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POWER ENGINEERING **Course Code : 315371**

Programme Name/s : Mechanical Engineering
Programme Code : ME
Semester : Fifth
Course Title : POWER ENGINEERING
Course Code : 315371

I. RATIONALE

The diploma holders in Mechanical Engineering are mainly responsible for supervising, testing, and maintenance of power engineering devices. The knowledge of power engineering is useful in selecting a suitable prime mover for a given application along with maintaining and testing of these devices. Therefore, the knowledge and skills covering the basic principles of power engineering devices are necessary for mechanical diploma engineers. In view of the requirements, this course is designed to establish basic fundamental and practical knowledge in the fields of I.C. engines, air compressors, refrigeration & air conditioning, and energy-saving opportunities in air compressor and refrigeration & air conditioning systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Maintain power engineering and refrigeration devices for various industrial / field applications using relevant knowledge & skills related to power engineering.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Assess the performance of given refrigeration systems.
- CO2 - Measure the cooling capacity of air-conditioning systems.
- CO3 - Carryout test for the performance of an I.C. engine.
- CO4 - Analyze the performance of air compressor.
- CO5 - Use the knowledge of energy saving in air compressor & refrigeration and air-conditioning systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		
315371	POWER ENGINEERING	PER	DSC	5	-	4	3	12	4	3	30	70	100	40	25	10	25#	10	25	10	175	

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Total IKS Hrs for Sem. : 1 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Draw Carnot and Bell Coleman cycle on P-V & T-S diagram. TLO 1.2 Calculate the COP of the given vapor compression cycle. TLO 1.3 Illustrate the working of the vapor absorption refrigeration system. TLO 1.4 Select relevant refrigerant for a given application with justification TLO 1.5 Explain with a neat sketch working of a domestic refrigerator, water cooler, ice plant & cold storage. TLO 1.6 Compare traditional methods of cooling with the recent cooling process.	**Unit - I Refrigeration** 1.1 Definition of refrigeration, refrigeration effect, unit of refrigeration, coefficient of performance, air refrigeration, reverse Carnot cycle, Bell – Coleman cycle & its representation on P-V & T-S diagram. 1.2 Vapor Compression Refrigeration Systems (VCRS) : Basic components, flow diagram of the vapor compression cycle, working of VCRS, representation of the vapor compression cycle on P-H & T-S diagram, sub cooling and superheating, expression for refrigerating effect, work done and power required, coefficient of performance COP. (Simple numerical on VCRS) 1.3 Vapor Absorption Refrigeration System (VARS) : Principle of vapor absorption refrigeration system, basic components, construction and working of simple vapor absorption refrigeration system, comparison of VCRS and VARS. (No numerical on VARS) 1.4 Refrigerants : Definition, desirable properties of refrigerant, primary and secondary refrigerant, selection of refrigerant, concept of Global Warming Potential (GWP) , Ozone Depletion Potential (ODP). 1.5 Applications : Specification, construction and working of refrigerator, water cooler, ice plant, and cold storage. 1.6 Traditional methods of cooling used in ancient India (IKS). (No question to be asked)	Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Classify air conditioning systems. TLO 2.2 Determine properties of air using a psychrometric chart for given application. TLO 2.3 Represent psychrometric processes on psychrometric chart. TLO 2.4 Explain with a neat sketch working of 2/4-way ceiling mounted cassette air conditioner.	**Unit - II Air Conditioning** 2.1 Air conditioning : Definition, factors affecting comfort air conditioning, classification of air conditioning systems, comfort air conditioning and industrial air conditioning. 2.2 Psychrometry : Definition of dry air, moist air, saturated air, dry bulb temperature, wet bulb temperature, dew point temperature, absolute humidity, relative humidity, specific humidity, enthalpy of moist air. Psychrometric chart, use of psychrometric chart. 2.3 Psychrometric Processes : Sensible heating, sensible cooling, humification, dehumidification, heating and humidification, heating and dehumidification, cooling and humidification, cooling and dehumidification. Representation of the above process on a psychrometric chart. Sling psychrometer. (Simple numerical using psychrometric charts and tables) 2.4 Applications : Construction and working of window air conditioner, split air conditioner, 2/4-way ceiling mounted cassette air conditioner.	Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations
3	TLO 3.1 Calculate the performance parameters of the given I.C. engine. TLO 3.2 Explain the procedure to calculate the indicated power of the given engine using the morse test. TLO 3.3 Explain with neat sketch working of catalytic converter to control the emissions from the I.C engine. TLO 3.4 Illustrate the diagnostic procedure of the Engine Control Unit with flow diagram.	**Unit - III I.C Engine Testing and Pollution Control** 3.1 Purpose of I.C. engine testing, I.C. engine testing norms. Definition & measurement of performance parameters like brake power, indicated power, frictional power, brake and indicated mean effective pressures, brake specific fuel consumption, brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, and relative efficiency. Morse test, heat Balance sheet, (Simple numerical on the performance of I.C. engines, morse test & heat balance sheet) 3.2 Polluting emissions in S.I. & C.I engines and their effects on the environment. Controlling methods : Catalytic converters, Exhaust Gas Recirculation (EGR) . Standard pollution norms like EURO IV & VI, BS-VI. Engine Control Unit (ECU) : Working and Diagnostic procedure.	Lecture Using Chalk-Board Presentations Video Demonstrations

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Classify air compressors. TLO 4.2 Explain the construction and working of single-stage & two-stage reciprocating air compressors. TLO 4.3 Calculate the performance parameters of the given compressor. TLO 4.4 Select relevant air compressor for the given application with justification.	**Unit - IV Air Compressors** 4.1 Function of air compressor, uses of compressed air, classification of air compressors. Construction and working of single-stage and two-stage reciprocating air compressors, screw compressor, centrifugal compressor, axial flow compressor. Comparison of rotary compressor with reciprocating air compressor. 4.2 Necessity of multi-staging, advantages of multi-staging, intercooling, representation of processes involved on P-V diagram, calculation of work done. 4.3 Specifications of air compressors, pressure ratio, compressor capacity, free air delivered, volumetric efficiency, isothermal efficiency. (Simple numerical on reciprocating air compressor)	Lecture Using Chalk-Board Presentations Video Demonstrations
5	TLO 5.1 List the different components of a compressed air system. TLO 5.2 Elaborate the energy saving opportunities in compressed air systems. TLO 5.3 List the factors affecting the performance and energy efficiency of refrigeration and air conditioning systems. TLO 5.4 Explain the energy saving opportunities in refrigeration and air conditioning systems.	**Unit - V Energy Efficiency in Air Compressor & Refrigeration and Air Conditioning** 5.1 Air Compressor : Compressed air system components, need of energy management in compressed air systems, factors affecting efficient operation of compressed air systems, checklist for energy efficiency in compressed air systems. 5.2 Refrigeration & Air conditioning : Factors affecting performance and energy efficiency of refrigeration and air conditioning system, energy saving opportunities in refrigeration and air conditioning system.	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare a schematic diagram showing the various components of a domestic refrigerator. LLO 1.2 Prepare a sketch of flow- path of refrigerant.	1	Trace the flow of refrigerant through various components of the domestic refrigerator.	2	CO1
LLO 2.1 Perform the test using vapor compression refrigeration test rig to measure the various parameters like temperature, pressure, etc. LLO 2.2 Calculate the COP of the system.	2	*Test on vapor compression refrigeration test rig.	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Select the proper tools for dismantling/assembling. LLO 3.2 Perform the dismantling /assembling of given water cooler by following proper sequence.	3	Assemble / Dismantle various components of water cooler.	2	CO1
LLO 4.1 Measure air properties of conditioned air such as dry bulb temperature, wet bulb temperature using a sling psychrometer.	4	*Use of sling psychrometer.	2	CO2
LLO 5.1 Select the proper tools for dismantling/assembling. LLO 5.2 Perform the dismantling /assembling of given window air conditioner by following proper sequence.	5	Assemble / Dismantle various components of window air conditioner.	2	CO2
LLO 6.1 Perform a test using a window air conditioner to measure temperature, pressure, mass flow rate etc. LLO 6.2 Perform a test using a window air conditioner to determine its COP.	6	*Test on window air conditioner.	2	CO2
LLO 7.1 Measure the input current, voltage, working pressure and temperature by using appropriate measuring instruments. LLO 7.2 Diagnose the faults in the given air-conditioning system.	7	Demonstration of split air conditioner.	2	CO2
LLO 8.1 Perform the test using air conditioning test rig to measure the various parameters like temperature, pressure, mass flow rate of air etc. LLO 8.2 Calculate the COP and cooling capacity of the given air conditioning system.	8	Test on air conditioning test rig.	2	CO2
LLO 9.1 Select proper instrument to conduct a test. LLO 9.2 Measure the various parameters like temperature, pressure, fuel consumption, water flow rate, using I.C. engine test rig.	9	*Demonstration of I.C. engine test rig.	2	CO3
LLO 10.1 Calculate the various parameters like Brake power, Frictional power, and Mechanical efficiency. LLO 10.2 Draw the performance curves.	10	*Test on I.C. engine test rig Part – I	2	CO3
LLO 11.1 Perform the test using I.C. engine test rig to measure the various parameters like temperature, pressure, fuel consumption, water flow rate, etc. LLO 11.2 Prepare a heat balance sheet.	11	*Test on I.C. engine test rig Part – II	2	CO3
LLO 12.1 Measure the speed & load by using tachometer & dynamometer. LLO 12.2 Determine indicated power and mechanical efficiency.	12	*Morse Test on I.C. engine test rig.	2	CO3
LLO 13.1 Measure various pollutants in the S.I. engine. LLO 13.2 Analyze pollutants in the given S.I. engine.	13	Use of exhaust gas analyzer for S.I. engine.	2	CO3
LLO 14.1 Measure various pollutants in the C.I. engine. LLO 14.2 Analyze pollutants in the given C.I. engine.	14	Use of exhaust gas analyzer for C.I. engine.	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Interpret the notation code on the dashboard and monitor of the computer. LLO 15.2 Diagnose the faults in given I.C. engine. LLO 15.3 Suggest the remedies over the faults detected.	15	Diagnosis test on I.C. engine using engine control unit.	2	CO3
LLO 16.1 Perform the test using two stage reciprocating air compressor test rig to measure the various parameters like temperature, pressure, air flow rate, etc. LLO 16.2 Determine actual volume of free air delivered.	16	*Test on two-stage reciprocating air compressor Part I	2	CO4
LLO 17.1 Calculate pressure ratio, volumetric efficiency & thermal efficiency. LLO 17.2 Draw the performance characteristics.	17	*Test on two-stage reciprocating air compressor Part II	2	CO4
LLO 18.1 Inspect the given compressed air system. LLO 18.2 Find out the sources of losses that occurred in the given compressed air system.	18	Losses in the compressed air system.	2	CO5
LLO 19.1 Inspect the air conditioning system. LLO 19.2 Prepare the checklist for energy efficiency.	19	*Energy saving in air conditioning system.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Prepare a power point presentation on Bharat Stage & Euro emission norms for I.C. Engine.
- Make charts for performance characteristics of I.C. engine.
- Make a chart showing the heat balance sheet format to display in a laboratory.
- Collect specifications of domestic refrigerators of various air conditioners from manufacturers websites.
- Collect information on different tests used for I.C. engines.
- Prepare troubleshooting chart for domestic refrigerator/window air conditioner.
- Make a chart showing valve timing diagrams of four stroke petrol and diesel engines.
- Prepare maintenance schedule of air compressor.
- Collect information about fuel injection systems used in S.I & C.I engine.

Micro project

- Select the old parts of any rotary air compressor and mount it on a wooden board with the label and display it in laboratory.
- Collect constructional and working details of different types of reciprocating and rotary compressors.
- Collect major specifications & constructional details of different types of refrigeration and air conditioning units.
- Prepare and present a seminar on energy saving opportunities in compressed air systems using any suitable source of information.

- Prepare and present a seminar on energy saving opportunities in refrigeration and air conditioning systems using any suitable source of information.
- Collect information and pictures about ancient cooling methods from suitable sources of information.
- Display various components of Multi Point Fuel Injection (MPFI) system on wooden board with labels.
- Specifications &types of various components like compressor, condenser, air handling unit, chillers, etc.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Actual working or scrap unit of a domestic refrigerator of a minimum 165 liters having all necessary parts.	1
2	Test rig of multi-cylinder I.C. Engine with 3/5/7 HP Petrol/Diesel Engine with the necessary arrangement to conduct morse test.	12
3	Exhaust gas analyzer 3/5 gas analyzer - For CO (%)-Range 0-10, For HC (ppm)- Range 0 -10000, PM-Range 0-9000.	13,14
4	Engine Control Unit (ECU),OBD II car diagnostic tool Grade II	15
5	Test rig of two-stage reciprocating air compressor with minimum ½ HP motor with necessary pressure and temperature gauges at a suitable location.	16,17,18
6	Available air conditioning system in your institute.	19
7	Vapor compression refrigeration test rig with hermitically sealed compressor ½ to ¼ HP motor, air-cooled condenser, expansion devices like TEV or capillary tube, pressure and temperature gauges at suitable locations.	2
8	Actual working or scrap unit of water cooler of minimum 200 liter capacity having all necessary parts.	3
9	Standard sling psychrometer to measure DBT and WBT.	4
10	Old cut section of window air conditioner , tool Box containing flaring tool, spanner, piercing pliers, hammer, side cutter, cordless screw driver, rounding tool etc.	5
11	Window air conditioner test rig with 1 to 2 TR cooling capacity with forced convection condenser and evaporator fitted with all necessary instrumentation.	6
12	Split air conditioner model with 1 to 2 TR capacity, Expansion Device Capillary Tube compatible capacity, Temperature Sensors RTD PT-100 Type, Air cooled condenser compatible to 1 Ton compressor	7

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
13	Air conditioning test rig with hermitically sealed compressor ½ to ¼ HP motor, air-cooled condenser, expansion devices like TEV or capillary tube, pressure and temperature gauges at suitable locations, blower unit with 1HP,3 phase motor, steam generator to generate steam with suitable piping for introducing steam in the duct- 8-liter capacity with 2 kw heater.	8
14	Test rig of single cylinder/multi cylinder I.C. Engine with 3/5/7 HP Petrol/Diesel Engine with necessary arrangement	9,10,11

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Refrigeration	CO1	12	4	4	8	16
2	II	Air Conditioning	CO2	12	4	4	8	16
3	III	I.C Engine Testing and Pollution Control	CO3	12	4	4	8	16
4	IV	Air Compressors	CO4	9	2	4	8	14
5	V	Energy Efficiency in Air Compressor & Refrigeration and Air Conditioning	CO5	5	2	2	4	8
Grand Total				**50**	**16**	**18**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks and the average of two-unit tests.
- For laboratory learning 25 Marks
- For Self-Learning 25 Marks

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning.
- End semester assessment of 70 marks

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	1	1	2	1	2			
CO2	3	2	1	1	2	1	2			

CO3	3	2	-	1	2	1	2			
CO4	3	2	-	1	2	1	2			
CO5	3	2	-	1	2	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Mathur M.L , Sharma R. P	Internal Combustion Engines	Dhanpatrai Publication (P) Ltd , New Delhi 2018, ISBN : 9789383182428
2	V. Ganeshan	Internal Combustion Engines	Tata McGraw Hills, New Delhi, ISBN :9781259006197
3	C.P Arora	Refrigeration and Air Conditioning	Tata McGraw Hill Education, New Delhi 2021, ISBN : 9789390385843
4	Dr. Sadhu Singh	Refrigeration and Air Conditioning	Khanna Book Publication Co (P) Ltd, New Delhi 2017, ISBN : 9789386173089
5	Mahesh M. Rathore	Thermal Engineering	Tata McGraw Hill Education, New Delhi 2010, ISBN : 9780070681132
6	R.K. Rajput	Thermal Engineering	Laxmi Publications New Delhi, 2020, ISBN: 9788131808047
7	R.S.Khurmi & J.K.Gupta	A Textbook of Thermal Engineering	S.Chand Limited New Delhi 2022 , ISBN : 9789355010544
8	Bureau of Energy Efficiency	Energy Efficiency in Electrical Utilities	Bureau of Energy Efficiency, Fourth Edition 2015

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=4mWsRUr0A7A&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=3	Introduction to Refrigeration
2	https://www.youtube.com/watch?v=QZp7LzYEMCs&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=4	Air Refrigeration Cycle
3	https://www.youtube.com/watch?v=XO2PBDMEHfs&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=8	Vapor Compression Cycle - 1
4	https://www.youtube.com/watch?v=urFrdSAJmyM&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=9	Vapor Compression Cycle - 2
5	https://www.youtube.com/watch?v=4w3Obp8ILpA&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=19	Vapor Absorption Refrigeration System
6	https://www.youtube.com/watch?v=ExNJoT_2XeI&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=22	Introduction to Air Conditioning
7	https://www.youtube.com/watch?v=8Id1SZQpWY0&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=23	Properties of Moist Air

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Sr.No	Link / Portal	Description
8	https://www.youtube.com/watch?v=e2IryaMQQ6A&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=24	Psychrometric Chart
9	https://www.youtube.com/watch?v=l_3K5Hr6bB8&list=PLJjrv2_3aFXdh1PQVeO1RRl_NmXiiPZh0&index=25	Psychrometric Processes
10	https://www.youtube.com/watch?v=2chEheloWIU	Performance analysis parameters of I.C. Engine
11	https://www.youtube.com/watch?v=zH-vv5be91M	Simple tips to improve energy efficiency of your compressed air system
12	https://www.youtube.com/watch?v=CMFRJ4rGXsc	Axial flow compressor
13	https://www.youtube.com/watch?v=4JiQ5XfpwfA	Energy Savings in Compressed Air system
14	https://www.coolingindia.in/energy-conservation-in-refrigeration-hvac-system	Energy Conservation in Refrigeration & HVAC System
15	https://www.youtube.com/watch?v=zqXgmVnI3L8&list=PLE2DA184A2E479885&index=1	History of refrigeration
16	https://archive.nptel.ac.in/content/storage2/courses/112105129/pdf/RAC%20%20Lecture%201.pdf	History of refrigeration

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 24/02/2025 **Semester - 5, K Scheme**