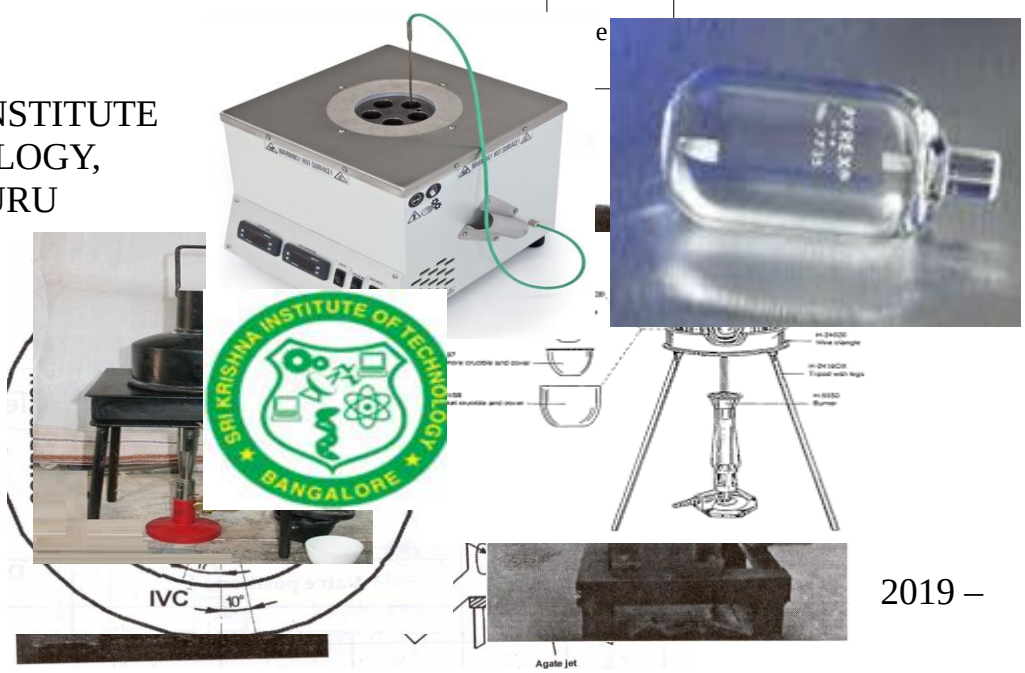


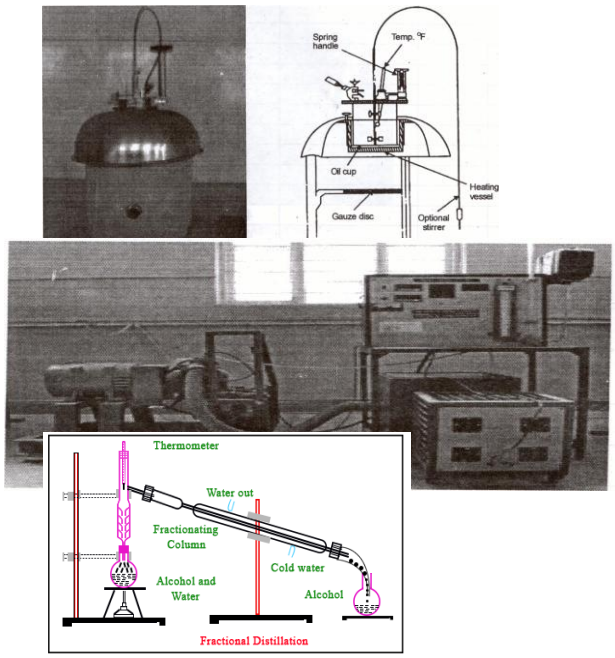
SRI KRISHNA INSTITUTE OF TECHNOLOGY, BENGALURU



COURSE PLAN

Academic Year 2019 – 20

Program:	B E
Semester :	5/A1
Course Code:	17MEL58



Course Title:	Energy Lab
Credit / L-T-P:	2/ 1-0-2
Total Contact Hours:	30
Course Plan Author:	APPESE S D

#29, Hesaraghatta Main road, Chimney Hills, Chikkabanavara P.O.,
Bengaluru – 560090, Karnataka, INDIA
Phone / Fax :+91 80 23721477 -STD- 080-23721477
Web: http://www.skit.org.in/ ,
e-mail: skit1princi@gmail.com / principal@skit.org.in

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Table of Contents

Note : Remove "Table of Content" before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

15MEL58: Energy Lab

A. LABORATORY INFORMATION

1. Lab Overview

Degree:	B.E	*Program:*	ME
Year / Semester :	3/V	*Academic Year:*	2019-20
Course Title:	Energy Lab	*Course Code:*	17MEL58
Credit / L-T-P:	2/ 1-0-2	*SEE Duration:*	180 Minutes
Total Contact Hours:	30	*SEE Marks:*	60 Marks
CIA Marks:	40	*Assignment*	1 / Module
Course Plan Author:	Mr. Appese S D	*Sign*	Dt:
Checked By:	Mr. Naveen Kumar P	*Sign*	Dt :

2. Lab Content

Unit	Title of the Experiments	Lab Hours	Concept	Blooms Level
	PART – A			
1	Lab layout, calibration of instruments and standards to be discussed	3	Standards	L3
2	Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleveland's (Open Cup) Apparatus.	3	Flash and fire point	L3
3	Determination of Calorific value of solid, liquid and gaseous fuels.	3	Energy conversion concept	L3
4	Determination of Viscosity of a lubricating oil using Redwoods, Say bolt and Torsion Viscometers.	3	Fluid property	L3
5	Analysis of moisture, volatile matter, ash content and fixed carbon of solid and liquid fuel samples	3	Proximity and ultimate	L4

			analysis	
6	Valve Timing/port opening diagram of an I.C. Engine.	3	Thermodynamics cycle	L4
	PART – B			
7	Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiency, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio, heat balance sheet for; a. Four stroke Diesel Engine b. Four stroke Petrol Engine, Multi Cylinder Diesel/Petrol Engine, (Morse test) d. Two stroke Petrol Engine e. Variable Compression Ratio I.C. Engine.	3 3 3 3	Performance characteristics of I.c engines	L4
8	Measurements of Exhaust Emissions of Petrol engine.	3	chemical composition	L4
9	Measurements of Exhaust Emissions of Diesel engine.	3	chemical composition	L4
10	Measurement of pθ, pV plots using Computerized IC engine test rig	3	Pressure crank angle and pressure volume variation	L4
	PART – C (Optional)			L4
11	Visit to Automobile Industry/service stations.	3	Practical knowledge	
12	CFD Analysis of design, development, performance evaluation and process optimization in I C Engines.	3		L4

3. Lab Material

Unit	Details	Available
1	Text books	
	M. L. Mathur And R.P. Sharma A course in internal combustion engines, Dhanpat Rai& sons- India.	In Lib
2	Reference books	
	Ganesan, V., Fundamentals of IC Engines, Tata McGraw Hill, 2003	In dept
3	Others (Web, Video, Simulation, Notes etc.)	
	Lab Manual	Available

4. Lab Prerequisites:

-	-	Base Course:		-	-
SNo	Course Code	Course Name	Topic / Description	Sem	Remarks
1	17ME33	Basic and Applied	Explanation of working principle of	3rd	

		Thermodynamics	thermodynamic cycles.	and 4th	
				-	Plan Gap Course

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

5. General Instructions

SNo	Instructions	Remarks
1	Observation book and Lab record are compulsory.	
2	Students should report to the concerned lab as per the time table.	
3	After completion of the experiments, certification of the concerned staff in-charge in the observation book is necessary.	
4	Student should bring a notebook of 100 pages and should enter the readings /observations into the notebook while performing the experiment.	
5	The record of observations along with the detailed experimental procedure of the experiment in the Immediate last session should be submitted and certified staff member in-charge.	
6	Should attempt all problems / assignments given in the list session wise.	
7	It is responsibility to create a separate directory to store all the programs, so that nobody else can read or copy.	
8	When the experiment is completed, should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.	
9	Any damage of the equipment or burn-out components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year	
10	Completed lab assignments should be submitted in the form of a Lab Record in which you have to write the algorithm, program code along with comments and output for various inputs given	

6. Lab Specific Instructions

S. No	Specific Instructions	Remarks
1	Students should come with thorough preparation for the experiment to be conducted.	
2	Students will not be permitted to attend the laboratory unless they bring the practical record fully completed in all respects pertaining to the experiment conducted in the previous class.	
3	Experiment should be started only after the staff-in-charge has checked the experimental setup.	
4	All the calculations should be made in the observation book. Specimen calculations for one set of readings have to be shown in the practical record.	
5	Wherever graphs are to be drawn, A-4 size graphs only should be used and the same should be firmly attached to the practical record.	

6	Practical record should be neatly maintained.	
7	They should obtain the signature of the staff-in-charge in the observation book after completing each experiment.	
8	Theory regarding each experiment should be written in the practical record before procedure in your own words.	

B. OBE PARAMETERS

1. Lab / Course Outcomes

#	COs	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms ' Level
1	To determine the flash and fire point of a given fuel	10	Flash and fire point	Demonstrate	Slip Test	L3
2	Determination of Energy release per definite amount of fuel burn	06	Energy conversion concept	Demonstrate	Assignment	L3
3	Determination of Viscosity of a lubricating oil using Redwoods, Say bolt and Torsion Viscometers.	07	Fluid property	Demonstrate	Assignment and Slip Test	L3
4	Analysis of moisture, volatile matter, ash content and fixed carbon of solid and liquid fuel samples	03	combustion characteristics	Simulation	Assignment	L3
5	Draw the actual Valve Timing diagram of an I.C. Engine.	03	Thermodynamics cycle	Tutorial	Slip test	L3
6	Draw the performance characteristics of 1) Four stroke Diesel Engine 2) Four stroke petrol Engine	03	Performance characteristics of I.c engines	Tutorial	Assignment	L3
7	Determination of compositions of burnt and unburnt in exhaust gases in petrol engine	03	chemical composition	Demonstrate	Assignment and Slip Test	L3
8	Determination of compositions of burnt and unburnt in exhaust gases in diesel engine	03	chemical composition	Demonstrate	Assignment	L3
9	Measurement of Pressure vs crank angle variation and pressure volume diagram using Computerized IC engine test rig	03	Pressure crank angle and pressure volume variation	Demonstrate	Assignment	L3
10	Understanding about all automobile parts and their service by Visiting Automobile Industry/service stations.	03	Analysis of engine	Demonstrate		L3
11	CFD Analysis of design, development, performance evaluation and process optimization in I C Engines.	03	CFD analysis of an IC engine	Demonstrate		L3
-	**Total**	**60**	-	-	-	-

Note: Identify a max of 2 Concepts per unit. Write 1 CO per concept.

2. Lab Applications

SNo	Application Area	CO	Level
1	Fuel preparation	CO1	L3
2	Application of IC engines	CO2	L3
3	the viscosity of paints, varnishes, and similar household products	CO3	L3
4	Application of IC engines	CO4	L3
5	Air craft engines	CO5	L3
6	Automobile industry	CO6	L3
7	Electric power stations industrial and domestic fuel consumers	CO7	L3
8	Electric power stations industrial and domestic fuel consumers	CO8	L3
9	Application of IC engines	CO9	L3

Note: Write 1 or 2 applications per CO.

3. Articulation Matrix
(CO – PO MAPPING)

-	Course Outcomes	Program Outcomes												
#	COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	Level
15MEL58.1	To determine the flash and fire point of a given fuel	√	√	-	-	-	-	-	-	√	-	-	-	L3
15MEL58.2	Determination of Energy release per definite amount of fuel burn	√	√	-	-	-	-	-	-	√	-	-	-	L3
15MEL58.3	Determination of Viscosity of a lubricating oil using Redwoods, Say bolt and Torsion Viscometers.	√	√	-	-	-	-	-	-	√	-	-	-	L3
15MEL58.4	Analysis of moisture, volatile matter, ash content and fixed carbon of solid and liquid fuel samples	√	√	-	-	-	-	-	-	√	-	-	-	L3
15MEL58.5	Draw the actual Valve Timing diagram of an I.C. Engine.	√	-	-	-	-	-	-	-		-	-	-	L2
15MEL58.6	Draw the performance characteristics of 1) Four stroke Diesel Engine 2) Four stroke petrol Engine	√	√	-	-	-	-	-	-	√	-	-	-	L3
15MEL58.7	Determination of compositions of burnt and unburnt in exhaust	√	√	-	-	-	-	-	-	√	-	-	-	L3

	gases in petrol engine													
15MEL58.8	Determination of compositions of burnt and unburnt in exhaust gases in diesel engine	√	√	-	-	-	-	-	-	√	-	-	-	L3
15MEL58.9	Measurement of Pressure vs crank angle variation and pressure volume diagram using Computerized IC engine test rig	√	√	-	-	-	-	-	-	√	-	-	-	L3
15MEL58.10	Understanding about all automobile parts and their service by Visiting Automobile Industry/service stations.	√	√	-	-	-	-	-	-	√	-	-	-	L3
15MEL58.11	CFD Analysis of design, development, performance evaluation and process optimization in I C Engines.	√	√	-	-	-	-	-	-	√	-	-	-	L3

Note: Mention the mapping strength as 1, 2, or 3

4. Mapping Justification

Mapping		Mapping Level	Justification
CO	**PO**	-	-
CO1	PO1	L3	Knowledge of different fuels is required
CO1	PO2	L3	Analyzing different fuels flash and fire points
CO1	PO9	L3	Individual work, mapping
CO2	PO1	L3	Knowledge of different fuel energy content is required to understand the different calorific value of fuels.
CO2	PO2	L3	Analyzing different fuel energy content.
CO2	PO9	L3	Individual work, mapping
CO3	PO1	L3	Knowledge of different fuel properties is required.
CO3	PO2	L3	Analyzing different fuel properties
CO3	PO9	L3	Individual work, mapping
CO4	PO1	L3	Knowledge of different fuels and fuel properties is required.
CO4	PO2	L3	Analyzing different fuel properties
CO4	PO9	L3	Individual work, mapping
CO5	PO1	L3	Knowledge of engine components is required to understand the valve time diagram
CO5	PO9	L3	Individual work, mapping
CO6	PO1	L3	Knowledge of engineering fundamentals required to understand the performance characteristics
CO6	PO2	L3	Analysis of different engine parameters.
CO6	PO9	L3	Team work is require to conduct experiment
CO7	PO1	L3	Knowledge of engineering fundamentals required to understand the performance

			characteristics
CO7	PO2	L3	Analysis of different engine parameters.
CO7	PO9	L3	Team work is require to conduct experiment
CO8	PO1	L3	Knowledge of engineering fundamentals required to understand the performance characteristics
CO8	PO2	L3	Analysis of different engine parameters.
CO8	PO9	L3	Team work is require to conduct experiment
CO9	PO1	L3	Knowledge of engineering fundamentals required to understand the performance characteristics
CO9	PO2	L3	Analysis of different engine parameters.
CO9	PO9	L3	Team work is require to conduct experiment
CO10	PO2	L3	Analysis of different engine parameters.
CO10	PO9	L3	Team work is require to conduct experiment
CO11	PO1	L3	Knowledge of engineering fundamentals required to understand the performance characteristics
CO11	PO2	L3	Analysis of different engine parameters.
CO11	PO9	L3	Team work is require to conduct experiment

Note: Write justification for each CO-PO mapping.

5. Curricular Gap and Content

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Advanced IC engine	Seminar /workshop	IC Engine workshops		

Note: Write Gap topics from A.4 and add others also.

6. Content Beyond Syllabus

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping

Note: Anything not covered above is included here.

C. COURSE ASSESSMENT

1. Course Coverage

Unit	Title	Teaching Hours	No. of question in Exam							CO	Levels
			CIA-1	CIA-2	CIA-3	Asg-1	Asg-2	Asg-3	SEE		
1	Lab layout, calibration of instruments and standards to be discussed	03	1	-	-	-	-	-	1	CO1	L2
2	Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleveland's (Open Cup) Apparatus.	03	1	-	-	-	-	-	1	CO2	L3

3	Determination of Calorific value of solid, liquid and gaseous fuels.	03	1	-	-	-	-	-	1	CO3	L3
4	Determination of Viscosity of a lubricating oil using Redwoods, Say bolt and Torsion Viscometers.	03	1	-	-	-	-	-	1	CO4	L3
5	Analysis of moisture, volatile matter, ash content and fixed carbon of solid and liquid fuel samples	03	1	-	-	-	-	-	1	CO5	L4
6	Valve Timing/port opening diagram of an I.C. Engine.	03	1	-	-	-	-	-	1	CO6	L4
	PART – B	03	1	-	-	-	-	-	1	CO7	L4
7	Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiency, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio, heat balance sheet for; a. Four stroke Diesel Engine b. Four stroke Petrol Engine c. Multi Cylinder Diesel/Petrol Engine, (Morse test) d. Two stroke Petrol Engine e. Variable Compression Ratio I.C. Engine.	03	-	1	-	-	-	-	1	CO8	
8	Measurements of Exhaust Emissions of Petrol engine.	03	-	1	-	-	-	-	1	CO9	
9	Measurements of Exhaust Emissions of Diesel engine.	03	-	1	-	-	-	-	1	CO10	
10	Measurement of pθ, pV plots using Computerized IC engine test rig	03	-	1	-	-	-	-	1	CO11	
	PART – C (Optional)	03	-	1	-	-	-	-	1	CO12	
11	Visit to Automobile Industry/service stations.	03	-	1	-	-	-	-	1	CO13	
12	CFD Analysis of design, development, performance evaluation and process optimization in I C Engines.	03	-	1	-	-	-	-	1	CO14	
-	**Total**	**30**								-	-

Note: Write CO based on the theory course.

2. Continuous Internal Assessment (CIA)

Evaluation	Weight-age in Marks	CO	Levels
CIA Exam – 1	30	CO1, CO2, CO3, CO4	L23, L3
CIA Exam – 2	30	CO5, CO6, CO7,	L1, L2, L3
CIA Exam – 3	30	CO8, CO9	L1, L2, L3

Assignment – 1	05	CO1, CO2, CO3, CO4	L2, L3, L4
Assignment – 2	05	CO5, CO6, CO7, CO8, CO9	L1, L2, L3
Assignment – 3	05	CO8, CO9	L1, L2, L3
Seminar – 1	05	CO1, CO2, CO3, CO4	L2, L3, L4
Seminar – 2	05	CO5, CO6,CO7,CO8, CO9	L2, L3, L4
Seminar – 3	05	CO8, CO9	L2, L3, L4
Other Activities – define – Slip test		CO1 to Co9	L2, L3, L4
Final CIA Marks	**40**	-	-

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SNo	Description	Marks
1	Observation and Weekly Laboratory Activities	05 Marks
2	Record Writing	15 Marks for each Expt
3	Internal Exam Assessment	20 Marks
4	Internal Assessment	40 Marks
5	SEE	60 Marks
-	**Total**	**100 Marks**

D. EXPERIMENTS

Experiment 01: Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed)

-	**Experiment No.:**	1	**Marks**	30	**Date Planned**	22/8/2019	**Date Conducted**	22/8/2019
1	Title	Flash and fire point						
2	Course Outcomes	To determine the flash and fire point of a given fuel						
3	Aim	To determine the flash and fire point of a given test oil.						
4	Material/ Equipment Required	Pensky Martin apparatus, Thermometer, Stop watch						
5	Theory, Formula, Principle, Concept	**Flash point:** It is the **minimum** temperature at which the oil vapors give out a flash (spark) when a flame is brought near it. **Fire point:** It is the **minimum** temperature at which the oil vapors give out a continuous flame (fire) when a flame is brought near it.						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	➓ The given oil is filled up to the mark in the oil cup and is placed in hemispherical dome of the apparatus. ➓ A thermometer is immersed into the oil.						

<table>
<tr><td></td><td></td><td>➓ The oil cup is heated with the lid closed and is stirred continuously.
➓ The rate of heating is carried out at an increase in temperature of about 5-6^{0}C per minute.
➓ The test flame is brought near the slit and tested for every 2° C rise in temp.
➓ The flash point is obtained and further heating is done at same rate till fire point is noticed.</td></tr>
<tr><td>7</td><td>Block, Circuit, Model Diagram, Reaction Equation, Expected Graph</td><td></td></tr>
<tr><td>8</td><td>Observation Table, Look-up Table, Output</td><td><table><tr><th>SI. No.</th><th>TEMP</th><th>OBSERVATION</th></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>9</td><td>Sample Calculations</td><td>NA</td></tr>
<tr><td>10</td><td>Graphs, Outputs</td><td>NA</td></tr>
<tr><td>11</td><td>Results & Analysis</td><td>1] Flash point of the given oil is:-----^{0}C
2] Fire point of the given oil is:-------^{0}C</td></tr>
<tr><td>12</td><td>Application Areas</td><td>Fuel preparation, lubricating oil, used in AUTOMOBILES.</td></tr>
<tr><td>13</td><td>Remarks</td><td>NA</td></tr>
<tr><td>14</td><td>Faculty Signature with Date</td><td></td></tr>
</table>

Experiment 02: SAY BOLT VISCOMETER

-	**Experiment No.:**	2	**Marks**	30	**Date Planned**	29/8/2019	**Date Conducted**	29/8/2019
1	Title	**SAY-BOLT VISCOMETER**						
2	Course Outcomes	Determination of Viscosity of a lubricating oil using Say bolt **viscometer.**						
3	Aim	To determine viscosity of a given test oil using Say Bolt viscometer.						
4	Material/ Equipment Required	Say Bolt viscometer, Measuring jar, Thermometer, Stop watch and weighing machine.						
5	Theory, Formula, Principle, Concept	Viscosity id defined as the property of a fluid which offers resistance to the movement of one layer of fluid over another adjacent layer of the fluid. Temperature affects the viscosity. The viscosity of liquids decreases with the increase of temperature. This is due to the reason that in liquids the cohesive forces predominates the molecular momentum transfer, due to closely packed molecules and with the increase in temperature, the cohesive forces deceases with the result in decreasing viscosity. With the increase in temperature, molecular						

momentum transfer increases and hence viscosity increases.

6 Procedure, Program, Activity, Algorithm, Pseudo Code.

1) To start with, the oil cup is cleaned so that no dust particles are be present in orifice.
2) The orifice is closed by means of a cork and oil is filled up to the mark.
3) A thermometer is introduced into the oil and is heated.
4) A measuring jar is placed below the orifice of the viscometer.
5) The oil is allowed to flow into the collecting jar by opening the cork.
6) The time taken for collecting 60 cc of oil is recorded in seconds using a stop watch.
7) The cork is closed, and then the weight of 60cc is measured using a weighing balance. Same procedure is repeated for different temperatures.

7 Block, Circuit, Model Diagram, Reaction Equation, Expected Graph

OBSERVATION: Given test oil is
Weight of empty jar (Vi) EQUATIONS:
1. Density (p) in Kg/m^3 = $\frac{\text{Mass of oil in gms}}{\text{Volume of oil in cm3}}$ = X 103 =
2.Kinematic viscosity (v) in stokes= 0.0022s - 1.8/s

Where s = say bolt universal second.
Absolute viscosity (j1) in poise = Kinematic viscosity (v) X density (p) X

8 Observation Table, Look-up Table, Output

Si no	Temperature	Time (t) for collecting 60cc of oil in Sec.	Say bolt universal Seconds = t X 1.005*	Wt. of 60 cc oil +jar (W2) in gms	Weight of oil x W= (W2-Wii in gms	Density Kgim,	Kinematic viscosity Viscosity In stoke	Absolute . Viscosity poise
1								
2								
3								

9 Sample Calculations

10 Graphs, Outputs

GRAPH:1. Temp. V/s Kinematic viscosity NATURE OF GRAPH:

11 Results & Analysis

1] Given test oil is----------
2] Viscosity of the given oil is :-------

12 Application Areas The viscosity of paints, varnishes, and similar household products

13 Remarks

14 Faculty Signature with Date

Experiment 03: Red Wood viscometer

-	**Experiment No.:**	3	**Marks**	30	**Date Planned**	05/9/2019	**Date Conducted**	05/9/2019
1	Title	Red Wood viscometer						
2	Course Outcomes	Determination of Viscosity of a lubricating oil using Redwoods, Say bolt and Torsion Viscometers.						
3	Aim	To determine viscosity of a given test oil using Red Wood viscometer.						
4	Material/ Equipment Required	Red Wood viscometer, Measuring jar, Thermometer, Stop watch and weighing machine.						
5	Theory, Formula, Principle, Concept	1. Density (p) in Kg/m^3 = Mass of oil in gm/ Volume of oil in cm^3 =----------$X10^3$ = 2. Kinematic viscosity (v) in stokes =0.0022t – 1.8/t 3. Absolute viscosity (ii) in poise = Kinematic viscosity (v) X density (p) X 10^{-3} 3. Red wood number (RWN)= 100 X (Time for collecting 50 cc of oil) X (Density) 5 535X0.915X1000						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	1.To start with, the oil cup is cleaned so that no dust particles are be present in orifice. 2.The orifice is closed by means of a cork and oil is filled up to the mark. 3.A thermometer is introduced into the oil and is heated. 4.A measuring jar is placed below the orifice of the viscometer. 5.The oil is allowed to flow into the collecting jar by opening the cork. 5.The time taken for collecting **50 cc** of oil is recorded in seconds using a stop watch 6.The cork is closed, and then the weight of **50cc** is measured using a weighing balance. 7.Same procedure is repeated for different temperatures.						
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph							
8	Observation							

	Table, Look-up Table, Output	Temp ^{0} C	Time (t) for collecting 50cc of oil in Sec.	Wt. of 60 cc $_{oil}$ + j_{ar} $(W2)_i$ n gm	Weight of oil (W2 – W1) in gm	Density Kg/m3	Kinematic Viscosity in stoke	Absolute Viscosity in poise	R W N
9	Sample Calculations								
10	Graphs, Outputs	1.RWN v/s Kinematic viscosity. 2.Temperature v/s Kinematic viscosity							
11	Results & Analysis	1] Given test oil is---------- 2] Redwood Viscosity of the given oil is :------- 3}] Redwoods Number is :-------							
12	Application Areas	the viscosity of paints, varnishes, and similar household products							
13	Remarks								
14	Faculty Signature with Date								

Experiment 04: Analysis of moisture, volatile matter by using distillation apparatus.

-	**Experiment No.:**	4	**Marks**	30	**Date Planned**	26/9/2019	**Date Conducted**	26/9/2019
1	Title	Analysis of moisture, volatile matter by using distillation apparatus						
2	Course Outcomes	Analyze the moisture, volatile matter by using distillation apparatus Analysis of moisture, volatile matter by using distillation apparatus						
3	Aim	To determine the distillation characteristics of petroleum products.						
4	Material/ Equipment Required	Heater unit with temperature regulator, S.S condenser bath with cover, Thermometer, Stop watch, Condensing tank, Heater &Flask.						
5	Theory, Formula, Principle, Concept	Impure liquid is purified by the process of distillation the process in which evaporation & condensation are going on side by side is called distillation.						
6	Procedure, Program, Activity,	Keep SS condenser bath on stand & fill up distilled water up to top and cover It						

	Algorithm, Pseudo Code	properly. Place the graduated measuring cylinder near the outer neck of condenser tube. Fill up to 50ml of sample oil is distillation flask keep flask inside heater unit on asbestos board. Heat the sample oil and inspect when first drop of oil falls from the condenser. Record the initial boiling temperature. Continue to heat the sample oil & record the maximum temperature observed on indicator. It is boiling point. When last drop of sample oil leaves the flask the dry point of sample is noted. Record the total volume of distillation collected in receiver it is known as total recovery of sample oil.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	
9	Sample Calculations	
10	Graphs, Outputs	
11	Results & Analysis	The percentage of purified given sample is --------
12	Application Areas	Fuel preparation
13	Remarks	
14	Faculty Signature with Date	

Experiment 05: Ash content & fixed carbon of solid & liquid fuel samples by Canrodson Carbon residue test.

-	**Experiment No.:**	5	**Marks**	30	**Date Planned**	12/9/2019	**Date Conducted**	12/9/2019
1	Title	Ash content & fixed carbon of solid & liquid fuel samples by Canrodson Carbon residue test						
2	Course Outcomes	Percentage of carbon residue present in given test sample.						
3	Aim	To determine the percentage of carbon residue of the given oil using						

		carbon residue test apparatus.
4	Material/ Equipment Required	Samples, Thermometer, porcelain crucible, iron crucible and skid mose crucible, wire support, hood & burner.
5	Theory, Formula, Principle, Concept	Oil contain mainly chemical compounds of carbon & hydrogen. If heated in a closed vessel in absence of sufficient air, the oil will vaporizer & thin deposit of carbon residue will be left thus test serves as index & gives result some relative measure of amount of residue to be formed by lubricating oils, specially IC Engine.
6	Procedure, Program, Activity, Algorithm, Pseudo Code	The crucible is weighed accurately. About 10 gms of oil is to be tested for carbon residue is taken in the crucible & weighed. This crucible is placed in the center of the iron crucible. Now sand is taken in the spun sheet iron crucible& oil sample crucible is placed. The hood is placed on the block & heat is applied with the burner at the bottom of the spun iron crucible. After about 20 to 25 min of heating the cover is slightly displaced to make the vapour escape. The hood is removed first then the cover is lifted the crucible is taken out & placed in a designation for getting cooled & take weight. The difference between the initial & finial weight of the crucible give the amount of carbon residue and is exposed as a percentage of carbon residue as shown in the calculation.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	
9	Sample	

	Calculations	
10	Graphs, Outputs	
11	Results & Analysis	Percentage of carbon residue is ---------%
12	Application Areas	Fuel preparation
13	Remarks	
14	Faculty Signature with Date	

Experiment 06: Ash content & fixed carbon of solid & liquid fuel samples by Rams bottom carbon residue test.

-	**Experiment No.:**	6	**Marks**	30	**Date Planned**	03/10/2019	**Date Conducted**	03/10/2019
1	Title	Ash content & fixed carbon of solid & liquid fuel samples by Rams bottom Carbon residue test						
2	Course Outcomes	Percentage of carbon residue present in given test sample.						
3	Aim	Ash content & fixed carbon of solid & liquid fuel samples by Rams bottom Carbon residue test						
4	Material/ Equipment Required	Samples, Thermometer, porcelain crucible, iron crucible and skid mose crucible, wire support, hood & burner.						
5	Theory, Formula, Principle, Concept							
6	Procedure, Program, Activity, Algorithm, Pseudo Code							
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph							
8	Observation Table, Look-up Table, Output							
9	Sample Calculations							
10	Graphs, Outputs							
11	Results & Analysis							
12	Application Areas	Fuel preparation						
13	Remarks							

14	Faculty Signature with Date	

Experiment 07: VALVE TIME DIAGRAM

-	**Experiment No.:**	7	**Marks**	30	**Date Planned**	10/10/2019	**Date Conducted**	10/10/2019
1	Title	**VALVE TIME DIAGRAM**						
2	Course Outcomes	Draw the actual Valve Timing diagram of an I.C. Engine.						
3	Aim	To draw a valve time diagram for a given engine.						
4	Material/ Equipment Required	Four Stroke single cylinder engine, scale, thread, chalk and protractor.						
5	Theory, Formula, Principle, Concept							
6	Procedure, Program, Activity, Algorithm, Pseudo Code	**1.** Rotate flywheel freely by hand. 2. Now while rotating observe and identify the suction stroke 3. When the piston is at TDC (Top dead centre) mark the position with a chalk on flywheel and rotate the flywheel in anticlockwise (-ve)direction so that the inlet valve just begins to open (IVO), mark this position and measure the arc length between the two marked positions (distance along the circumference of the flywheel). 4. Now rotate the flywheel in clockwise (+ ve) direction until the inlet valve fully closes (IVC), mark this point and measure the arc length from the previously marked TDC position on the flywheel. 5.Continue rotating the flywheel in **clockwise** (+ ve) direction until the exhaust valve **just opens (EVO),** mark this position and measure the arc length from the TDC position on the flywheel. 6.Further rotate the flywheel in **clockwise** (+ ye) direction until the exhaust valve **fully closes (EVC),** mark this position and measure the arc length from the TDC position on the flywheel.							
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph							

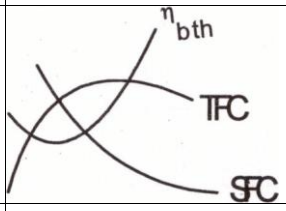
8	Observation Table, Look-up Table, Output	**Valve position** / **Distance (x) from TDC in cm** / **Angle from TDC in degrees = (x) X (f)** Inlet valve open (IVO) / (-ve) / Inlet valve close (IVC) / (+ve) / Exhaust valve open **(EVO)** / **(+ve)** / Exhaust valve close **(EVC)** / **(+ve)** /
9	Sample Calculations	Diameter of the flywheel (d) ---------- cm Circumference of flywheel (td) ---------- cm Multiplication factor (f) = 360^0 / (td) = (To convert circumference (in cm) to angle (in degrees))
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	Application of IC engines
13	Remarks	
14	Faculty Signature with Date	

Experiment 08: SINGLE CYLINDER TWO STROKE PETROL ENGINE

-	**Experiment No.:**	8	**Marks**	50	**Date Planned**	17/10/2019	**Date Conducted**	17/10/2019
1	Title	**SINGLE CYLINDER TWO STROKE PETROL ENGINE**						
2	Course Outcomes	To Draw the performance characteristics						
3	Aim	To determine the performance characteristics of a two stroke single cylinder petrol engine.						

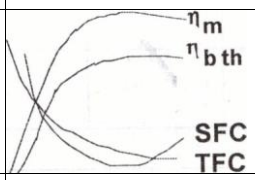
4	Material/ Equipment Required	A two stroke engine coupled to electrical dynamometer, Measurement control panel and Electrical Loading.
5	Theory, Formula, Principle, Concept	
6	Procedure, Program, Activity, Algorithm, Pseudo Code	1.Check all electrical connections; ensure fuel level in the fuel tank. 2.Tighten all fuel lines and open 3 -way cock, make fuel to flow into the engine directly. 3.Press hold the choke and kick start the engine with the help of leg crank. 4.Wait till the engine stabilizes for a rated speed. 5.Close valve of 3 -way cock, allow the fuel to flow into the engine through burette. 6.Note down the time for 10 cc of fuel consumption. 7.Now switch on the electrical loading for first resistance. Note down reading of all above and repeat experiment for different load by switching all switches one by one.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	
9	Sample Calculations	BRAKE POWER (BP) in KW BP = $\frac{(V \times I)}{(1000 \times li_g)}$ KW **TOTAL FUEL CONSUMPTION (Mf) in Kg/hr Mf=** $\frac{(10 \text{ cc} \times 3600 \times pf)}{(t \times 1000)}$ Kg/hr AIR FUEL RATIO A/F Ma / Mf

SL. No.	Voltage V (volts)	Current I (amps)	Time (t) taken for 10 cc of fuel consumption	Manometer reading Cd			BP
				H1 cm	**H.** cm	(Hi-H2) X 10^{-2}	
1							
2							

		SPECIFICFUEL CONSUMPTION (SFC) in Kg/Kw-hr SFC = (Mf / BP) **BRAKE THERMAL EFFICIENCY (11,0 in % ribth =**BP X 100 % Heat supplied Where, heat supplied = Mf X CV X 3600 **MECHANICAL EFFICIENCY (1 /** jimech, **-n** Timech = BP X 100 ^{O}/0 IP Where IP = BP + FP
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	Application of IC engines
13	Remarks	
14	Faculty Signature with Date	

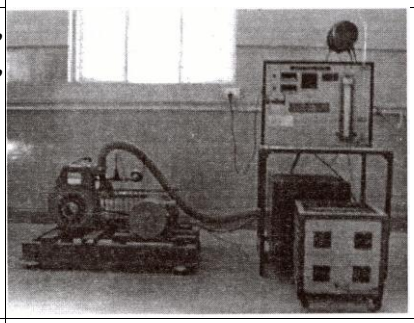
Experiment 09: FOUR STROKE SINGLE CYLINDER DIESEL ENGINE

-	**Experiment No.:**	9	**Marks**	50	**Date Planned**	24/10/2019	**Date Conducted**	
1	Title	4- stroke single cylinder diesel engine						
2	Course Outcomes	To Draw the performance characteristics						
3	Aim	To determine the performance characteristics and prepare a heat balance sheet of a 4- stroke single cylinder diesel engine						
4	Material/ Equipment Required	A Four stroke single cylinder diesel engine with rope brake dynamometer, Control panel with temperature indicators, Stop watch and Loads.						
5	Theory, Formula, Principle, Concept							

6	Procedure, Program, Activity, Algorithm, Pseudo Code	1) Check all electrical connections; ensure fuel level in the fuel tank and water level in the manometer and continuous water flow in the dynamometer and engine cylinder. 2) Ensure that there is no air trapped in the engine and keep the decompressor lever to OFF position. 3) Open 3-way cock and loosen rope on the break drum by rotating the flywheel. 4) Allow the water to cool the engine and keep at desired rate, and measure flow rate. 5) Now with the help of hand crank start the engine, once it is started, ON the de-compressor lever. 6) Allow the engine to attain a rated speed, note down the readings of speed, manometer, load, time take for flow of fuel, all temperatures and time taken for flow of 1000 cc of cooling water. 7) Now add weights and note down all above, repeat it for various loads 8) Tabulate all readings and calculate various parameters.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	1) BP v/s TFC 2) BP v/s imth 3) BP v/s imech
8	Observation Table, Look-up Table, Output	
9	Sample Calculations	
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	Application of IC engines
13	Remarks	
14	Faculty Signature with Date	

Experiment 10 : Four stroke single cylinder petrol engine.

-	**Experiment No.:**	10	**Marks**	50	**Date Planned**	31/10/2019	**Date Conducted**	

1	Title	Four stroke single cylinder petrol engine.
2	Course Outcomes	To Draw the performance characteristics
3	Aim	To determine the performance characteristics of a four stroke single cylinder petrol engine.
4	Material/ Equipment Required	A four stroke petrol engine coupled to electrical dynamometer, Measurement control panel and Electrical Loading.
5	Theory, Formula, Principle, Concept	
6	Procedure, Program, Activity, Algorithm, Pseudo Code	1) Check all electrical connections; ensure fuel level in the fuel tank. 2) Tighten all fuel lines and open 3 -way cock, make fuel to flow into the engine directly. 3) Put the carburetor knob to RUN position and with the help of rope start the engine 4) Wait till the engine stabilizes for a rated speed. 5) Close valve of 3 -way cock, allow the fuel to flow into the engine through burette. 6) Note down the time for 10 cc of fuel consumption. 7) Now switch on the electrical loading for first resistance. 8) Note down reading of all above and repeat experiment for different load by switching all switches one by one.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	**OBSERVATIONS :** Calorific value of petrol (CV) 41,000 KJ/Kg Specific Gravity of Petrol (pf) 0.72 Kg / Liter Efficiency of Generator (ri_g) 0.68 Orifice diameter (do) 15.25 mm = 0.01525 m Coefficient of discharge (CO Air 0.65 density (pa) 1.2 Kg / m^3 Acceleration due to gravity (g) 9.81 m / sec^2 Water density (p_w) 1000 Kg/ m^3

9	Sample Calculations	**BRAKE POWER (BP) in KW** BP = (V X I) KW (1000 X ri_g) **TOTAL FUEL CONSUMPTION (Mf) in Kg/hr Mf=** (10 cc X 3600 X o (t X 1000) **AIR FUEL RATIO** A/F = M_a / Mf Where Mass flow rate of air (Ma) in Kg / hr Area of =A.X Cd X 3600 X orifice (AO = (7cdo^2 / 4) m^2 Head of air in mts (H_a) = Hw X pw Pa **SPECIFIC FUEL CONSUMPTION (SFC) in Kg/Kw-hr** SFC = (Mf / BP) BRAKE THERMAL EFFICIENCY (nbth) in % ib_th = BP X 100 % Heat supplied Where, heat supplied = Mf X Cv X 3600 MECHANICAL EFFICIENCY (rimed') in (3/0 firnech = BP X 100 % IP Where IP = BP + FP FP is obtained by plotting Willians Curve i.e. a graph between TFC v/s BP
10	Graphs, Outputs	1. TFC v/s BP 2. SFC v/s BP 3. ibth v/s BP
11	Results & Analysis	
12	Application Areas	Application of IC engines
13	Remarks	
14	Faculty Signature with Date	