



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE
JECRC Campus, Shri Ram Ki Nangal, Via-Vatika, Tonk Road, Jaipur
Department of Mechanical Engineering

Name of Subject: IC Engine (ICE)

Subject Code: 7ME5-11

Year: 4th Year, 7th Semester



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VISION AND MISSION OF THE INSTITUTE

VISION OF JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

MISSION OF JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

M1: Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2: Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3: Offer opportunities for interaction between academia and industry.

M4: Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

VISION AND MISSION OF THE DEPARTMENT

VISION OF DEPARTMENT OF MECHANICAL ENGINEERING

The Mechanical Engineering Department strives to be recognized globally for outcome based technical knowledge and to produce quality human resource, who can manage the advance technologies and contribute to society.

MISSION OF DEPARTMENT OF MECHANICAL ENGINEERING

M1: To impart quality technical knowledge to the learners to make them globally competitive mechanical engineers.

M2: To provide the learners ethical guidelines along with excellent academic environment for a long productive career.

M3: To promote industry-institute relationship.



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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To equip graduates with a strong foundation in engineering sciences, with an emphasis on mechanical engineering principles, enabling them to analyze, design, and solve real-world engineering challenges.

PEO2: To prepare graduates with sound scientific and engineering fundamentals to innovate and deliver effective solutions addressing practical challenges in mechanical engineering.

PEO3: To inculcate in graduates a professional and ethical attitude, effective communication and teamwork skills, a multidisciplinary approach, entrepreneurial mindset, and the ability to connect engineering solutions with societal and environmental concerns.

PEO4: To provide students with an academic environment that fosters excellence, leadership, adherence to ethical standards, and encourages self-motivated lifelong learning essential for a successful professional career in mechanical.

PEO5: To prepare students to excel in industry and higher education by providing quality education grounded in strong technical knowledge and high moral values.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Graduates will be able to design, analyze, and fabricate electric and hybrid vehicles using modern engineering tools and sustainable practices.

PSO2: Graduates will be able to apply design principles and computational techniques, including programming and data structures, to analyze and solve mechanical engineering problems.



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PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



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SYLLABUS



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Scheme & Syllabus

IV Year- VII & VIII Semester: B. Tech. (Mechanical Engineering)

7ME5-11: I. C. Engines

Credit: 3

Max. Marks: 100(IA:30, ETE:70)

3L+0T+0P

End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	History of IC engines: Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel-air cycles, Actual cycles.	4
3	Testing & Performance: Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Indian & International standards of Testing, Emission.	4
4	Fuel & Combustion: Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber.	4
5	Alternative Fuels: Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas.	2
6	Engine Systems & Components: Fuel System (SI Engine), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburetors, types, Aircraft carburettor, comparison of carburetion & injection, F/A ratio calculations.	4
7	CI engine: Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors.	3
8	Ignition system: Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs.	3
9	Engine Friction & Lubrication: Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc., Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components.	5

Office of Dean Academic Affairs
Rajasthan Technical University, Kota



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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Scheme & Syllabus

IV Year- VII & VIII Semester: B. Tech. (Mechanical Engineering)

10	Supercharging: Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations, Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines.	5
11	Dual & Multi fuel engines: Principle, fuels, Combustion, performance Advantages, Modification in fuel system.	3
12	Special Engines: Working principles of Rotary, Stratified charge, Free piston, Variable compression ratio engines.	2
Total		40

TEXT BOOK

1 Mathur and Sharma, Internal Combustion Engines, Dhanpat Rai & Sons

REFERENCE BOOKS

SN Name of Authors /Books /Publisher

1 Gupta H.N., Fundamentals of Internal Combustion Engines, Prentice Hall of India

2 F. EdwardObert, Internal Combustion Engines, Harper and Raw Publisher

3 John B. Heyword, Internal Combustion Engines Fundamentals, McGraw Hill

4 Lichty, Internal Combustion Engines, McGraw Hill.

5 Gill, Smith, Ziurs, Fundamentals of Internal Combustion Engines, Oxford & IBH Publishing

6 Rogowsky, IC Engines, International Book Co.

7 Ganeshan V., Internal Combustion Engines, Tata McGraw Hill.

8 R. Yadav, I.C. Engines, Central Publishing House, Allahabad

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COURSE OUTCOMES (COs)

Subject: I C Engine

Code: 7ME5-11

Course Outcomes:

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

CO1: Explain the classification, construction, and working principles of various types of internal combustion engines and their operating cycles.

CO2: Analyze combustion processes, performance parameters, and efficiency characteristics of SI and CI engines.

CO3: Apply knowledge of fuel systems, ignition systems, and lubrication methods to enhance engine performance and reduce losses.

CO4: Evaluate engine testing methods, performance characteristics, and cooling techniques using standard procedures.

CO5: Assess the use of alternative fuels, dual-fuel systems, and supercharging techniques in improving engine performance and emissions.

CO6: Describe modern and special engine concepts such as rotary, stratified charge, and variable compression ratio engines.

CO-PO/PSO MAPPING

CO-PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2	1	1	2	2	1	1	3	3
CO2	3	3	2	2	2	2	1	2	2	2	1	3	3
CO3	3	3	2	2	2	1	1	2	2	2	1	3	2
CO4	3	2	3	3	2	2	2	3	3	2	2	3	3
CO5	3	3	3	3	2	2	2	2	2	2	3	3	2
CO6	3	2	3	2	2	1	2	2	2	2	2	3	3



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COURSE PLAN

Name of the Course: **IC Engine**

Code of the course: **7ME5-11**

Name of Faculty: **Lalit Kumar Sharma**

Course Outcome

CO1: Explain the classification, construction, and working principles of various types of internal combustion engines and their operating cycles.

CO2: Analyze combustion processes, performance parameters, and efficiency characteristics of SI and CI engines.

CO3: Apply knowledge of fuel systems, ignition systems, and lubrication methods to enhance engine performance and reduce losses.

CO4: Evaluate engine testing methods, performance characteristics, and cooling techniques using standard procedures.

CO5: Assess the use of alternative fuels, dual-fuel systems, and supercharging techniques in improving engine performance and emissions.

CO6: Describe modern and special engine concepts such as rotary, stratified charge, and variable compression ratio engines.

Unit No.	Topic	Lec No.	CO	Specific Objective	Expected Outcome	Book Referred	From Page to
Unit-1	Introduction: Objective, scope and outcome of the course	1	1	To introduce course structure and applications	Students understand course relevance	T1	1–15
Unit-2	History of IC engines, nomenclature	2	1	To introduce development of IC engines	Students understand evolution	T1	1–20
	Classification & comparison of engines, SI vs CI	3	1	To classify engines	Students differentiate engines	T1	20–40
	4-stroke & 2-stroke engines, First Law analysis	4	1	To explain working cycles	Students understand thermodynamic cycles	T1	40–70
	Energy balance, fuel-air cycles, actual cycles	5	2	To analyze real engine cycles	Students identify losses	T1	70–110
Unit-3	Performance parameters and testing basics	6	4	To introduce testing	Students understand performance terms	T1	500–520
	Measurement of speed, fuel & air consumption	7	4	To measure parameters	Students learn instrumentation	T1	520–540
	IHP, BHP, FHP and efficiencies	8	4	To evaluate engine performance	Students calculate efficiencies	T1	540–560
	Emission measurement and standards	9	4	To study emissions	Students understand norms	T1	900–930
Unit-4	Combustion in SI & CI engines, ignition limits	10	2	To explain combustion	Students understand ignition	T1	150–180
	Stages of combustion, combustion parameters	11	2	To study combustion stages	Students analyze parameters	T1	180–210
	Delay period, ignition lag, turbulence & swirl	12	2	To analyze combustion factors	Students understand delay effects	T1	210–230
	Abnormal combustion: knocking & detonation	13	2	To explain abnormal combustion	Students differentiate knocking	T1	170–200
	Combustion chamber design & types	14	2	To study chamber design	Students evaluate design	T1	200–220



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Unit-5	Alternative fuels: methanol, ethanol	15	5	To introduce alternative fuels	Students compare fuels	T1	300–320
	Biofuels, vegetable oils, biogas	16	5	To study renewable fuels	Students assess fuel performance	T1	320–350
Unit-6	Fuel system (SI), A/F mixture requirements	17	3	To explain fuel systems	Students understand mixture needs	T1	360–380
	Carburetion and types of carburetors	18	3	To study carburetors	Students analyze carburetion	T1	380–410
	Aircraft carburetor, carburetion vs injection	19	3	To compare systems	Students differentiate systems	T1	410–430
	A/F ratio calculations	20	3	To apply mixture concepts	Students perform calculations	T1	430–445
Unit-7	CI engine mixture requirements	21	3	To study diesel engines	Students understand constraints	T1	420–440
	Injection methods and systems	22	3	To explain injection	Students understand injection systems	T1	440–470
	CRDI system components	23	3	To study modern injection	Students understand CRDI	T1	470–490
Unit-8	Ignition systems (conventional & modern)	24	3	To explain ignition	Students compare systems	T1	450–470
	Magneto vs battery ignition, electronic ignition	25	3	To differentiate ignition types	Students understand ignition control	T1	470–490
	Spark advance, firing order, spark plugs	26	3	To study ignition timing	Students understand mechanisms	T1	490–510
Unit-9	Engine friction and its determination	27	4	To analyze friction	Students evaluate losses	T1	480–500
	Lubrication principles and types	28	3	To explain lubrication	Students understand lubrication	T1	500–520
	Lubricating oils: properties & additives	29	3	To study oils	Students select lubricants	T1	520–540
	Lubrication systems	30	3	To study systems	Students understand applications	T1	540–560
	Engine cooling systems	31	4	To explain cooling	Students evaluate cooling	T1	520–560
Unit-10	Heat balance and heat flow	32	4	To analyze heat distribution	Students interpret heat balance	T1	560–580
	Supercharging: objectives & thermodynamics	33	5	To explain boosting	Students understand performance	T1	580–600
	Methods and limitations of supercharging	34	5	To study systems	Students evaluate methods	T1	600–620
	Two-stroke engines and scavenging	35	1	To explain 2-stroke engines	Students compare engines	T1	60–80
Unit-11	Dual fuel engines: principles	36	5	To explain dual fuel engines	Students understand working	T1	650–670
	Combustion and performance	37	5	To analyze performance	Students evaluate efficiency	T1	670–690
	Advantages and modifications	38	5	To study system changes	Students understand improvements	T1	690–710
Unit-12	Special Engines: Rotary, Stratified charge, Free piston, VCR	39	6	To introduce modern engines	Students understand advanced engines	T1	800–830
BS-1	Latest trends in vehicles	40	6	To explore future technologies	Students understand EVs & hybrids	NPTEL	



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Reference Books:

T1-Mathur & Sharma, Internal Combustion Engines, Dhanpat Rai & Sons

T2- R. Yadav, I.C Engine, Central Publishing House, Allahabad

T3- Ganeshan, V., Internal Combustion Engine, Tata Mc Graw Hill.

T4- John B. Heyword, Internal Combustion Engines Fundamentals, McGraw Hill