVE ACTION USING SUITABLE DEVICES
To be conversant with various types of damage (leak) stopping devices. To be conversant with various types of damage and be able to take necessary counter measures. To be familiar with procedure for demarcation of zones of damage and take corrective actions. Leak stopping devices, stopper plate, splinter box, GRP Dome, shoring materials, wedges & plugs. Shoring - Principles, General Rules, Types and Methods of shoring. Damage to underwater hull, damage to pipes, shell plating cracks, methods of shoring, use of suitable leak stopping devices for various types of damages.

(MODULE III)

TO IDENTIFY VARIOUS COMPARTMENTS, SYSTEMS AND OPENINGS BY THE USE OF LOCATION MARKINGS

To practically see layout of compartment/ systems and various location markings used onboard ships. To be see water tight & Gas tight risk and control markings and their importance/implications.

(MODULE IV)

TO BE CONVERSANT WITH VARIOUS NBCD STATES OF READINESS AND THEIR APPLICATION

To understand and assume Various NBCD States, arrangements governed by NBCD states, material conditions in various NBCD States. Super -imposition of GT condition over WT condition. Relationship Between NBCD States, Responsibility for setting state, Special Sea Duty Men, Assuming State 2, Control of openings in lower state of readiness. Emergency procedures at harbour/sea, men and material, purpose & control of emergency procedure.

References :-

1. INBR 1835 Vol –II and IV
2. Navy Orders (str) 22/02 issued from time to time
3. DC Dockets for the Navy
4. Various international standards like NFPA and SOLAS

02.02.08 – FF DRILLS TRAINING
PROGRAMME CODE - 61:2

Total hours : 82
Max marks : 50
(MODULE I)

USAGE OF DIFFERENT PORTABLE FIRE FIGHTING EXTINGUISHERS AND HOSES

The trainees are required to be conversant with all portable fire fighting extinguishers in use in the Indian Navy. To carry out maintenance of the same, and their advantages/disadvantages. Types of hoses, specifications and various couplings adopters, nozzles – spray/jet and jet/spray nozzles. Y pieces, methods of stowage and care of hoses. Practicals at Hose Training Gallery for handling of nozzles fire hoses and entry through door with charged hoses.

(MODULE II)

TO CARRY OUT THE DUTIES OF OFFICER-IN-CHARGE AS REGARDS TO FIRE FIGHTING ASPECTS

To practically carry out the duties of officer–in-charge of fire fighting team individually. To arrange various parties as per given INBR/Navy order. To ensure operation of major fire fighting system eg:- Fireman & Accessories, Rising Mains, Emergency Rising Mains, Hydrants, Foam Making Branch Pipes at Helo deck of FFTF (FB 5X, FB 10 X), Foam Inlet Tubes. Helo Hanger Foam Sprinkling System and Magazine Sprinkling System, Portable inline inductors, Emergency Bulkhead Connections. Practicals at FFTF. Precautions to be taken before & after operating major FF systems.

(MODULE III)

FAMILIARIZATION WITH FIRE PROTECTION GEARS AND EQUIPMENT

To practically carry out the donning and undonning of fire fighting gears and equipments. To carry out donning and undonning of BASCCA apparatus and also charging/maintenance of the same. Trainee will to operate TIC in smoke filled compartments, The trainee will be able to understand the latest trends, induction procedure of new equipment in the Navy. Use of Breathing Air Apparatus for fire fighting, BASSCA. Importance and use of Life Line, Guide Line and Personal Line. Duties of BA controller. Use of ELSA. Protective clothing against fire. Description, Donning, Type, Specification, Purpose, Stowage and Maintenance of Fearnaught Suit, Aluminized Fire Proximity Suit, Nomex Based Suits (Bristol Suits),Latest Flame Retardant Textile. Constructional details, purpose, salient features, principles of operation and use of Thermal Imaging Camera. Practicals inside burn rooms of FFTF. Details of new equipment inducted / being inducted / likely to be inducted in the Navy.

(MODULE IV)

TO CARRY OUT VARIOUS FIRE FIGHTING DRILLS

1. The trainees is trained in following drills:-
   (a) Closed door/hatch fire.

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2. Trainees to fight fire and carry out the drills like entry, exit and fire fighting in confined spaces. The sequence of operations are enumerated below:-

(a) When opening a hatch to approach a fire
(b) When opening a door to approach a fire
(c) Details and use of Kill Card at DCHQ of FFTF
(d) Details of E-Kill Cards
(e) Mass casualty evacuation at FFTF
(f) Practical in burn rooms of FFTF on escape through smoke filled compartment.

3. Organization of DCHQ and duties and responsibilities of OOD/OOW/NBCDO for FEP/SSFP/Action Organization/ Helo crash. Action by Heads of Deptt, NBCD boards (Incident Board only) including marking and control. Emergency procedures in harbour and at Sea. Boundary cooling, Methodology and Precautions to be observed whilst Boundary cooling. Shore Support in case of concurrent Major Fire and Major Flooding.

References:-

1. INBR 1835 Vol -I.
2. Navy Orders (str) 22/02 issued from time to time.
3. FF Dockets for the Navy.
4. Various international standards like NFPA and SOLAS.

References:-

1. INBR 1835.
2. Navy Orders.
3. FF Dockets for the Navy.
4. Various international standards like NFPA and SOLAS.
5. Open Net.
1. **Training Attachments/ Visits.** The training attachment for two weeks is conducted on one of the frontline warships of Indian Navy to acquaint the trainees with various practical aspects of NBCD onboard ships. Visits to following reputed institutes are also conducted:

   (a) Faculty of Chemical Biological radiological and Nuclear wing CME, Pune.

   (b) Bhaba Atomic Research center (BARC), Trombay.

   (c) National Disaster Response Force (NDRF), Talegaon.

   (d) National Institute of Virology, Pune.

   (e) CQAE, Aundh.

   (f) Naval Dockyard, Mumbai.
MEETING OF THE BOARD OF STUDIES IN COMPUTER SCIENCES HELD ON 
22.12.2017 AT 2.30 PM IN SYNDICATE ROOM

AGENDA
(1) Revision of Syllabi of M.Tech. Programme in Department of Computer Science
(2) Any other matter permitted by the Chair

Members Present
1. Dr. Sumam Mary Idicula (Chairman)
2. Dr. Santhosh Kumar G
3. Dr. Sheena Mathew
4. Dr. Philip Samuel
5. Dr. B. Kannan

Minutes of the Board of Studies met on 22.12.2018

The Committee studied the Syllabus prepared for CIS and SE stream. Syllabus for the
Second Semester for SE is decided to revise based on the suggestion of the Committee.
However, Syllabus for CIS is approved.

CHAIRMAN, BOARD OF STUDIES
IN COMPUTER SCIENCES
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

PROGRAMME STRUCTURE & SYLLABUS

[2018 ADMISSIONS ONWARDS]

- MTECH COMPUTER AND INFORMATION SCIENCE
- MTECH SOFTWARE ENGINEERING
# M TECH COMPUTER AND INFORMATION SCIENCE

## Semester - I

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### Electives
- CSC 3105: Virtualized Systems
- CSC 3106: Computational Linguistics
- CSC 3107: Advanced Optimization Techniques
- CSC 3108: Algorithms for Modern Data Models
- CSC 3109: Wireless Communications & Networking

## Semester - II

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### Electives
- CSC 3204: Bioinformatics
- CSC 3205: Programming Massively Parallel Processors
- CSC 3206: Computer Vision
- CSC 3207: Modelling Cyber Physical Systems
- CSC 3208: Number Theory and Cryptography
- CSC 3209: Algorithmic Game Theory
- CSC 3210: Deep Learning

## Semester - III

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## Semester - IV

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<td>Project &amp; Viva Voce</td>
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**Total credits for Degree: 72**
CSC3101: MATHEMATICAL CONCEPTS FOR COMPUTER SCIENCE
Core/Elective: Core Semester: 1 Credits: 4

Course Description:

This course introduces the study of mathematical structures that are fundamentally discrete in nature. It introduces linear algebra, graph theory and probability. The course is intended to cover the main aspects which are useful in studying, describing and modeling of objects and problems in the context of computer algorithms and programming languages.

Course Objectives:

- To understand Linear systems using Linear Algebra
- To get deep understanding of stochastic processes and their applications
- To study graph theory and its applications using matrix formulation

Course Content:


2. Graph theory — simple graphs — isomorphism — subgraphs — weighted graphs — matching problems — stable marriage problem — graph coloring — paths and walks — shortest paths — connectivity — Eulerian and Hamiltonian tours — travelling salesman problem — trees — spanning trees — planar graphs — Euler’s formula — directed graphs — strong connectivity — relations — binary relations — surjective and injective relations symmetry, transitivity, reflexivity, equivalence of relations — posets and dags — topological sort


REFERENCES:

1. Eric Lehman, F Thomson Leighton, Albert R Meyer, Mathematics for Computer Science, 1e, MIT, 2010
2. Susanna S. Epp, Discrete Mathematics with Applications, 4e, Brooks Cole, 2010
3. Gary Chartrand, Ping Zhang, A First Course in Graph Theory, 1e, Dover Publications, 2012
5. A First Course in Probability, 9e, Pearson, 2013

ONLINE RESOURCES


CSC3102: MACHINE LEARNING ALGORITHMS
Core/Elective: Core Semester: 1 Credits: 4

Course Description:

Machine learning is programming computers to optimize a performance criterion using example data or past experience. This course is to discuss many methods that have their bases in different fields: statistics, pattern recognition, neural networks, artificial intelligence, signal processing, control, and data mining. Major focus of the course is on the algorithms of machine learning to help students to get a handle on the ideas, and to master the relevant mathematics and statistics as well as the necessary programming and experimentation.

Course Objectives:

- To understand basics to advanced concepts of Machine Learning
- To attain certain amount of statistical and mathematical sophistication to deal with the subject
- To gain confidence in building Machine Learning algorithms and applications
- To understand the multi-disciplinary aspect of the subject

Course Content:


REFERENCES:

1. Ethem Alpaydin, Introduction to Machine Learning, 3e, MIT Press, 2014
2. Tom M. Mitchell, Machine Learning, McGraw Hill Education; le, 2017
5. Ethem Alpaydin, Machine Learning- The New AI, MIT Press, 1e, 2016
ONLINE RESOURCES

2. Andrew Ng, https://www.coursera.org/learn/machine-learning
CSC3103: DESIGN AND ANALYSIS OF ALGORITHMS
Core/Elective: Core Semester: 1 Credits: 3

Course Description:
The course covers the foundational algorithms in depth.

Course Objectives:
- To understand the working and complexity of the fundamental algorithms.
- To develop the ability to design algorithms to attack new problems.

Course Content:


REFERENCES:
CSC3104: ALGORITHMS LAB
Core/Elective: Core Semester: 1 Credits: 1

Course Description:
This lab aims to give hands-on practice at implementing the algorithms taught in the associated course.

Course Objectives:
- To develop the ability to efficiently implement the fundamental algorithms.
- To have the ability to analyze the efficiency of implementations pragmatically.

Course Content:

Session 1
- Introduction to the programming language and the version control system.
- How to add, commit and push changes.
- How to randomly generate inputs and test programs.
- Solve a problem using insertion sort and merge sort.

Session 2
- How to profile programs and how to plot the empirical performance curves.
- Solve a problem using Heaps.
- Plot the running time versus the size of the input.

Session 3
- Solve a problem using Binary Search Trees and Tree balancing.

Session 4
- Solve a problem related to graph traversal and shortest paths.

Session 5
- How to generate complete graphs with random weights.
- Solve a problem related to minimum spanning trees.

Session 6
- Solve a problem using the Union-Find data structure.
- Solve a Maximum flow problem.

Session 7
- Solve a problem using Monte Carlo simulation.
- Solve a problem related to Indicator random variables.

Session 8
- Solve a problem using randomized and non-randomized algorithms. Compare the average running times.

Session 9
- Solve problem related to hashing. Use both hashing using chaining and hashing using open addressing and compare them both.
• Solve a problem related to Perfect hashing. Empirically verify the running time.

Session 10
• Solve a problem using dynamic programming.

Session 11
• Solve a problem using greedy approach and compare with the corresponding dynamic programming solution.

Session 12
• Solve one NP-Complete problem and use the solution to solve another NP-Complete problem.

REFERENCES:
CSC3105: VIRTUALIZED SYSTEMS
Core/Elective: Elective Semester: 1 Credits: 3

Course Description:

Virtualization provides the benefit of reducing the total cost of ownership and improving the business agility. This course systematically introduces the concepts and techniques used to implement the major components of virtual servers behind the scene. It discusses the details on hypervisor, CPU scheduling, memory management, virtual I/O devices, mobility, and etc.

Course Objectives:

- The course introduces the concepts and principles of virtualization, the mechanisms and techniques of building virtualized systems, as well as the various virtualization-enabled computing paradigms.

Course Content:

1. Overview: Why server virtualization — History and re-emergence — General structures — Architectures comparison — Commercial solutions — VMWare, Xen

2. Virtual machines: CPU virtualization - Privileged instructions handling - Hypervisor - Paravirtualization - Hardware-assisted virtualization - Booting up - Time keeping - CPU scheduling - Commercial examples.

3. Memory management in virtualization: partitioning - reclamation - ballooning. Memory sharing. OS-level virtualization — VMWare — Red Hat Enterprise Virtualization


5. Virtualized computing: Virtual machine based distributed computing - elastic cloud computing - clustering - cold and hot migration - Commercial examples - Challenges and future trends

REFERENCES:

1. Jim Smith, Ravi Nair, Virtual Machines: Versatile Platforms for Systems and Processes, 1e, Morgan Kaufmann, 2005
2. Sean Campbell, Applied Virtualization Technology - Usage models for IT professionals and Software Developers, 1e, Intel Press, 2006
CSC3106: COMPUTATIONAL LINGUISTICS
Core/Elective: Elective Semester: I Credits: 3

Course Description:

Computational Linguistics deals with statistical and rule based modelling of natural languages from a computational point of view. This course is intended to give a comprehensive coverage of language processing fundamentals like morphology, Syntax, Semantics and pragmatics. Application of various computational models in application domains like Machine translation, information retrieval etc. is also dealt with.

Course Objectives:

- To familiarise the fundamentals of speech and written language processing
- To study the applications of these techniques in real world problems like spell-checking, Parts-of Speech Tagging, Corpus development, Wordnet, speech recognition, pronunciation modelling, dialogue agents, document retrieval etc
- To gather information about widely used language processing resources

Course Content:

1. Words- Regular Expressions and Finite Automata-Morphology and Finite State Transducers-Probabilistic Models of Pronunciation and Spelling - N grams


5. Statistical alignment and machine translation-clustering- text categorization

REFERENCES:

1. James Pustejovsky, Amber Stubbs, Natural language annotation for machine learning, 1e, O’Reilly, 2013
3. Grant S Ingersoll, Thomas Morton, Andrew L Farris, Taming Text: How to Find, Organize, and Manipulate It, 1e, Manning Publications 2013
4. Daniel Jurafsky and James Martin, Speech and Language Processing, 2e, Pearson, 2013
5. Christopher D. Manning and HinRichSchutze, Foundations of statistical natural language processing, 1e, MIT press, 1999
CSC3107: ADVANCED OPTIMIZATION TECHNIQUES
Core/Elective: Elective Semester: 1 Credits: 3

Course Description:

This course is about the well-known population-based optimization techniques developed during last three decades. This course emphasizing on the advanced optimization techniques to solve large-scale problems especially with nonlinear objective functions.

Course Objectives:

- To study concepts of Population based Optimization techniques
- To understand the mathematical foundations for various advanced optimization techniques
- To apply the algorithms to various inter disciplinary applications

Course Content:

1. Introduction to optimization- formulation of optimization problems-Review of classical methods-Linear programming-Nonlinear programming-Constraint optimality criteria-constrained optimization-Population based optimization techniques


REFERENCES:
2. Xin-She Yang, Engineering Optimization: An Introduction with Meta-heuristic Applications, 1e, Wiley, 2010
CSC3108: ALGORITHMS FOR MODERN DATA MODELS
Core/Elective: Core Semester: 1 Credits: 3

Course Description:
This course describes the randomization and probabilistic techniques for modern computer science, with applications ranging from combinatorial optimization and Machine learning to communication networks. The course covers the core material to advanced concepts. Also the emphasis is on methods useful in practice.

Course Objectives:
- To know problem solving techniques for modern problems
- To understand probabilistic techniques and analysis of algorithms
- To be able to design algorithms for new problems with volume of data

Course Content:
2. Entropy, Randomness, and Information: Measure of randomness – Monte Carlo Method – Markov Chain Monte Carlo Method
3. Graph models and algorithms— Random graph Models- Algorithms for graph generation - Random graphs as models of networks, Power laws, Small world Phenomena
4. Components of evolutionary algorithms – Example applications – Genetic algorithms – Evolution strategies – Evolutionary programming
5. Sampling, sketching, data stream models, read-write streams, stream-sort, map-reduce - Algorithms in evolving data streams

REFERENCES:
3. S. Muthukrishnan, Data Streams: Algorithms and Applications, 1e, Now Publishers, 2005
5. Agoston E. Eiben, J.E. Smith , Introduction to evolutionary computing, 1e, Springer, 2010
CSC3109: WIRELESS COMMUNICATIONS & NETWORKING
Core/Elective: Elective Semester: 1 Credits: 3

Course Description:

This course focuses on imparting knowledge about the practical aspects of wireless network systems with the required basic principles behind them, along with some practical assignments. The course examines the conceptual framework for specifying a wireless network and the related protocols.

Course Objectives:

- Comprehend and demonstrate command in the principles of wireless networking.
- Describe the networking technologies including Cellular networks, WLANs and WWANs.
- Understand the functions of TCP/IP and the organization of the Internet.
- Design and evaluate a wireless network in terms of cost, performance, privacy and security.
- Plan and design a small and practical network for home or small business applications under a specified set of constraints
- To understand new trends and emerging technologies

Course Content:

1. Overview of wireless systems — Tele traffic engineering — Radio propagation — Path loss models — Digital communication over radio channels — Modelling of a Wireless Channel - Capacity of wireless channels — AWGN channel - Fading channels

2. Cellular concepts — Multiple access and interference management- Narrowband and Wideband systems- GSM, CDMA and OFDM - Channel reuse analysis- spread spectrum and CDMA systems — Random access and Wireless LANs — Data and voice sessions over 802.11 — Association in WLANs


4. Design of a wireless network — radio design for a cellular network — Link budget for GSM and CDMA

5. Beyond 3G – HSPA+, WiMAX and LTE – Cognitive radio networks

REFERENCES:

2. Vijay K Garg, Wireless Communications & Networking, 1e, Morgan Kaufmann, 2008
5. Web Resources: http://standards.ieee.org
CSC3201: ALGORITHMS FOR MASSIVE DATASETS
Core/Elective: Core Semester: 2 Credits: 4

Course Description:
Big Data concerns large-volume, complex, growing data sets with multiple, autonomous sources. With the fast development of networking, data storage, and the data collection capacity, Big Data is now rapidly expanding in all science and engineering domains. The traditional data mining algorithms also need to be adapted for dealing with the ever-expanding datasets of tremendous volume.

Course Objectives:
- To understand emphasis on the algorithms to be applied on large amounts of data
- To develop hands-on experience on the distributed file systems and MapReduce as a tool for creating parallel algorithms
- To explore streaming data and some of the techniques and algorithms specifically extended for mining on stream data

Course Content:
1. Introduction to MapReduce – the map and reduce tasks, MapReduce workflow, fault tolerance. - Algorithms for MapReduce – matrix multiplication, relational algebra operations- Complexity theory for MapReduce
2. Locality-Sensitive Hashing - shingling of documents, min-hashing. Distance measures, nearest neighbors, frequent itemsets- LSH families for distance measures, Applications of LSH- Challenges when sampling from massive data
4. MapReduce and link analysis - PageRank iteration using MapReduce, topic-sensitive PageRank - On-line algorithms - Greedy algorithms, matching problem, the adwords problem - the balance algorithm

REFERENCES:
CSC3202: PROBABILISTIC GRAPHICAL MODELS
Core/Elective: Core Semester: 2 Credits: 4

Course Description:

Probabilistic graphical models (PGM) is one of the most advanced techniques in machine learning to represent data and models in the real world with probabilities. PGM present a general framework for constructing and using probabilistic models of complex systems that would enable a computer to use available information for making decisions. This course is for anyone who has to deal with lots of data and draw conclusions from it, especially when the data is noisy or uncertain. Data scientists, machine learning enthusiasts, engineers, and those who curious about the latest advances in machine learning will find PGM interesting.

Course Objectives:

- Understand the concepts of PGM and which type of PGM to use for which problem
- To understand techniques for representation, inference and learning from graph based models
- To apply Bayesian networks and Markov networks to many real world problems

Course Content:

2. Representation: Bayesian Network (BN) representation – Independencies in BN – Factorizing a distribution – D-separation- Algorithm for D-separation – From distributions to Graphs

REFERENCES:

1. Daphne Koller, Nir Friedman, Probabilistic Graphical Models- Principles and Techniques, 1e, MIT Press, 2009
CSC3203: SEMINAR  
Core/Elective: Core Semester: 2 Credits: 1

Course Description:

The student has to prepare and deliver a presentation on a research topic suggested by faculty member before the peer students and staff. They also have to prepare a comprehensive report of the seminar presented.

Course Objective:

- Review and increase their understanding of the specific topics tested.
- Inculcating presentation and leadership skills among students
- Offering the presenter student an opportunity of interaction with peer students and staff
Course Description:

Present fundamental concepts from molecular biology, computational problems in molecular biology and some efficient algorithms that have been proposed to solve them.

Course Objectives:
- To familiarize computational problems in biology
- To understand models of DNA and DNA mapping
- To study structure prediction

Course Content:


4. Phylogenics Trees –Binary Character States-Parsimony and Compatibility in Phylogenies-Algorithm for Distance Matrices-Additive Trees- Genome rearrangements-Oriented Blocks-unoriented Blocks

5. Molecular Structure Prediction- RNA secondary structure prediction-Protein Folding problems-Protein threading-Computing with DNA-Hamilton Path Problems. —Satisfiability

REFERENCES:
3. Concord Bessant, Darren Oakley, Ian Shadforth, Building Bioinformatics Solutions, OUPress, 2014
4. Peter Clote and Rolf Backofen, Computational Molecular Biology-An introduction, 1e, Wiley Series, 2000
CSC3205: PROGRAMMING MASSIVELY PARALLEL PROCESSORS
Core/Elective: Elective Semester: 2 Credits: 3

Course Description:
It used to be the case that parallel computing was confined to giant supercomputers. But nowadays it is literally everywhere - even in the small mobile handsets that most of us carry around. This course introduces parallel computing with a strong emphasis on programming.

Course Objectives:
- To understand the basics of parallel computing
- To develop programming skills required for parallel computing.
- To learn about strategies for how algorithms that were originally developed for single-processor systems can be converted to run efficiently on parallel computers
- To know about current practical implementations of parallel architectures

Course Content:
1. Introduction - parallel computing - more speed or parallelism - languages and models - sequential vs parallel - concurrent, parallel, distributed - parallel hardware architecture - modifications to the von Neumann Model.
2. Evolution of GPU - GPGPU - introduction to data parallelism - CUDA program structure - vector addition kernel - device global memory and data transfer
3. CUDA thread organization - mapping threads to multi-dimensional data - assigning resources to blocks - synchronization and transparent scalability - thread scheduling and latency tolerance
4. Memory access efficiency - CUDA device memory types - performance considerations - global memory bandwidth - instruction mix and thread granularity - floating point considerations
5 Parallel programming patterns - convolution - prefix sum - sparse matrix and vector multiplication - application case studies - strategies for solving problems using parallel programming

REFERENCES:
2. Peter Pacheco, Introduction to Parallel Programming, 1e, Morgan Kaufmann, 2011
4. Jason Sanders, Edward Kandrot, CUDA by Example: An Introduction to General-Purpose GPU Programming, 1e, AW Professional, 2010
CSC3206: COMPUTER VISION
Core/Elective: Elective Semester: 2 Credits: 3

Course Description:
This course introduces concepts and applications in computer vision. Starting with image formation the course covers image processing methods such as filtering and edge detection, segmentation and classification. It includes vision tasks like: object detection, recognition and human motion detection. The content of the course also includes practical exercises to help the students formulating and solving computer vision problems.

Course Objectives:
- To understand processing of digital images
- To familiarise different mathematical structures
- To study detailed models of image formation
- To study image feature detection, matching, segmentation and recognition
- To understand classification and recognition of objects.
- To familiarize state-of-the-art problems in computer vision

Course Content:
1. Low-level vision: Images and imaging operations — Convolutions and point spread functions — Image filtering and morphology- filters — mathematical morphology — thresholding — edge detection.
2. Corner, interest point, and invariant feature detection — Local invariant feature detectors and descriptors: Harris, Hessian, SIFT, SURF and HOG — Texture analysis
5. Motion: Optical flow — Kalman Filter — Surveillance: Foreground-background separation- Particle filters- combining views from multiple cameras — In-vehicle vision systems

REFERENCES:
CSC3207: MODELING CYBER PHYSICAL SYSTEMS
Core/Elective: Elective Semester: 2 Credits: 3

Course Description:

The course examines wireless cellular, ad hoc and sensor networks, covering topics such as wireless communication fundamentals, medium access control, network and transport protocols, unicast and multicast routing algorithms, mobility and its impact on routing protocols, application performance, quality of service guarantees, and security. Energy efficiency and the role of hardware and software architectures may also be presented for sensor networks.

Course Objectives:

- To know problem solving techniques
- To understand techniques for the design and analysis of efficient algorithms
- To be able to design algorithms for new problems with volume of data

Course Content:


4. Composition of State Machines: Concurrent Composition: Side-by-Side Synchronous Composition, Side-by-Side Asynchronous Composition, Shared Variables, Cascade Composition, General Composition, Hierarchical state machines


REFERENCES:

3. Raj Rajkumar, Dionisio de Niz, Mark Klein, Cyber-Physical Systems, 1e, AW Professional, 2017
CSC3208: NUMBER THEORY AND CRYPTOGRAPHY
Core/Elective: Elective Semester: 2 Credits: 3

Course Description:

The course provides an introduction to basic number theory, where the focus is on computational aspects with applications in cryptography. Applications to cryptography are explored including symmetric and public-key cryptosystems. Modern cryptographic methods are also discussed.

Course Objectives:

- To understand the number theoretic foundations of modern cryptography
- To implement and analyze cryptographic and number theoretic algorithms
- To understand public key cryptosystems
- To understand modern cryptographic techniques

Course Content:

1. Divisibility, Division Algorithm, Euclidean Algorithm, Congruences, Complete Residue systems, Reduced Residue systems, Fermat's little theorem, Euler’s Generalization, Wilson's Theorem, Chinese Remainder Theorem, Euler Phi-function, multiplicative property, Finite Fields, Primitive Roots, Quadratic Residues, Legendre Symbol, Jacobi Symbol, Gauss’s lemma, Quadratic Reciprocity Law


4. Cubic Curves, Singular points, Discriminant, Introduction to Elliptic Curves, Geometry of elliptic curves over reals, Weierstrass normal form, point at infinity, Addition of two points, Bezout's theorem, associativity, Group structure, Points of finite order


REFERENCES:

3. Christof Paar and Jan Pelzl, Understanding Cryptography, 1e, Springer, 2010
5. Song Y.Yan, Computational Number Theory & Modern Cryptography, 1e, Wiley, 2013
Course Description:

Game theory is a branch of mathematics and economics which models interactions of agents as games. Algorithmic game theory is the intersection of game theory and computer science. This course introduces algorithmic game theory in an application-oriented manner.

Course Objectives:

- To get a practical understanding of game theory
- To be able to solve computer science problems using the concepts of game theory

Course Content:

1. Introduction to game theory — strategies, costs, payoffs — solution concepts — finding equilibria — games with sequential moves — games with simultaneous moves — discrete strategies, continuous strategies — mixed strategies — games with incomplete information — expected payoffs — Prisoner’s dilemma and repeated games — Nash equilibrium — Computational complexity of Nash equilibrium


3. Epistemic game theory — Modeling knowledge — rationality and belief — common belief in rationality — game strategies and perfect recall — cryptography and game theory — modeling cryptographic algorithms as games — multi-party computations — MPC and games

4. Mechanism design — general principles — social choice — incentives — algorithms mechanism design — distributed aspects — cost-sharing mechanisms — mechanism design without money — house allocation problem — stable matchings

5. Voting — evaluation of voting systems — strategic manipulation of votes — auctions — types of auctions — winner’s curse — bidding strategies — fairness in auctions

REFERENCES:

1. Avinash K. Dixit et al., Games of Strategy, 4e, W. W. Norton & Company, 2014
CSC3210: DEEP LEARNING
Core/Elective: Elective Semester: 2 Credits: 3

Course Description:
Deep learning is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms. This course describes deep learning techniques used by practitioners in industry, including deep feed forward networks, regularization, optimization algorithms, convolutional networks, sequence modeling, and practical methodology. This course is useful to students planning careers in either industry or research, and for software engineers who want to begin using deep learning in their products or platforms.

Course Objectives:
- To develop a clear understanding of the motivation for deep learning
- To get a practical understanding of machine learning methods based on learning data
- To design intelligent systems that learn from complex and/or large-scale datasets
- To apply deep learning to practical problems

Course Content:


REFERENCES:
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 1e, MIT Press, 2017
3. Josh Patterson and Adam Gibson, Deep Learning: A Practitioner's Approach, 1e, Shroff/O'Reilly, 2017
### DEPARTMENT OF COMPUTER SCIENCE
### PROGRAMME STRUCTURE AND SYLLABUS (2018 ADMISSIONS)

#### M TECH SOFTWARE ENGINEERING

#### Semester - I

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**Electives**

- CSS 3105: Artificial Intelligence
- CSS 3106: Human Computer Interaction
- CSS 3107: Information Retrieval and Web search
- CSS 3108: Functional Programming
- CSS 3109: Software Quality Management
- CSS 3110: Patterns in Software Engineering

#### Semester - II

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**Electives**

- CSS 3204: Design of Real Time/Embedded Software
- CSS 3205: Software Agent Systems
- CSS 3206: Network Forensics
- CSS 3207: Enterprise Application Integration & Business Process Management
- CSS 3208: Advanced Data Mining
- CSS 3209: Fuzzy Set Theory: Foundations & Applications
- CSS 3210: Complex Networks: Theory & Applications
- CSS 3211: Data Science & Big Data Analytics

#### Semester - III

1. CSS 3301: Project & Viva Voce

#### Semester - IV

1. CSS 3302: Project & Viva Voce

Total credits for Degree: 72

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**Note:** The page includes a margin note "APPENDIX VII (D)" at the top right corner.
Course Description:

This course introduces the study of mathematical structures that are fundamentally discrete in nature. It introduces linear algebra, graph theory and probability. The course is intended to cover the main aspects which are useful in studying, describing and modelling of objects and problems in the context of computer algorithms and programming languages.

Course Objectives:

- To understand Linear systems using Linear Algebra
- To get deep understanding of stochastic processes and their applications
- To study graph theory and its applications using matrix formulation

Course Content:

1. Linear Systems: Vector Spaces, Linear Independence and Rank, Basis, Quadratic forms and Semi Definite matrices, Eigen values and Eigen Vectors, LU Decomposition, Orthogonality, Least squares problem, QR decomposition, SVD, Basic Tensor Concepts

2. Probability axioms, Bayes theorem, Random variables and distributions, Expectation and Variance, Covariance and correlation, Moment generating functions, Inequalities: Markov, Chebyshev, Chernoff bound, Laws of large numbers, Central limit theorem


4. Matrix representation of graphs, Hypergraphs, Bipartite graphs, Components, Independent paths, connectivity and cut sets, Graph Laplacian - Random walks - Measures and metrics on graphs

5. Random Graphs : Models, Ramsey theory, Random graphs with general degree distributions Connectivity and Matchings, Diameter of Random Graphs

REFERENCES:

1. Eric Lehman, F Thomson Leighton, Albert R Meyer, Mathematics for Computer Science, 1e, MIT, 2010
2. Susanna S. Epp, Discrete Mathematics with Applications, 4e, Brooks Cole, 2010
3. Gary Chartrand, Ping Zhang, A First Course in Graph Theory, 1e, Dover Publications, 2012
5. A First Course in Probability, 9e, Pearson, 2013

ONLINE RESOURCES


Course Description:

This is a second course in database systems which cover advanced aspects of database systems touching upon the theoretical advancements to handle the new areas and challenges related to the management of data. The course introduces the students to the frontiers of the classical database systems and takes them to the multidimensional data and the associated processing techniques. Later, a large multitude of specialty databases are introduced. This course consolidates the theory and practices pertaining to big data storages and cloud databases.

Course Objectives:

- The course introduces the emerging theories and practices in the field of database systems management.
- The orientation of the contents are towards the more challenging data management areas like big data, cloud computing and data science.

Course Content:


2. Online Analytical Processing: Recent Enhancements and Extensions to SQL - Analytical and OLAP Functions-Multidimensional Analysis - New Data Types- New Temporal Features in SQL- Other Enhancements. Need for Data Warehousing – Architectures- Data Mart and Data Warehousing Environment - Real-Time Data Warehouse Architecture - Enterprise Data Model- Status/Event/Transient/Periodic Data - Derived Data - Star Schema and variations - Fact Tables - Dimension Tables - Normalization - Surrogate Key - Hierarchies - Unstructured Data.


REFERENCES:

6. Michael Stonebreaker, Paul Brown, and Dorothy, Object-Relational DBMSs, 2e, Morgan Kaufman, 1998
7. Philippe Rigaux, et. al, Spatial Databases (with applications to GIS), 1e, Morgan Kaufmann, 2001
CSS3103: DESIGN AND ANALYSIS OF ALGORITHMS
Core/Elective: Core Semester: 1 Credits: 4

Course Description:

The course covers the foundational algorithms in depth.

Course Objectives:

- To understand the working and complexity of the fundamental algorithms.
- To develop the ability to design algorithms to attack new problems.

Course Content:


REFERENCES:

CSS3104: ALGORITHMS LAB

Core/Elective: Core Semester: 1 Credits: 1

Course Description:
This lab aims to give hands-on practice at implementing the algorithms taught in the associated course.

Course Objectives:
- To develop the ability to efficiently implement the fundamental algorithms.
- To have the ability to analyze the efficiency of implementations pragmatically.

Course Content:

Session 1
- Introduction to the programming language and the version control system.
- How to add, commit and push changes.
- How to randomly generate inputs and test programs.
- Solve a problem using insertion sort and merge sort.

Session 2
- How to profile programs and how to plot the empirical performance curves.
- Solve a problem using Heaps.
- Plot the running time verses the size of the input.

Session 3
- Solve a problem using Binary Search Trees and Tree balancing.

Session 4
- Solve a problem related to graph traversal and shortest paths.

Session 5
- How to generate complete graphs with random weights.
- Solve a problem related to minimum spanning trees.

Session 6
- Solve a problem using the Union-Find data structure.
- Solve a Maximum flow problem.

Session 7
- Solve a problem using Monte Carlo simulation.
- Solve a problem related to Indicator random variables.

Session 8
- Solve a problem using randomized and non-randomized algorithms. Compare the average running times.

Session 9
- Solve problem related to hashing. Use both hashing using chaining and hashing using open addressing and compare them both.
• Solve a problem related to Perfect hashing. Empirically verify the running time.

Session 10
• Solve a problem using dynamic programming.

Session 11
• Solve a problem using greedy approach and compare with the corresponding dynamic programming solution.

Session 12
• Solve one NP-Complete problem and use the solution to solve another NP-Complete problem.

REFERENCES
CSS3105: ARTIFICIAL INTELLIGENCE
Core/Elective: Elective Semester: 1 Credits: 3

Course Description:

Artificial Intelligence (AI) is a field that has a long history but is still constantly and actively growing and changing. In this course basics of modern AI as well as some of the representative applications of AI along with huge possibilities in the field of AI, which continues to expand human capability beyond our imagination are taught.

Course Objectives:

- Introduce the foundational principles of AI that drive real world complex applications and practice implementing some of these systems
- Equip students with the tools to tackle new AI problems that they may encounter in life

Course Content:


REFERENCES:

CSS3106: HUMAN-COMPUTER INTERACTION
Core/Elective: Elective Semester: 1 Credits: 3

Course Description:

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and the major phenomena surrounding them. It is often regarded as the intersection of Computer Science and behavioural science. HCI is also sometimes referred to as man–machine interaction (MMI) or computer–human interaction (CHI).

Course Objectives:

- To understand basic HCI concepts and definitions
- To understand the different types of interfaces
- To study and design multimodal interfaces
- To design & develop interfaces for diversified users

Course Content:

1. Overview of HCI — Mental models — Cognitive architecture — task loading and stress in HCI — Human error identification.
2. Input technologies — sensor and recognition based input — visual displays — Haptic interfaces — Non speech auditory output — network based interactions.

REFERENCES:

2. Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale, Human - Computer Interaction, 3e, Pearson, 2012
CSS3107: INFORMATION RETRIEVAL AND WEB SEARCH  
Core/Elective: Elective  Semester: 1  Credits: 3

Course Description:
A coherent treatment of classical and web based information retrieval that includes web search, text classification, text clustering, gathering, indexing and searching documents and methods of evaluating systems.

Course Objectives:
- Basic and advanced techniques for text-based information systems: efficient text indexing;
- Boolean and vector space retrieval models; evaluation and interface issues
- Web search including crawling, link-based algorithms, and Web metadata
- Understand the dynamics of the Web by building appropriate mathematical models.
- Build working systems that assist users in finding useful information on the Web

Course Content:
1. Taxonomy of IR Models – Classic models- Set theoretic model- Algebraic models- Probabilistic model- Structured text retrieval models- Models for browsing- Retrieval evaluations-Reference collections

2. Query languages-query operations-text and multimedia languages-Text operations-document preprocessing- matrix decompositions and latent semantic indexing-text compression —indexing and searching-inverted files-suffix trees- Boolean queries-sequential searching-pattern matching

3. Text Classification, and Naive baye’s-vector space classification-support vector machines and machine learning on documents-flat clustering —hierarchical clustering

4. Web search basics-web characteristics-index size and estimation- near duplicates and shingling-web crawling-distributing indexes- connectivity servers-link analysis-web as a graph-PageRank-Hubs and authorities- question answering

5. Online IR systems- online public access catalogs-digital libraries-architectural issues-document models -representations and access- protocols

REFERENCES:
2. Christopher D. Manning, PrabhakarRaghavan and HinrichSchütze , Introduction to Information Retrieval, 1e, Cambridge University Press, 2008
CSS3109: SOFTWARE QUALITY MANAGEMENT
Core/Elective: Elective Semester: 1 Credits: 3

Course Description:

This course discusses basic software project quality management principles and techniques as they relate to software project planning, monitoring and control. This course describes the basics of software verification and validation planning with an emphasis on software peer reviews and software testing. The course also covers software configuration management, technical metrics for software.

Course Objectives:

- Understand the basics and benefits of software quality engineering
- Plan, implement and audit a Software Quality Management program for their organization
- Select, define, and apply software measurement and metrics to their software products, processes and services
- Understand the fundamentals of the configuration management process to include configuration identification, configuration control, status accounting, and audits

Course Content:

1. Introduction to software quality: Software Quality - Hierarchical models of Boehm and McCall - Quality measurement - Metrics measurement and analysis - Gilb's approach - GQM Model


4. Software reliability and availability - standards and evaluation of process - ISO 9000 - SEI Capability Maturity Model (CMM) - Software configuration management -

5. Technical metrics for software - metrics for the analysis model - metrics for design model - metrics for source code - metrics for testing - metrics for maintenance - technical metrics for object oriented systems - distinguishing characteristics - class oriented metrics - operation oriented metrics - testing metrics - project metrics

REFERENCES:

CSS3108: FUNCTIONAL PROGRAMMING
Core/Elective: Elective Semester: 1 Credits: 3

Course Description:
As big data and multiple cores become ubiquitous, functional programming has become relevant as never before. The latest standards for popular programming languages like C++ and Java have included support for a large number of functional programming features. This course aims to provide a thorough introduction to functional programming. It covers both the theoretical underpinnings and practical, programming aspects.

Course Objectives:
- To have a theoretical understanding of functional programming.
- To develop the ability to design and implement functional programs.

Course Content:
1. Introduction to Functional Programming — Motivation — Defining features of the functional Paradigm — First Class Functions — Referential Transparency — Introduction to Haskell — Data Types and Pattern Matching— Laziness — Program Correctness
3. Classes for Numbers — Lists in Haskell — Basic List operations — Higher order list functions — List comprehension — Strings and Tuples — User defined data types: lists, queues, trees.

REFERENCES
Course Description:
Software architecture and design requires to be warned against subtle issues that can cause major problems during implementation. Often, people only understand how to apply certain software architecture and design techniques to certain problems. Formatting and applying these techniques to a broader range of problems is, by itself, a complex problem. Patterns in the areas of software architecture and design provide general solutions, documented in a format that doesn't require specifics tied to a particular problem.
In addition, patterns give a more educated vocabulary to the software architects and designers while expressing the various scenarios of software interactions.

Course Objectives:
- To give a comprehensive overview of recurring patterns in software development
- To impart the technical details on various patterns
- To provide insight into pattern based development

Course Content:
1. Patterns — Patterns category — Relationships between patterns — Patterns and Software Architecture — Architectural patterns — Idioms — Pattern systems — Documentation of Patterns
2. Analysis Patterns — Patterns in analysis — business patterns — Support patterns — Patterns for typed models — Association patterns
3. Design Patterns — Catalog of design patterns — Case study implementation — Creational — Structural Patterns — Behavioural patterns
4. Patterns of Enterprise application architecture — Object relational patterns — Web presentation patterns — Distribution patterns — Concurrency patterns
5. Business Process Improvement Patterns — Pedagogical patterns — Pattern languages — Anti-patterns — Major criticisms

REFERENCES
3. Martin Fowler, Analysis Patterns: Reusable Object Models, 1e, Addison-Wesley, 1997
4. Eric Gamma et al, Design Patterns: Elements of Reusable Object-Oriented Software, 1e, Pearson, 2008
5. Martin Fowler, Patterns of Enterprise Application Architecture, 1e, AW, 2002
6. Hohpe, Gregor, Bobby Woolf, Enterprise Integration Patterns, 1e, Addison-Wesley, 2005
7. Kircher, Michael, Markus Völter and UweZdun, Remoting Patterns: Foundations of Enterprise, Internet and Realtime Distributed Object Middleware, 1e, John Wiley & Sons, 2004
8. Kaplan, Jonathan, William C. R. Crawford, J2EE Design Patterns, 1e, O'Reilly, 2003
CSS3201: SOFTWARE ARCHITECTURE
Core/Elective: Core Semester: 1 Credits: 4

Course Description:

This course introduces the essential concepts of software architecture. Software architecture is an abstract view of a software system distinct from the details of implementation, algorithms, and data representation. Architecture is, increasingly, a crucial part of a software organization's business strategy.

Course objectives:

- To understand the relationships between system qualities and software architectures.
- To study software architectural patterns and their relationship to system qualities
- To know software architecture documentation and reuse

Course Content:


2. Life cycle view of architecture design and analysis – Eliciting quality attributes - QAW – Design of architecture - the ADD method – Evaluating architecture - ATAM method


5. Case study of J2EE/EJB - Future of software architecture

REFERENCES:

2. G.Zayaraz , Quantitative approaches for Evaluating Software Architectures: Frame Works and Models, 1e, VDM Verlag, 2010
https://www.sei.cmu.edu/webinars/view_webinar.cfm?webinarid=298346
Course Description:

Software development is a human activity. Agile methods, whether for project management or software development, are the ideal approach for developing software products where change is a risk factor. This course discusses the important milestones in effective software development and project management in the agile way.

Course Objectives:

- To introduce the changing concepts of software product development following the agile methods
- To equip the students with recent advances in software testing and refactoring that makes the product development more streamlined and efficient
- To provide an understanding of project management and its principles in a contemporary iterative, incremental Agile project environment

Course Content:

1. Agile product architecting: Envisioning the product – product vision – desirable qualities of the vision - customer needs – techniques for creating vision – dependencies and layering

2. Agile testing and development: Testing in agile, Refactoring development artifacts, agile patterns for user interface development


4. Agile practices: Facilitated workshops, MoSCoW approach to prioritization, iterative development methodologies – SCRUM and XP, modeling, timeboxing

5. Agile project planning and estimation: Agile requirements - structure and hierarchy of requirements. The Agile approach to estimating- Agile measurements

REFERENCES

CSS3203: SEMINAR
Core/Elective: Core Semester: 2 Credits: 1

Course Description:

The student has to prepare and deliver a presentation on a research topic suggested by faculty
member before the peer students and staff. They also have to prepare a comprehensive report of
the seminar presented.

Course Objective:

- Review and increase their understanding of the specific topics tested.
- Inculcating presentation and leadership skills among students.
- Offering the presenter student an opportunity of interaction with peer students and staff.
Course Description:

This course describes software-engineering techniques to develop software for embedded systems. This course examines requirements analysis, the definition of object structure and behaviour, architectural and mechanistic design, and more detailed designs that encompass data structure, operations, and exceptions. The object-based Unified Modeling Language (UML) is used to describe the structural and behavioral aspects critical to real-time systems.

Course Objectives:

- To understand the principles of software design for resource constrained devices
- To understand real-time/embedded software modelling with UML
- To understand and apply real-time design patterns

Course Content:


2. Real Time Operating Systems: Case studies of QNX, VxWorks, Windows CE


REFERENCES:

2. Hassan Gomaa, Designing Concurrent, Distributed, and Real-Time Applications with UML –, 1e, AW, 2013
CSS3205: SOFTWARE AGENT SYSTEMS
Core/Elective: Elective Semester: 2 Credits: 3

Course description:

This course provides a thorough understanding of agent related system development. Software agents are finding their way into areas such as environmental security, climate change, seismic safety, epidemic prevention, detection and response, computer emergency response and human and societal dynamics.

Course objectives:

- To understand Agent development
- To gain Knowledge in Multi agent and intelligent agents
- To Understand Agents and security
- To gain Knowledge in Agent Applications

Course Content


REFERENCES:

CSS3206: NETWORK FORENSICS
Core/Elective: Elective Semester: 2 Credits: 3

Course Description:
This course will introduce the student to the essential aspects of information security and network forensics. The student will be provided with the tools, techniques and industry accepted methodologies so that upon completion of the course the student will be able to describe key concepts of network security and forensics and how those concepts apply to themselves and their organization.

Course Objectives:
- Describe key principles, such as defense in depth and demilitarized zones (DMZ)
- Provide an overview of the requirement for intrusion detection systems (IDS) and their implementation
- Provide an overview of network security devices and infrastructures, including proxy servers and firewalls
- Describe the methodologies used in network forensics
- Describe data hiding and obfuscation and outline obfuscation methods

Course Content:


5. Data Hiding and Obfuscation Obfuscation Using Encryption - Obfuscation through Tunneling - Covert Channels - Watermarking and Stenography - Hiding File Contents - File Contents

REFERENCES:
Course description:

The course will introduce the major design, implementation and deployment issues regarding system integration, data-oriented cross-platform integration, e-business applications implementation and the security considerations in enterprise level multi-location systems integration. Business Process Management (BPM) is the set of concepts, methods, and tools that help organizations define, implement, measure and improve their end-to-end processes.

Course Objectives

The course will introduce the concepts and techniques related to the service-oriented as well as the data-oriented application integration approaches. Reasonable emphasis will be given for the middleware technologies and large-scale application integration standards. The course will also focus on the methods and techniques required to analyze, design, implement, automate, and evaluate business processes and workflows related to process-aware information systems.

Course Content


REFERENCES:

1. Thomas Erl, Service Oriented Architecture: A field guide to Integrating XML and Web Services, 1e, Prentice Hall, 2004
2. G.Hohpe and B. Woolf Enterprise Integration Patterns: Designing, Building and Deploying Messaging Solutions, 1e, AW Professional, 2003
4. Michael Havey, Essential Business Process Modeling, 1e, O'Reilly Media, 2005
CSS3208: ADVANCED DATA MINING
Core/Elective: Elective Semester: 2 Credits: 3

Course Description:

Data mining is the science of extracting hidden information from large datasets. This course offers clear and comprehensive introduction to both data mining theory and Practice. All major data mining techniques will be dealt with and how to apply these techniques in real problems are explained through case studies.

Course Objectives:

- Introduce the fundamental concepts of data and data analysis
- Case based study of specific data mining tasks like Clustering, Classification, Regression, Pattern Discovery and Retrieval by Content.
- Introduce algorithms for temporal data mining and spatial data mining.

Course Content:


2. mining frequent patterns, associations and correlations - pattern mining in multidimensional space- colossal patterns- approximate patterns- applications- Mining data streams-Mining Sequence patterns in transactional databases- mining sequence pattern in Biological Data


4. Outlier detection- outliers and outlier analysis- outlier detection methods-statistical approaches-proximity based approaches- clustering based approaches- classification based approaches-mining contextual and collective outliers- outlier detection in High-Dimensional data

5. Time series representation and summarization methods-mining time series data -Spatial data mining-spatial data cube construction-mining spatial association and co-location patterns-spatial clustering and classification methods-spatial trend analysis- Multimedia data mining-text mining- mining world wide web- trends in Data mining

REFERENCES:

1. TheophanoMitsa, Temporal Data mining, 1e, CRC Press, 2010
2. Jiawei Han &MichelineKamber, Jian Pei, Data mining concepts and techniques, 1e, Elsevier, 2014
4. G.K Gupta, Introduction to Data mining with case studies, 1e, PHI, 2008
CSS3209: FUZZY SET THEORY: FOUNDATIONS AND APPLICATIONS  
Core/Elective: Core  Semester: 2  Credits: 3

Course Description:

This course concentrates on fuzzy set theory and its application. This includes the concepts, and techniques from fuzzy sets and fuzzy logic to enhance machine learning techniques.

Course Objectives:

☐ To review the concepts of fuzzy set theory.
☐ To understand the fuzzy set theory techniques
☐ To use the theory in optimization problems
☐ To apply the theory to enhance machine learning techniques

Course Content:

1. Crisp sets and Fuzzy sets - Introduction - crisp sets an overview-the notion of fuzzy sets-basic concepts of fuzzy sets- membership functions - methods of generating membership functions- Defuzzification methods-operations on fuzzy sets- fuzzy complement- fuzzy union- fuzzy intersection- combinations of operations-General aggregation operation

2. Fuzzy arithmetic and Fuzzy relations-Fuzzy numbers-arithmetic operations on intervals-arithmetic operations on fuzzy numbers-fuzzy equations- crisp and fuzzy relations-binary relations- binary relations on a single set - equivalence and similarity relations- compatibility or tolerance relation

3. Fuzzy measures - Fuzzy measures - belief and plausibility measure - probability measures - possibility and necessity measures- possibility distribution- relationship among classes of fuzzy measures.


REFERENCES:

CSS3210: COMPLEX NETWORKS: THEORY AND APPLICATIONS
Core/Elective: Core Semester: 2 Credits: 3

Course description:

Complex networks provide a powerful abstraction of the structure and dynamics of diverse kinds of interaction viz people or people-to-technology, as it is encountered in today’s inter-linked world. This course provides the necessary theory for understanding complex networks and applications built on such backgrounds.

Course Objectives

- Representation and analysis of complex networks

Course Content

1. Networks of information – Mathematics of networks – Measures and metrics – Large scale structure of networks – Matrix algorithms and graph partitioning


REFERENCES:

2. Charu C Aggarwal (ed.), Social Network Data Analytics, 1e, Springer, 2011
3. David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a highly connected World, 1e, Cambridge University Press, 2010
CSS 3211: DATA SCIENCE & BIG DATA ANALYTICS
Core/Elective: Elective Semester: 2 Credits: 3

Course Description:

In the age of big data, data science (the knowledge of deriving meaningful outcomes from data) is an essential skill that should be equipped by software engineers. It can be used to predict useful information on new projects based on completed projects. This course provides a practitioners approach to some of the key techniques and tools used in Big Data analytics. Knowledge of these methods will help the students to become active contributors to the field of Data Science and Big Data Analytics

Course Objectives:

- To examine fundamental statistical techniques for data analytics
- To attain certain amount of statistical and mathematical sophistication to deal with the subject
- To gain thorough understanding on specific technologies for advanced analytics with Big Data
- To provide a guidance on operationalizing Big Data analytics projects

Course Content:

1. Big data ecosystem – Data analytics life cycle – Data preparation – Model planning – Model building – Communicate results – Operationalize – Case studies

2. Basic data analytics using R: R data structures - Exploratory data analysis - Statistical methods for evaluation – Data visualization using R: Visualization of categorical data, time series, distributions – Plots and Maps - Visualization packages


5. Advanced analytics: Technology and tools – MapReduce and Hadoop – Analytics with RDBMS -NoSQL – Big data analytics stream data - In-database analytics

REFERENCES

2. Hadley Wickham, Garrett Grolemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, Shroff/O’Reilly; First edition (2017)
AGENDA


Board of Studies approved the revised course structure for M.Sc. Computer Science with specialization in Soft Computing courses as per Annexure A. The paper CAM 2202 Advanced Operating System is moved to First Semester as CAM 2102 Operating System Concepts and the paper CAM 2102 Principles of Programming Languages is removed from syllabus. CAM 2302 Data Mining is moved to second semester as CAM2204 Data Mining. The paper CAM 2203 Intelligent System is moved to list of electives for II semester. The list of electives was revised and rearranged as per Annexure A.

The Board also approved

A) The introduction of following core subjects with syllabi
   1. CAM 2202 Database Management System
   2. CAM 2203 Software Engineering

B) The revision of syllabi following subjects
   1. CAM 2101 Mathematical Foundations for Computer Science
   2. CAM 2104 Programming in Python
   3. CAM 2105 Artificial Intelligence
   4. CAM 2204 Data Mining
   5. CAM 2301 Machine Learning

C) The revision of syllabi and title change of following subjects
   CAM 2103 Data Structures and Algorithms
   CAM 2201 Networks and Data Communications

The changes are to be made effective from 2018-19 academic year onwards.
M.Sc. COMPUTER SCIENCE with specialization in SOFT COMPUTING  
(2018 Admission onwards)  
Course Structure

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Course Code</th>
<th>Paper</th>
<th>Marks</th>
<th>Credit</th>
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<td>Mathematical Foundations for Computer Science</td>
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<td>Operating System Concepts</td>
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<td>Data Structures and Algorithms</td>
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List of Electives

Semester II

1. Distributed Computing
2. Intelligent System.
4. Quantum Computing #

Semester III

1. Big Data analytics (Syllabus from MCA)
2. Deep Learning #
3. Swarm Intelligence #
4. Wireless Networks
5. Web Technology and Web Programming.#
6. Knowledge Based Systems #
7. Fuzzy Logic. #
8. Evolutionary algorithms #
9. Rough Set.#
10. Cyber Forensics.#
11. Pattern Recognition.#
12. Artificial Neural Networks.(Syllabus from MCA)
13. Information Retrieval systems. #
14. Digital Signal Processing. #
15. Natural Language Processing.

# Syllabus to be approved


UNIT III  Transaction Management and Concurrency - Introduction to transactions, States of a transaction, Desirable properties of transaction (ACID), Schedules. Concurrent transactions – Serializability concepts, Testing serializability, Transaction support in SQL.

UNIT IV  Concurrency control - Lock-based protocols: Two-phase locking techniques, Deadlock detection and prevention, Timestamp-based protocols.

UNIT V  Distributed Database Concepts, NOSQL Databases and Big Data Storage Systems, Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia and Deductive Databases


CAM 2203 Software Engineering
(Report 2018)

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V


**********
# CAM 2101 MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE

(December 2018 Revision)

**UNIT I**
Foundation-Logic, Sets, Functions – Propositional Logic, Propositional equivalences, Predicates and Quantifiers, Sets, Set operations, Functions, Sequences and summation.

**UNIT II**

Introduction to automata theory and Significance, Regular Expressions, Finite state automata – DFA, NFA, Conversion of NFA to DFA, Mealy and Moore machine. Converting a DFA to Regular expression.

**UNIT III**
Perfect numbers, Mersenne numbers, Carmichael numbers, Prime Number, Primality Testing, Divisibility, Modular Arithmetic, GCD, Euclidean algorithm, Linear Diophantine equations, congruences, linear congruences. Euler Phi function and properties, Fundamental Theorem of Arithmetic.

**UNIT IV**
Probability, basics, Conditional Probability, Bayes Theorem, Distributions - Binomial, Poisson, Normal distributions and related problems.

**UNIT V**

**Text Book:**

**References:**
CAM 2104 Programming in Python
(January 2018 Revision)

UNIT I
Introduction to computer programming: Brief discussion on algorithms, programs, programming languages and Python as a programming language.
Introduction to Python: Python Data Types, Expressions, Variables, and Assignments, Strings, Lists.
Imperative Programming: Python Programs, Execution Control Structures, Decision (if-elif-else) and Looping (for variants and while), Using break, continue and pass statements in loops, User-Defined Functions, Python Variables and Assignments, Parameter Passing (thrusting mutable and immutable parameters). Recursion, Examples, Brief discussion on Memory Management During Recursive Function Calls Using Program Stack.

UNIT II
Strings and Lists: Negative Indexing, String Methods. Formatted Output, Two Dimensional Lists, iterating through Two Dimensional Lists.
Files: Opening and Closing a File, Opening Modes, Various Read and Write Methods.
Errors and Exceptions: Exception Types, Exception Handling using Try & Except.
Containers: Dictionaries, Tuples and Sets, Properties Operators and Methods of Containers.
Python Standard Library: Brief Discussion on Library Methods and Modules, Mention important methods from math, fractions and random modules.

UNIT III
Object Oriented Programming: Objects and Classes, Defining a Class in Python, Constructors.
Inheritance: Multiple and Multilevel Inheritance, Modifying Built in Classes Using Inheritance, Operator Overloading (Integer Class Operators only) Using Inheritance, User Defined Exceptions.
Namespaces: Encapsulation in Functions, Global versus Local Namespaces, Exceptional Control Flow, Modules as Namespaces, Classes as Namespaces.

UNIT IV
Graphical User Interfaces: Tkinter Widgets – Label, Text, Entry, Button, Canvas & Frames, Event-Based tkinter Widgets, Designing GUIs, OOP for GUIs.
Pattern Matching Using Regular Expressions: Python Standard Library Module RE.

UNIT V
NumPy: Creating Arrays (array() and arange), reshape(), sum(), min() and max() methods, Item wise arithmetic operations.
Database Programming in Python with sqlite3: Creating Tables, Querying (Inserting Tuples, Selecting Rows and Updating Tuples) Using Cursor to Iterate over Selected Tuples.

Text Book:

References:
2. Dr. R. Nageswara Rao “Core Python Programming, 2ed” Wiley 2018

**********
UNIT I
What is AI, Intelligent Agents – Agents and environments – Good behavior – 
The nature of environments – Structure of agents – Problem Solving – 
Problem solving agents – Example problems. Uniform search strategies: 
BFS, DFS, Iterative deepening depth-first search, Depth limited search, 
Uniform cost search, Bidirectional search. Informed Search Strategies – 
Greedy best-first search, A* search: Minimizing the total estimated solution 
cost, Heuristic function.

UNIT II
Local search algorithms and optimization problems – Hill-climbing search, 
Local beam search, Genetic algorithms. Games – Optimal decisions in games 
– Alpha – Beta Pruning. Constraint satisfaction problems (CSP) – defining 
constraint satisfaction problems, constraint propagation: inference in CSPs, 
Backtracking search and Local search.

UNIT III
Logical Agents-Knowledge based Agents. The Wumpus world. Logic- 
Propositional Logic, Propositional theorem proving. First order logic-syntax 
and semantics – Using first order logic – Knowledge engineering in FOL. 
Inference – Prepositional versus first order logic – Unification and lifting – 
Forward chaining – Backward chaining.

UNIT IV
Planning: The planning problem – Planning with state space search – Partial 
order planning, planning graphs – Planning with propositional logic 
Knowledge representation – Ontological Engineering – Categories and objects 
– Actions – Simulation and events.

UNIT V
Learning From Observations – forms of learning – Inductive learning – 
Learning decision trees – Ensemble learning.


**********
UNIT I
Introduction to Data Mining and Data Warehousing: Definition of Data mining, Knowledge Discovery Process, Basic forms of data for Data Mining, Data Mining functionalities, Technologies for Data Mining, Application areas of Data Mining; Major issues in Data Mining; Getting familiar with data for Data Mining – Various type of attributes and data values, Basic statistical descriptions of data; Data Warehouse and OLAP Technology for Data Mining- Data Warehouse definition, Multidimensional Data Model, Schemas for Multidimensional Databases.

UNIT II
Data Preprocessing: Introduction and need of Preprocessing the Data, Data Cleaning – Missing Values, Noisy Data, Data cleaning as a Process; Data Reduction – Overview, Wavelet Transforms, Principal Component Analysis, Parametric Data Reduction; Data Transformation and Discretization – Data Transformation Strategies Overview, Data transformation by Normalization, various methods of Discretization, Concept Hierarchy Generation for nominal data.

UNIT III
Mining Frequent Patterns, Associations, and correlations: Basic Concepts – Market Basket Analysis, Frequent Itemsets and Association Rules; Frequent Itemset. Mining Methods - The Apriori Algorithm, Generating Association Rules from Frequent Itemsets, Finding Frequent Itemsets without Candidate Generation, FP-Growth, FP-Tree.

UNIT IV
Classification - Basic Concepts, Decision tree induction, Bayes Classification, Rule Based Classification, Model evaluation and selection, Advanced Classification methods – Bayesian Belief Networks, Classification by Backpropagation, Support Vector Machines, Classification by Frequent patterns, Lazzy Classifiers.

UNIT V
Cluster Analysis: Introduction to Cluster Analysis, Overview of Clustering Methods; Partitioning methods - k-Means, k-Medoids; Hierarchical methods - Agglomerative versus Divisive Clustering, Distance Measures, BIRCH, Chameleon, Probabilistic Hierarchical Clustering; Density based methods - DBSCAN, OPTICS, DENCLUE; Grid based methods – STING, CLIQUE; Evaluation of Clustering.

Text Book:

References:

**********
CAM 2301 Machine Learning

(January 2018 Revision)

UNIT I FOUNDATIONS OF LEARNING:

UNIT II SUPERVISED LEARNING:

UNIT III UNSUPERVISED LEARNING:

UNIT IV SOFT COMPUTING TECHNIQUES

UNIT V DEEP LEARNING & TRENDS IN MACHINE LEARNING

Text Book:

References:
3. Fakhreddine O. Karray, Clarence De Silva, ‘Soft Computing and Intelligent systems design’, Pearson Education,

**********
CAM 2103 Data Structures and Algorithms
(January 2018 Revision)

UNIT I  Algorithm Analysis: Mathematical Background — Complexity Analysis — Computational and Asymptotic Complexity, Asymptotic Notations — Big O, Big \(\theta\) and Big \(\Omega\), Running time calculations — General Rules, Solutions for the Maximum Subsequence Sum Problem, Logarithms in Running time.

UNIT II  Linked List, Stack, Queue, Trees: Abstract Data Types (ADTs), List ADT — Array Implementation, Doubly Linked list, Circular Linked list, Stack ADT, Queue ADT, Trees — Binary trees, Binary Search Trees, AVL trees, Tree traversals, B trees, Red Black Tree.


UNIT IV  Disjoint set class, Graph Algorithms: Disjoint sets — Union by rank and path compression. Graphs — Topological sort, shortest path algorithms, Network flow problems, Minimum spanning tree, Applications of DFS.

UNIT V  Algorithm Design Techniques: Greedy Algorithm — Scheduling problem, Huffman codes, approximate bin packing, Divide and Conquer — Closest points problem, Selection problem, Dynamic Programming — All pairs shortest path.


2. Introduction to Design and Analysis of Algorithms, Anany Levitin, Pearson, 2012

**********


UNIT IV  Message Access Agent - POP, IMAP, MIME. Network Management: concepts, management components - SMI, MIB, SNMP, UDP Ports. IPv6 Addressing - Introduction, Address space allocation, Global Unicast addresses, auto configuration

UNIT V  IPv6 Protocol – Packet format, Transition from IPv4 to IPv6. ICMPv6 – Introduction, Error messages, Information messages, Neighbor- discovery messages, Group membership messages. Introduction to NS2 Programming -


**********
MINUTES OF THE MEETING OF THE BOARD OF STUDIES IN PHOTONICS HELD ON 4TH JAN., 2018

The meeting of the Board of Studies in Photonics was held on 4th January, 2018 in the syndicate room of the University Administrative building at 11 am. The following members were present.

1 Dr C Vijayan
2 Dr Suresh Nair
3 Dr Promod Gopinath
4 Dr M Kailasanath
5 Dr N V Unnikrishnan
6 Dr A Mujeeb
7 Dr V P N Nampoori
8 Dr P Radhakrishnan (Chairman)

At the outset, the Chairman, Board of Studies welcomed the members to the meeting. Following this, the meeting ratified the newly introduced elective papers in the M Sc (5 year integrated Photonics) course syllabus offered by International School of Photonics viz CEL 2E15: Solar Cells: Concepts and theory, CEL 2E16 Photonic band gap structures and meta materials and CEL 2E17 Holography and speckle metrology. It may be noted that these electives were earlier approved by the Academic Committee of the University. Subsequently, other aspects of the revision of the syllabus for the MSc course were also taken up for discussion. In the discussion, Director, ISP informed the member that the department has already taken up the revision of syllabus in a major way and the same will be finalized by the end of February, 2018. Hence it was decided that the new syllabus will be taken up for discussion in the next Board of studies meeting to be convened during March, 2018. It was also decided that the new syllabus should come into effect from the 2018 admission onwards.

Chairman, Board of Studies in Photonics