भारतीय समुद्री विश्वविद्यालय
INDIAN MARITIME UNIVERSITY
(केंद्रिय विश्वविद्यालय, भारत सरकार)
(A Central University, Govt. of India)
मुम्बई पोर्ट परिसर, MUMBAI PORT CAMPUS

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Ref. No.:

Date: 31.01.2018

To,

Sir,

Sub: Inviting Bids for Supply, Installation and Testing of Diesel Engine Combustion Gas Simulator at Indian Maritime University, Mumbai Port Campus.- Reg.

Indian Maritime University is a Central University, under Ministry of Shipping, Govt. of India.

Indian Maritime University, Mumbai Port Campus is intended to invite the Bids from the reputed suppliers/ manufacturers for the supply, installation and testing of Diesel Engine Combustion Gas Simulator at Mumbai Port Campus.

The Technical specifications, Terms and Conditions and formats of Financial Bids are enclosed.

The last date for submission of the tender is 15th Feb 2018 and tentative date of opening bids will be 16th Feb 2018.

Interested parties are requested to submit the bids before due date. For further information please visit Mumbai Port Campus website: www.imumumbai.com

Yours faithfully

Encl: As Above

(जे. आर. सी. मुर्ति \J. R. C. Murthy)
In charge Deputy Registrar

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MUMBAI PORT CAMPUS
Hay Bunder Road, Sweri, Mumbai-400033

SUPPLY, INSTALATION & TESTING

DIESEL ENGINE COMBUSTION GAS SIMULATOR

Description of Work

Consists of supply, installation (including accessories if any as per site & system requirement), testing & commissioning, Training to instructors of Diesel Engine Combustion Gas Simulator for IMU-Mumbai Port Campus

Part 1 - Technical Specifications

Part 2 - Terms & Conditions of Tender

Part 3 - Price Bid Performa

PART - 1

TECHNICAL SPECIFICATIONS

1. The technical specifications of Diesel Engine Combustion Gas Simulator (Specific) with respect to various Rules and Regulations are as mentioned below:

1.1 STCW 1978 amended 2010 Convention;

Regulation I/12 Use of simulators:
The performance standards and other provisions set forth in section A-I/12 and such other requirements as are prescribed in part A of the STCW code for any certificate concerned shall be complied with in respect of ;

(1) all mandatory simulator based training;
(2) any assessment of competency required by part A of the STCW Code which is carried out by means of a simulator; and
(3) any demonstration, by means of a simulator, of continued proficiency required by Part A of the STCW code.

1.2 STCW 1978 amendment 2010, Code;

As applicable to Diesel Engine Combustion Gas Simulator.

Simulator shall be capable of simulating a main diesel engine machinery combustion system and shall incorporates following as per STCW Code Section A-I/12 and B-I/12.

2.2.1 Section A- I/12 : Standard governing the use of Simulators

Part –1 Performance Standards

The simulator shall be designed to ensure that it shall

(i) be suitable for the selected objectives and training tasks;
(ii) be capable of simulating the operating capabilities of shipboard equipment concerned, to a level of physical realism appropriate to training objectives , and include the capabilities, limitations and possible errors of such equipment;
(iii) have sufficient behavioral realism to allow a trainee to acquire the skill appropriate to the training objective;
(iv) provide a controlled operating environment, capable of producing a variety of condition, which may include emergency, hazardous or unusual situations relevant to the training objectives;
(v) provide an interface through which a trainee can interact with the equipment, the simulated environment and, as appropriate, the instructor; and
(vi) permit an instructor to control, monitor and record exercises for the effective debriefing of trainees.

Performance standard for Simulators used in Assessment of competence:

The Simulator shall be designed to be capable of being used for assessment of competence required under convention for any demonstration of continued proficiency so required shall:

1. be capable of satisfying the specified assessment objectives
2. be capable of simulating the operational capabilities of shipboard equipment concerned, to a level of physical realism appropriate to the assessment objectives, and include the capabilities , limitations and possible errors of such equipment;
3. have sufficient behavioral realism to allow a candidate to exhibit the skills appropriate to the assessment objective;
4. provide an interface through which a candidate can interact with the equipment and simulated environment.
5. provide a controlled operating environment, capable of producing a variety of condition, which may include emergency, hazardous or unusual situations relevant to the assessment objectives;
6. permit an assessor to control, monitor and record exercises for the effective assessment of the performance of candidates.

2.2.2 **Section A-I/12 Part -2 – Other provisions**

Simulator training objectives

Aims and objectives of simulator-based training are defined within an overall training program and that specific training objectives and tasks are selected so as to relate as closely as possible to shipboard tasks and practices.

- **Training procedures (Simulator design should be such to be able to assist the instructor in following)**

  In conducting mandatory simulator-based training, instructors shall ensure that:

1. trainees are adequately briefed beforehand on the exercise objectives and tasks and are given sufficient planning time before the exercise starts;
2. trainees have adequate familiarization time on the simulator and with its equipment before any training or assessment exercise commences;
3. guidance given and exercise stimuli are appropriate to the selected exercise objectives and tasks and to the level of trainee experience;
4. exercises are effectively monitored, supported as appropriate by audio and visual observation of trainee activity and pre-and post-exercise evaluation reports;
5. trainees are effectively debriefed to ensure that training objectives have been met and that operational skills demonstrated are of an acceptable standard;
6. the use of peer assessment during debriefing is encouraged; and
7. simulator exercises are designed and tested so as to ensure their suitability for the specified training objectives.

- **Assessment procedures (Simulator design should be such to be able to assist the assessor in following)**

Where simulators are used to assess the ability of candidates to demonstrate levels of competency, assessors shall ensure that:

1. performance criteria are identified clearly and explicitly and are valid and available to the candidates;
2. assessment criteria are established clearly and are explicit to ensure reliability and uniformity of assessment and to optimize objective measurement and evaluation, so that subjective judgments are kept to the minimum;

3. candidates are briefed clearly on the tasks and /or skills to be assessed and on the tasks and performance criteria by which their competency will be determined;
4. assessment of performance takes into account normal operating procedures and any behavioral interaction with other candidates on the simulator or with simulator staff;
5. scoring or grading methods to assess performance are used with caution until they have been validated; and
6. the prime criterion is that a candidate demonstrates the ability to carry out a task safely and effectively to the satisfaction of the assessor.

2.2.3 STCW Code Section B-I/12: Guidance regarding use of Simulator: Main and auxiliary machinery operation Simulation:

As relevant to Diesel Engine Combustion Gas System.

B-I/12-73 :

The Diesel Engine Combustion Gas Simulator equipment shall be designed to be capable of simulating a main diesel engine machinery combustion system and shall be incorporated with facilities to:

1. monitor and evaluate engine performance
2. simulate machinery malfunctions;
3. allow for the variable external conditions to changed so as to influence the simulated operations: weather, ship's draught, seawater and air temperatures.
4. allow for instructor-controlled external conditions to be changed: ice conditions, ship load;
5. allow for instructor- controlled simulator dynamics to be changed: emergency run, process responses, ship responses.

2.3 Training Examination, and Assessment Programme (TEAP) PART –A; for Merchant Shipping, Standards of Training, Certification and Watchkeeping for Seafarers, (STCW) Rules, 2014; Section I/12 (D.G.S Requirement)

Rule 15: Use of Simulators -Performance standards of the simulators and provisions regarding training and assessment shall be as per section A-I/12 of the STCW code as amended.

2.4 Additional Details as per STCW Code: Competencies addressed by machineries operation

STCW reference	Competence	Knowledge. Understanding & proficiency
Table A-III/1	operate main machinery and associated control systems	Basic construction and operation principles of machinery systems, including: 1. marine diesel engine. 9. Fluid flow and characteristics of, fuel oil and cooling systems.
Table A-III/2	Plan and schedule operation	*Theoretical knowledge* Propulsive characteristics of diesel engine including speed, output and fuel consumption. Heat cycle, thermal efficiency and heat balance of the following: Marine diesel engine. Physical and chemical properties of fuels.

Table A-III/2	operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery	*Practical knowledge* Operating limits of propulsion plant. The efficient operation, surveillance, performance, assessments and maintaining safety of propulsion plant.

3. Technical Specifications of DIESEL ENGINE COMBUSTION GAS SIMULATOR

1) Pre-installed engine models, indicative list is given

- 84 cm bore two cycle slow speed engine (MANB&W type)
- 90 cm bore two cycle slow speed engine (WARTSILA/ SULZER type)

Simulator will simulate conditions for above low speed two stroke engines.
To some extent require to simulate a medium speed four stroke engine.

It should be possible to simulate conditions for various engine loads (25% to 110%) for two stroke engine.

2) INPUT

It should be possible to change following inputs:

- Engine speed
- Fuel injection volume
- Fuel injection timing
- Scavenging air pressure
- Scavenging air temperature
- Coolant flow rate
- Coolant temperature
- Compression pressure low (Piston ring worn, exhaust valve leaking, excessive bumping clearance)
- VEC – Variable Exhaust Valve closing
- Fuel temperature & viscosity
- Fuel quality
- VIT – Variable Injection Timing
- FQS – Fuel Quality Setting
- Air humidity(Engine Room)

3) OUTPUT

Result of analysis of diesel engine shall be displayed with data table including

- P-θ (cylinder gas pressure - crank angle) diagram, the Draw Card
- T-θ (cylinder gas Temperature - crank angle) diagram
- Heat release rate
- P-V diagram (cylinder gas pressure – cylinder volume), the Power Card
- Exhaust gas emission table
- Simulated data table

It should be possible to super-impose first three curves for comparison.

4) It should be possible to simulate following conditions of the engine and evaluate the engine performance :

- When injection timing is changed
- When intake air temperature is changed
- When scavenge temperature or pressure is changed
- When flow rate of JCW or Piston cooling is changed
- When fuel quality setting (FQS) is changed
- When fuel quality is changed
- Fouled turbocharger (turbine and/or compressor)
- When running in torque rich condition
- Operation with one cylinder cut off
- Miller's cycles and its effect on NOx
- Variable exhaust valve closing
- Turbocharger suction filter fouling
- Fouling of Turbo-Charger air cooler
- Temperature controller/s out of order (JCW, Piston Cooling, Air Cooler)
- Temperatures of JCW and piston cooling oil is changed
- Abnormality in the fuel injection mechanism like cam wear-out, advanced cam, raised plunger, slack chain, slipped cam shaft
- Low load operation with one turbocharger cut-off

5) It should be possible to simulate :

a. Torque rich condition like :
   - Fouled hull
   - Fouled propeller
   - Heavy weather

b. UMS class engine fuel limiters :- i) Scavenge air pressure ii) load iii) Torque

c. To do trouble shooting (when instructor introduces abnormal operating conditions and lets the student find the cause of abnormal condition and verify it logically)

d. To monitor changes in exhaust gas parameters with change in fuel quality (Sulphur, carbon, viscosity, Density, Water, etc.)

6) Parametric analysis :

Parametric analysis shall allow the student to pinpoint where engine operating conditions require improvements to provide :

- Maximum thermal efficiency
- Minimum NOx
- Minimizing soot
- Minimizing unburnt fuel oil

7) **Running engine on conditions of** – a) Maximum power b) Economical power c) Most environmental friendly conditions

8) Procedure and simulation for assessing and grading student on diesel engine combustion knowledge.

Function:

The simulator shall be able to evaluate normal operating performances under predetermined parameters, and some other operating performances by setting the following parameters based on the expected conditions and real ship conditions.

Input data.

The following parameters can be evaluated as operational conditions:

1) Initial conditions
   a) Engine load .... % (25 ~ 110%, every 5%)
   b) Engine speed …. rpm
   c) Calculating interval (crank angle)
      i) Before injection and after combustion …. Deg (minimum 0.1 deg)
      ii) During injection and after combustion …. Deg (minimum 0.1 deg)
2) Conditions of Engine operation
   a) Fuel injection timing (FQS) ….deg
      (FQS : Fuel Quality Setting) (-2 ~ +2 deg)
   b) Jacket cooling water inlet temperature ……°C
   c) Piston cooling inlet temperature ……°C
   d) Scavenging air temperature at
      Intercooler outlet ……°C

Property of fuel oil

   a) Coefficient of kinematic viscosity ….cSt at 50°C
   b) Density …kg/m^3 at 15°C
   c) Specific Heat ..J/kg/K
   d) Lower calorific value … J/kg
   e) Elements of fuel oil
      a. Carbon content …wt%
      b. Hydrogen content …wt%
      c. Nitrogen content …wt%
      d. Sulfur content …wt%
      e. Emulsified fuel …wt% water

3) Conditions of fuel injection
   1) Fuel injection temperature …°C
   2) Injection volume of fuel oil … m^3/cylinder/stroke

4) Conditions of air

   1) Scavenging air pressure …MPa

   2) Engine room humidity …%

      (Relative humidity at intercooler outlet)

   3) Gas constant …J/kg/K

5) Conditions of cooling system

   1) Condition of jacket cooling water

      a) Volume flow rate … m^3/s

      b) Density …kg/ m^3

      c) Specific Heat …J/kg/K

6) Mechanical efficiency ….%

7) Comparison of engine performance curves:

   P –θ (Crank Angle), Temperature in cylinder – θ (Crank angle),

   Heat release rate pattern

OUTPUT

The following simulation results shall be displayed on the screen and can be printed out as shown later:

1) Draw curve (P – θ curve)
2) Indicator curve (P – V diagram)
3) Heat Release pattern
4) Thermal efficiency
5) Specific fuel oil consumption
6) Combustion gas temperature in the cylinder
7) Calculation results (table)
8) Exhaust gas composition (table)

The Extent of Simulations:

The following cases shall be simulated based on expected combustion conditions:

1) Load of main Engine (from 25 to 110% of MCR, every 5%)
2) Fuel injection timing (from -2° to +2° from predetermined set value)

3) One cylinder cut-out
4) Turbo-charger abnormal (One of the two Turbo chargers cut-off)
5) Coolant abnormal (as high and low coolant inlet temp)
6) Scavenging air abnormal (as high and low scavenge air temp)
7) Fuel oil abnormal (like high & low Carbon content, etc.)
8) Torque rich condition

Diagrammatic representation of output will be available as follows:

Output items

1) Draw curve (P - θ curve)
2) Temperature in cylinder (T – θ curve)
3) Heat release pattern (dQ/d θ curve)
4) Engine Power (kW)
5) Specific fuel oil consumption (g/PS/h)
6) Thermal efficiency (%)
7) Maximum Pressure in cylinder (MPa)
8) Break mean effective pressure (MPa)
9) NO_x content of exhaust gas
10) Quantity of soot generation per cycle (mg/cycle)
11) Quantity of unburnt fuel oil per cycle (mg/cycle)
12) Comparison between various combinations of above
13) Modeling of fuel injection system should include the following;
    - Fuel injection starting angle
    - Fuel injection period
    - Injection volume of fuel without water
    - Injection rate
14) Modeling of Engine should be based on
    - Engine specifications
    - Fuel injection system
    - Scavenging

- Heat transfer coefficient of coolant –side
- Heat transfer coefficient at the cylinder wall by Woschni's equation.
- Ignition, and premixed combustion
- Reaction rate coefficients of NO formation by "extended Zeldovich's mechanism".
- Formation and decomposition of carbon.

INPUT & OUTPUT RESULTS OF

DRAW CARD AT A PARTICULAR LOAD

Conditions:

Load 25%, 50%, 75%, 100%, 110% (at interval of 5%)

Speed -- rpm

Input:

File Number xxx

Load -- %

Speed -- rpm

Interval 0.1 degree

Mechanical efficiency -- %

FQS degree angle (-2, -1,0,+1,+2)

Scavenge air temperature -- degree C

J.C.W. Inlet -- degree C

Piston cooling oil Inlet -- degree C

Output:

Power (IP) -- kW

SFOC -- g/PS/h

Efficiency -- %

Pmax -- MPa

Pmean -- MPa

NOx -- ppm

Soot -- mg/cycle

Unburnt fuel -- mg/cycle

Liner Wall Tempearature -- degree C

Cylinder cover Wall Temperature -- degree C

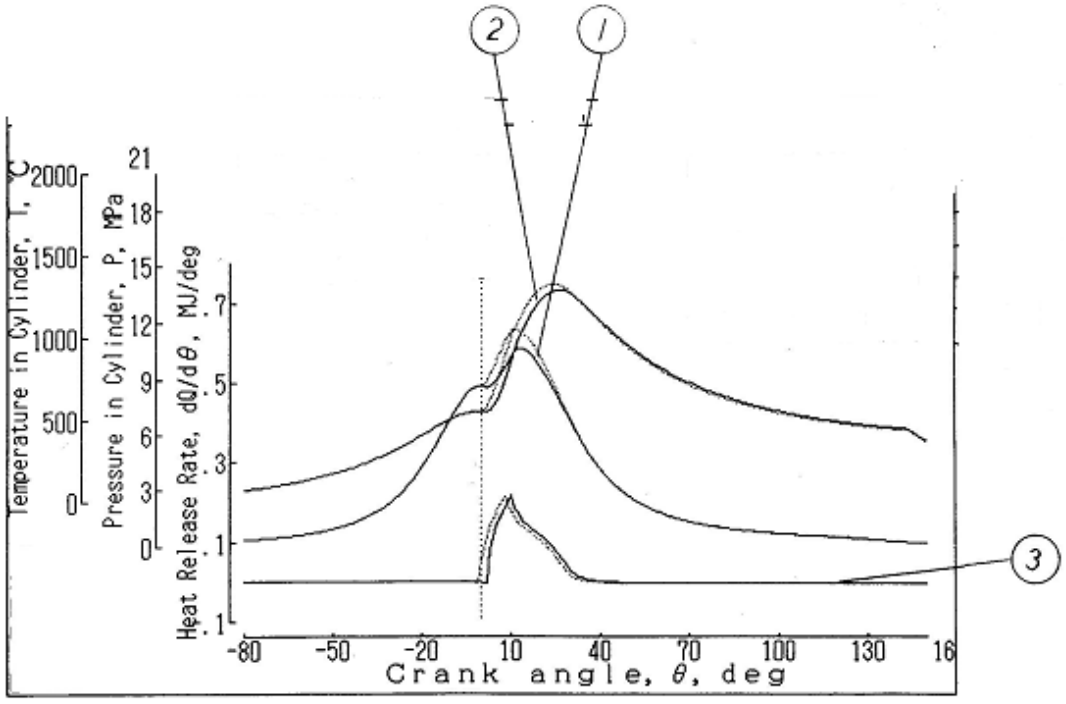
Piston Wall Temperature -- degree C

Jacket C.W. outlet Temperature -- degree C

Piston cooling oil outlet Temperature -- degree CEmission ppm by weight
1: CO2, 2: H2O 3: O2 4: N2 5: CO 6: H2 7: O 8: OH 9: H 10: NO 11: N

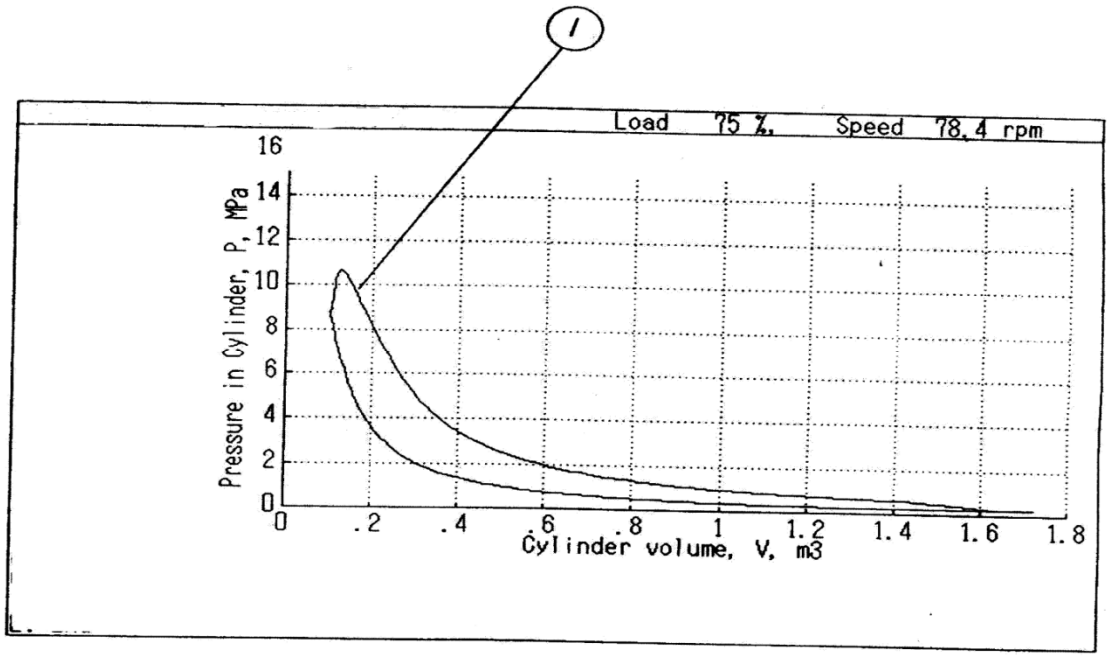
DRAW CARD AT A PARTICULAR LOAD

(1) Pressure in Cylinder [P-θ] (2) Temperature in cylinder [T-θ] (3) Heat Release rate dQ/dθ



TYPICAL POWER CARD

(P-V DIAGRAM)



Diesel Engine Combustion Gas Monitor Simulator-Exercises

LESSON PLAN FOR EXERCISES

Engine behaviour on change of fuel oil characteristics
(Flash point, water%, Conrad son weight, % Sulphur, Cetane number, density at 15 C, viscosity cst at 50 C, and its resulting influence on specific fuel consumption, IHP, mechanical efficiency, BHP, influence of VIT, FQS overload etc. on the engine performance.

Recording change in behaviour in stroke / cycle, cylinder pressure and fuel pressure graph.

Change of different fuel injection characteristics like angle behavior etc due to change of RPM, compression pressure, peak pressure, IHP/cylinder, fuel pressure before injection, fuel pump plunger/ barrel wear and tear etc.

EXERCISES AND TASKS

1. LOAD VARIATION: Engine running conditions vary with the load of main engine is changed, between 25% and 110%, in steps of 25% load variation.

2. VISCOSITY and DENSITY VARIATION

3. Fuel Injection timing variation: Fuel Injection timing is adjusted by Fuel Quality Setting, FQS, lever according to the fuel quality on board to get the optimum value of the maximum pressure. The optimum timing is to be judged, for fuel economy or NOx emission for quality of fuel used and peak pressure. -2 deg. And +2 deg. From pre determined set value.

4. One cylinder cut out: In case one cylinder is cut out, the remaining cylinders must take over the load of the cut out cylinder. More fuel is injected to each remaining cylinder with same quantity of air supply as in normal condition. This condition is simulated by increasing the fuel injection volume / cylinder with one cylinder cut out of a 7 cylinder engine becomes 7/6 of normal volume for the remaining each cylinder.

5. Turbo- charger abnormal condition: (as lean air /fuel ratio) when turbo-charger becomes abnormal, scavenging airflow is reduced and scavenge pressure decreases. This condition is simulated by reducing scavenge pressure.

6. Scavenging air abnormal condition: (as high and low scavenge air temperature) when an air cooler is fouled or insufficient cooling water is supplied to an air cooler, scavenge air temperature will become high. When cooling water temperature is low and not properly regulated, the scavenge air temperature will become excessively low. These condition are simulated by changing scavenge air temperature.

Following exercises are examples for stated machinery

STUDENTS TASK SCHEDULE

B&W 7K 90 MC (MCR 3,440 kW/Cylinder @ 86 rpm)

TASK	Group 1	Group 2
1-Load Varying	Load 95% FQS – 2, -1,0, +1, +2 Density 991 kg/m^3 Viscosity = 480 cSt	Load 100% FQS – 2, -1,0, +1, +2 Density 991 kg/m^3 Viscosity = 480 cSt
2-Density Varying	Load 100% FQS – 2, -1,0, +1, +2 Density 900 kg/m^3 Viscosity = 600 cSt	Load 100% FQS – 2, -1,0, +1, +2 Density 980 kg/m^3 Viscosity = 380 cSt
3-Viscosity Varying	Load 95% FQS – 2, -1,0, +1, +2 Density 991 kg/m^3 Viscosity = 380 cSt	Load 100% FQS – 2, -1,0, +1, +2 Density 950 kg/m^3 Viscosity = 480 cSt
4-T/C failure low Sc. Air Pressure	Load = ??? % FQS ? Density 950 kg/m^3 Viscosity = 600 cSt Sc. Air Pr 0.250 Bar	Load = ??? % FQS ? Density 980 kg/m^3 Viscosity = 480 cSt Sc. Air Pr 0.240 Bar
5- Air Cooler high Sc. Air Temp	Load = ??? % FQS ? Density 991 kg/m^3 Viscosity = 380 cSt Sc. Air Temp = 55°C	Load = ??? % FQS ? Density 950 kg/m^3 Viscosity = 600 cSt Air Temp = 65°C
6- one Cyl cut-out fuel vol = 7/6	Load = ??? % FQS ? Density 991 kg/m^3 Viscosity = 380 cSt	Load = ??? % FQS ? Density 975 kg/m^3 Viscosity = 380 cSt

1) Sulphur : Consider Sulphur content in the given fuel as 2.0%
2) Observe following limits :

Pmax	< 130 bars or 13.0 MPa	Explosion Ratio	< 1.35
NOx	< 1680 PP^M	T max	< 1500°C
		T exhaust	< 500°C

REPORT : Give conclusive report, ***on final day after last task,*** stating at What Load and FQS Control. The Main engine can be safely run under the above conditions, having best Specific Fuel Consumption (Economy) and below NOx limit.

NOTE : each group to use separate floppy & submit with the final report. Viscosity = mm^3/s, cSt@50° Density = kg/cm^3 @ 15°C

1PS = 0.986HP = 0.736 KW & 1KW = 1.340 HP = 1.359 PS

KW per unit X SFOC (q/PS/h) X 1.359 X 7 units X 24 hours = MT/Day FO

Cons 1000 x 1000

Following exercises are examples for stated machinery

STUDENTS TASK SCHEDULE

B&W 7K 90 MC (MCR 3,440 kW/Cylinder @ 86 rpm)

TASK	Group 3	Group 4
1-Load Varying	Load 105% FQS – 2, -1,0, +1, +2 Density 991 kg/m^3 Viscosity = 480 cSt	Load 90% FQS – 2, -1,0, +1, +2 Density 991 kg/m^3 Viscosity = 480 cSt
2-Density Varying	Load 100% FQS – 2, -1,0, +1, +2 Density 975 kg/m^3 Viscosity = 480 cSt	Load 100% FQS – 2, -1,0, +1, +2 Density 950 kg/m^3 Viscosity = 500 cSt
3-Viscosity Varying	Load 100% FQS – 2, -1,0, +1, +2 Density 950 kg/m^3 Viscosity = 380 cSt	Load 90% FQS – 2, -1,0, +1, +2 Density 980 kg/m^3 Viscosity = 500 cSt
4-T/C failure low Sc. Air Pressure	Load = ??? % FQS ? Density 975 kg/m^3 Viscosity = 380 cSt Sc. Air Pr 0.260 Bar	Load = ??? % FQS ? Density 990 kg/m^3 Viscosity = 500 cSt Sc. Air Pr 0.250 Bar
5- Air Cooler high Sc. Air Temp	Load = ??? % FQS ? Density 991 kg/m^3 Viscosity = 480 cSt Sc. Air Temp = 60°C	Load = ??? % FQS ? Density 980 kg/m^3 Viscosity = 500 cSt Air Temp = 55°C
6- one Cyl cut-out fuel vol = 7/6	Load = ??? % FQS ? Density 950 kg/m^3 Viscosity = 600 cSt	Load = ??? % FQS ? Density 980 kg/m^3 Viscosity = 500 cSt

1) Sulphur: Consider Sulphur content in the given fuel as 2.0%
2) Observe following limits :

Pmax < 130 bars or 13.0 MPa Explosion Ratio< 1.35
NOx < 1680 PP^M T max < 1500°C
T exhaust < 500°C

REPORT : Give conclusive report, ***on final day after last task,*** stating at What Load and FQS Control. The Main engine can be safely run under the above conditions, having best Specific Fuel Consumption (Economy) and below NOx limit.

NOTE : Each group to use separate floppy & submit with the final report. Viscosity = mm^3/s, cSt@50° Density = kg/cm^3 @ 15°C

1PS = 0.986HP = 0.736 KW & 1KW = 1.340 HP = 1.359 PS

KW per unit X SFOC (q/PS/h) X 1.359 X 7 units X 24 hours = MT/Day FO

Cons 1000 x 1000

Examples of exercises sheet for students

DECGM Course Batch No._____ Group No. _____ date _____ Name/s _____

Engine Condition	File Name	Engine Load	Engine Speed	F.Q.S	Sc Air Temp	Sc. Pr ABS	ER humidity ME Inlet	Heat release Max	Coef Kinamati Viscosity	Mechanical Efficiency
		25% to 100%	RPM	-2 to +2	°C	MPa	%	MJ	CSt@50°C	%
Example	Xyg5101	100	86	+0.0	40	0.323	89.3	0.22	500	93.6
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										

Engine Condition	P max P comp	Explosion Ratio	T max T exhst	Density	Fuel inject temp	Fuel inject volume	SFOC g/Ps/h X 1.359	Load per cylinder	Daily F.O. Consumption	Nox
	Bar	Pm/Pc	°C	Kg/cm^3 @15°C	°C	m^3/cyl/stroke	G/k W/h	Kw	Mtons/ day	Ppm/g/kW per hour
Example	14/11	1.272	1250/400	991.0	132	126.6	127.7	3688	90.9	1730
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										

LIMIT: Pmax<13.0 MPa, NOx<1680 ppm, Explosion ratio <1.35, Tmax< 1500°C, Texhaust<500°C

DECGM Course Batch No. Group No. 2 Date 17/07/2013 Name/s *PIYUSH/HARSHAL/DEVENDRA*

	Engine Condition	File Name	Engine Load	Engine Speed	F.Q.S.	Sc. Air Temp	Sc.Pr.ABS	ER humidity ME Inlet	Heat Release Max	Coef Kinematic Viscosity	Mechanical Efficiency
			25% to 100%	RPM	-2 to +2	^{0}C	MPa	%	MJ	CSt@50 °C	%
	Example	Xyg5101	100	86	+0.0	40	0.323	89.3	0.22	500	93.6
Task -1	1.	17 JUL 01	100	86	-2.0	40	0.3230	89.3	0.22	480	93.6
Task -1	2.	17 JUL 02	100	86	-1.0	40	0.3230	89.3	0.24	480	93.6
Task -1	3.	17 JUL 03	100	86	0	40	0.3230	89.3	0.22	480	93.6
	4.	17 JUL 04	100	86	+1.0	40	0.3230	89.3	0.23	480	93.6
	5.	17 JUL 05	100	86	+2.0	40	0.3230	89.3	0.22	480	93.6
Task -2	6.	17 JUL 06	100	86	-2.0	40	0.3230	89.3	0.22	380	93.6
Task -2	7.	17 JUL 07	100	86	-1.0	40	0.3230	89.3	0.23	380	93.6
Task -2	8.	17 JUL 08	100	86	0	40	0.3230	89.3	0.23	380	93.6
	9.	17 JUL 09	100	86	+1.0	40	0.3230	89.3	0.24	380	93.6
	10.	17 JUL 10	100	86	+2.0	40	0.3230	89.3	0.26	380	93.6

	Engine Condition	P max P comp	Explosion Ratio	T max T exhst	Density	Fuel Inject Temp	Fuel Inject Temp	SFOC g/Ps/h /x 1.359	Load per Cylinder	Daily F.O. Consumption	NOx
		bar	Pm/Pc	°C	Kg/m^3 @ 15°C	^{0}C	m^3/cyl/ Stroke	G/KW/h	Kw	Mtons/day	Ppm/g/kW per hour
	Example	14/11	1.272	1250/400	991.0	132	126.6	127.7	3688	90.9	1730
Task -1	1.	14.2/10.5	1.35	1350/400	991.0	136	130.0	124.4	3776	107.246	1778

2.	13.5/10.6	1.22	1200/410	991.0	136	130.0	127.5	3683	107.211	1739
3.	12.8/10.7	1.19	1250/400	991.0	136	130.0	130.5	3599	107.23	1707
4.	12.3/10.5	1.17	1200/420	991.0	136	130.0	131.3	3575	107.17	1695
5.	11.8/10.5	1.12	1250/450	991.0	136	130.0	132.6	3542	107.23	1668
6.	14.0/11.0	1.27	1300/450	980.0	130	128.4	126.4	3739	107.90	1735
7.	13.5/11.0	1.22	1300/450	980.0	130	128.4	127.0	3722	107.92	1735
8.	13.0/11.0	1.18	1300/450	980.0	130	128.4	128.2	3688	107.77	1725
9.	12.4/11.0	1.12	1250/440	980.0	130	128.4	130.2	3630	107.80	1706
10.	11.7/11.0	1.06	1200/440	980.0	130	128.4	133.9	3530	107.91	1658

Task -2

LIMITS: P max < 13.0 mpa, NOx<1680 ppm Explosion ratio<1.35, T max<1500°C, T exhaust<500°C

DECGM Course Batch No. Group No. 2 Date 17/07/2013 Name/s *PIYUSH/HARSHAL/DEVENDRA*

Engine Condition	File Name	Engine Load	Engine Speed	F.Q.S.	Sc. Air Temp	Sc.Pr.ABS	ER humidity ME Inlet	Heat Release Max	Coef Kinematic Viscosity	Mechanical Efficiency
		25% to 100%	RPM	-2 to +2	^{0}C	MPa	%	MJ	CSt@50 °C	%
Example	Xyg5101	100	86	+0.0	40	0.323	89.3	0.22	500	93.6
1.	17 JUL 11	100	86	-2.0	40	0.323	89.3	0.22	480	93.6
2.	17 JUL 12	100	86	-1.0	40	0.323	89.3	0.22	480	93.6
3.	17 JUL 13	100	86	0	40	0.323	89.3	0.21	480	93.6
4.	17 JUL 14	100	86	+1.0	40	0.323	89.3	0.21	480	93.6
5.	17 JUL 15	100	86	+2.0	40	0.323	89.3	0.21	480	93.6
6.	17 JUL 16	25	54	+1.0	32	0.138	57	0.24	480	91.05
7.	17 JUL 17	25	54	-1.0	32	0.138	57	0.24	480	91.05
8.	17 JUL 18	35	60.6	0	32	0.160	66.3	0.24	480	91.6

Task -3

Task -4

9.	17 JUL 19	35	60.6	+1.0	32	0.160	66.3	0.24	480	91.6
10.	17 JUL 20	35	60.9	-1.0	32	0.24	66.3	0.24	480	91.6

	Engine Condition	P max P comp	Explosion Ratio	T max T exhst	Density	Fuel Inject Temp	Fuel Inject Temp	SFOC g/Ps/h /x 1.359	Load per Cylinder	Daily F.O. Consumption	NOx
		bar	Pm/Pc	°C	Kg/m³ @ 15°C	^{0}C	m³/cyl/ Stroke	G/KW/h	Kw	Mtons/day	Ppm/g/kW per hour
	Example	14/11	1.272	1250/400	991.0	132	126.6	127.7	3688	90.9	1730
Task -3	1.	14/11.0	1.272	1250/460	950	136	130.1	124.4	3700	105.08	1774
	2.	13.4/11.0	1.210	1260/460	950	136	130.1	125.9	3655	105.06	1748
	3.	12.8/11.0	1.16	1240/460	950	136	130.1	127.5	3609	105.05	1738
	4.	12.2/11.0	1.10	1260/460	950	136	130.1	130.3	3533	105.10	1700
	5.	11.7/11.0	1.06	1250/480	950	136	130.1	131.6	3497	105.06	1660
Task -4	6.	6.9/5.2	1.32	1400/450	980	138	57	182.1	1008	30.84	742
	7.	7.6/5.5	1.38	1500/400	980	138	57	174.35	1053	30.84	853
	8.	7.9/5.5	1.43	1400/430	980	138	68	178.03	1368	40.91	1305
	9.	7.6/5.5	1.38	1450/480	980	138	68	178.8	1361	40.89	1297
	10.	10.7/8.5	1.25	1150/350	980	138	68	175.85	1384	40.88	1627

LIMITS: P max < 13.0 mpa, NOx<1680 ppm Explosion ratio<1.35, T max<1500°C, T exhaust<500°C

DECGM Course Batch No. Group No. 2 Date 17/07/2013 Name/s *PIYUSH/HARSHAL/DEVENDRA*

	Engine Condition	File Name	Engine Load	Engine Speed	F.Q.S.	Sc. Air Temp	Sc.Pr.ABS	ER humidity ME Inlet	Heat Release Max	Coef Kinematic Viscosity	Mechanical Efficiency
			25% to 100%	RPM	-2 to +2	^{0}C	MPa	%	MJ	CSt@50 °C	%
	Example	Xyg5101	100	86	+0.0	40	0.323	89.3	0.22	500	93.6
Task -5	1.	17 JUL 21	35	60.6	0	65	0.16	13.4	0.18	600	91.6
Task -5	2.	17 JUL 22	45	66.0	0	65	0.18	15.1	0.18	600	92.05
	3.	17 JUL 23	55	72	0	65	0.21	17.6	0.25	600	92.4
Task -6	4.	17 JUL 24	40	63.4	0	32	0.17	70.48	0.2	380	91.8
Task -6	5.	17 JUL 25	45	66.8	0	32	0.18	74.63	0.25	380	92.05
	6.	17 JUL 26	30	57.6	+1	32	0.145	60.12	0.28	380	91.4
	7.	17 JUL 27	25	54.7	+2	32	0.138	57.2	0.28	380	91.05
	8.										
	9.										
	10.										

	Engine Condition	P max P comp	Explosion Ratio	T max T exhst	Density	Fuel Inject Temp	Fuel Inject Temp	SFOC g/Ps/h /x 1.359	Load per Cylinder	Daily F.O. Consumption	NOx
		bar	Pm/Pc	°C	Kg/m^3 @ 15°C	^{0}C	m^3/cyl/ Stroke	G/KW/h	Kw	Mtons/day	Ppm/g/kW per hour
	Example	14/11	1.272	1250/400	991.0	132	126.6	127.7	3688	90.9	1730
Task -5	1.	7.9/5.5	1.4	1600/500	950	141	68	170.96	1372	39.41	680
Task -5	2.	8.4/6.0	1.4	1600/500	950	141	78	172.45	1688	48.9	1009
	3.	9.5/7.0	1.35	1450/480	950	141	87	169.8	2036	58.1	1897
Task -6	4.	8.9/6.5	1.36	1700/52	975	131	86.3	173.2	1358	46.38	1091

			0				7			
5.	7.1/5.8	1.22	1650/500	975	131	72.9	185.36	1359	35.76	1765
6.	7.7/5.5	1.4	1700/500	975	131	72.9	177.0	1402	35.74	809
7.	7.0/5.5	1.27	1500/500	975	131	66.5	182.1	1175	30.81	1191
8.										
9.										
10.										

LIMITS: P max < 13.0 mpa, NOx<1680 ppm Explosion ratio<1.35, T max<1500°C, T exhaust<500°C

Part - 2
Terms & Conditions of Tender

1. Delivery period.

(a) Within 120 days from the date of receipt of Purchase Order, the Contractor shall complete the work as specified in the tender documents and shall hand over the fully operational Diesel Engine Combustion Gas Simulator to IMU, Mumbai Port Campus as specified in the tender documents.

(b) In the event of failure to deliver the fully operational Diesel Engine Combustion Gas Simulator to IMU, Mumbai Port Campus within the stipulated period in accordance with the tender documents IMU, Mumbai Port Campus would have the right to;

Recover from successful bidder, liquidated damages, of a sum not less than 0.5% of the contract amount per week, or part of a week subject to a maximum of 5%, if the fully operational Diesel Engine Combustion Gas Simulator is not handed over to IMU, Mumbai Port Campus.

2. Eligibility criteria for the bidder.

(a) The bidder shall have an experience of installation and commissioning of Diesel Engine Combustion Gas Simulator for not less than 5 years.

(b) The bidder shall submit the name, address and telephone numbers of the Maritime Training Institutes, where they have installed and commissioned the Diesel Engine Combustion Gas Simulator. Documentary evidence such as Purchase Order from the institute, delivery challan and completion certificate or any other proof shall be submitted in the technical bid.

(c) The bidders shall submit the numbers of years of experience in shipping related business.

(d) The bidder must have an annual turnover of minimum Rs. 3,00,00,000/- (Rupees Three Crores only), during the last preceding three years annually. The details shall be furnished by the bidder in the technical bid giving the audited profit & loss account and balance sheet for last three years ending on 31.03.2017. It should be duly attested by the bidder's Chartered Accountant.

3. All payments will be paid by IMU in Indian rupees.

4. Payment Conditions:

Terms and conditions of the payment:

(a) 50% of the "Contract Price" as mentioned in Purchase Order shall be made to the Contractor by IMU, Mumbai Port Campus against the submission of Bank Guarantee, signing of the formal agreement.

(b) 40% of the "Contract Price" on completion of installation, testing, certification and commissioning and on-site training and handing over of the fully operational Diesel Engine Combustion Gas Simulator to IMU, Mumbai Port Campus duly approved by D.G. Shipping and other bodies wherever required.

It is further added that during the time of Directorate General of Shipping (DGS)/other bodies inspection, the representative from the contractor should be physically present to clarify any doubt/ quarries with respect to operation of Diesel Engine Combustion Gas Simulator.

(c) 10% will be paid after the completion of the warranty period.

5. Annual Maintenance Contract (AMC):

(a) The comprehensive Maintenance for next 5 years shall be provided after the successful commissioning and handing over the fully operational simulator to IMU. During the warranty period of first two years, the comprehensive maintenance of the simulator shall be free of cost. This includes replacement / repair of parts. And for next three years the comprehensive annual maintenance contract shall be also quoted at the time of bidding.

(b) All maintenance issues shall be attended immediately to have zero down time during working hours. Working hours will be 0800 hrs to 2000 hrs IST. However, a maximum of down time of 5 days in 365 days will be accepted under extreme conditions. This excludes non-working days i.e. Sunday & public holidays. Non-working of simulators for more than four hours during the time mentioned herein will be counted as loss of day. This includes online and in person maintenance.

6. Upgradation of software;

Simulator should be upgraded every two years incorporating changes. It should include changes in any engine room technology. Changes in hardware as well as software during the two years. Wherever possible, the hardware and other items required for such simulator should be procured from India itself.

7. Simulator should be latest as per their versions on the day of the delivery.

The Bidder shall ensure that simulator should conform to the requirements of STCW & its 2010 amendments and subsequent amendment, if any, catering to the latest technology on the day of delivery.

8. IMU, Mumbai Port Campus at its sole discretion reserves the right to extend the last date of submission of tender and the same shall be intimated to those bidders, who have purchased the tender document.

9. The members nominated by the IMU may visit the Maritime Training Institutes if required, where they have installed fully operational Diesel Engine Combustion Gas Simulator to evaluate the performance of the simulator and also the quality of the equipment supplied, before opening of the financial bid. The committee, based upon their observations/evaluations, shall make their recommendation to the Director, IMU, Mumbai Port Campus, to either reject or accept any or all of the technical bids submitted by the bidders.

10. IMU, Mumbai Port Campus reserves the right to reject any tender including the lowest, cancel the tender process & reject all. IMU, Mumbai Port Campus shall be under no obligation to inform the bidders for the reasons of such action.

11. IMU, Mumbai Port Campus, in exceptional circumstances and at its discretion, may extend the tender due date by issuing a corrigendum.

12. IMU, Mumbai Port Campus reserves the right to annul the bidding process at any time without any liability for such annulment, without assigning any reason thereto.

13. IMU, Mumbai Port Campus reserves the right to invite revised tenders with or without amendment at any stage without any liability for such invitation and without assigning any reason thereof.

14. Upon receipt of the PO by the Contractor, contractor shall prepare two sets of the **Agreement** at the earliest and complete all the formalities and submit the same to IMU, Mumbai Port Campus duly executed on stamp paper for a value of Rs.200/ (Rupees Two Hundred only) within 15 days from the date of receipt of Purchase Order. The agreement shall be submitted by the Contractor along with security deposit one set of the agreement will be returned to the Contractor after the signature of IMU, Mumbai Port Campus authorized signatory.

15. All costs, charges and expenses, if any, in connection with the **Contract** as well as preparations and completions of **Agreement** formalities shall be borne and payable by the Contractor only.

16. The Contractor shall pay all taxes which he may be liable to pay to the State or Central Government or any other statutory authority under the law for the time being in force in respect of or in accordance with the execution of the contract.

17. Settlement of Disputes: The Bidder shall make request in writing to the IMU for settlement of any dispute within 30 (thirty) days of arising of the cause of dispute, failing which no disputes/claims shall be entertained by the IMU, Mumbai Port Campus. The decision of the IMU, Mumbai Port Campus will be final and binding on the parties.

18. Cancellation of order/ forfeiture of Security Deposit, Risk purchase clause: In the event of failure to deliver the fully operational Diesel Engine Combustion Gas Simulator to IMU, Mumbai Port Campus within the stipulated period as per the tender document, IMU, Mumbai Port Campus reserves the right: -

(i) To cancel the order
(ii) To forfeit the security deposit

19. The Contractor shall be fully responsible for all damages caused to the property of IMU, Mumbai Port Campus and the same shall be recovered at actual from the running bills of the Contractor/ Performance Bank Guarantee.

20. The bidder should submit the Income Tax return for last three previous years ending 31stMarch 2017 in the Technical bid of Tender documents.

21. The bidder shall submit the following documents: -

(a) Proof of Registration of the bidder under relevant law such as companies Act, and /or Shop & establishment Act etc.
(b) For partnerships firms, full name and address of each partner along with the certified copy of the registered partnership deed, copy of Trade License.
(c) For proprietorship firms, full name and address of proprietor along with the copy of trade license.

22. Bidder shall submit (where applicable) copy of the following in the technical bid of the tender documents: -

(i) Registration with GST Department.
(ii) Registration with Provident Fund (PF)
(iii) Registration with E.S.I.C.
(iv) PAN Card of the company.

23. Earnest Money Deposit of Rs. 32500/- (Rupees Thirty-two thousand five hundred only) should be drawn in the form of Demand Draft/Pay Order in the name of "Indian Maritime University, "Mumbai Port Campus" from any Nationalized bank/Scheduled banks payable at Mumbai and to be submitted to The Deputy Registrar (Admin.), IMU, Mumbai Port Campus.

24. The Technical Bid should not contain the Price Bid. Disclosure/indication of Price in the Technical Bid shall render the bidder disqualified and their bids shall stand rejected.

25. All the documents mentioned above should be submitted in the technical bid, failing which the tender shall be rejected.

26. Security deposit: The successful bidder shall, within 15 days from the date of receipt of Purchase Order, deposit with IMU, Mumbai Port Campus a sum equal to 10% of the value of accepted tender, in the form of Demand Draft/ Bank Guarantee from any Nationalized bank /scheduled bank of India, failing which IMU, Mumbai Port Campus may at its discretion cancel the Purchase Order and forfeit the earnest money deposit furnished along with the tender.

The security deposit amount of 10% of the contract value so deposited, will be refunded after handing over the fully operational Diesel Engine Combustion Gas Simulator to IMU, Mumbai Port Campus. In case security deposit amount fall short on subsequent order, the bidder must deposit the differential amount of Security deposit within 10 days of subsequent order. **Security Money will not carry any interest.**

PART 3

PRICE BID

(To be printed on letter head along with seal and signature of the competent authority)

SUPPLY, INSTALATION & TESTINGDIESEL ENGINE COMBUSTION GAS SIMULATOR - COMBUSTION SIMULATOR (1+6 Configuration)

Sl. No.	Description – Desktop Based Combustion Simulator	Cost (In Rs.)
	Scope	
1.	Combustion Simulator Server License	
2.	Six Trainee Stations and One Instructor Station Combustion Simulator Software licenses	
3.	Installation, Training and Handover	
4.	COST Items Computers, Monitors & Peripherals	
Total		
Tax (as applicable, separate line item for each tax)		
Amount (Inclusive of taxes)		

Net Amount in words (inclusive of taxes) _____only)

Signature with official seal

Name:

Date : Place: