

AUTOMOBILE SYSTEMS**Course Code : 314343**

Programme Name/s : Automobile Engineering.
Programme Code : AE
Semester : Fourth
Course Title : AUTOMOBILE SYSTEMS
Course Code : 314343

I. RATIONALE

Automobile control systems play an important role in enhancing vehicle performance, fuel efficiency, and reducing emissions. These systems are instrumental in safeguarding the safety of drivers, passengers, and pedestrians alike. Considering the above needs, this course will equip students to acquire relevant knowledge and skills in this area. Additionally, this course will help students analyze the performance of automobiles during inspection, installation, operation, and maintenance. This course will be a prerequisite for studying fifth and sixth-semester courses such as automobile component design and vehicle maintenance.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Select relevant automobile control system parts and vehicle bodies.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify different components in the front axle and steering system.
- CO2 - Select a suitable braking system as per the vehicle.
- CO3 - Select relevant suspension systems for vehicles.
- CO4 - Select relevant body materials for better performance.
- CO5 - Use safety and advanced driver assistance systems in vehicles.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week	SLH	NLH	Paper Duration	Theory				Based on LL & TL				Based on SL						
												Practical										
								CL		TL	LL	FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
																Max	Min	Max	Min	Max	Min	
314343	AUTOMOBILE SYSTEMS	ASY	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175	

Total IKS Hrs for Sem. : 0 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.* 15 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 Identify the type of front axle and stub axle in the given vehicle. TLO 1.2 Describe the function of various front axle and stub axle with applications. TLO 1.3 Describe the parts of the steering system in the given vehicle. TLO 1.4 Suggest the suitable steering gearbox for the given application. TLO 1.5 Describe with sketches the working principle of the given type of power steering.	Unit - I Front Axle and Steering 1.1 Types of front axle- Dead axle, Live axle. 1.2 Types of stub axle arrangements- Elliot, Reverse Elliot, Lamoine and Reverse Lamoine; Front wheel assembly. 1.3 Steering linkages for the vehicle with rigid axle, independent suspension system. 1.4 Ackerman steering gear mechanism. (Only Theory, No Derivation). 1.5 Steering geometry parameters: Caster, Camber, King-pin inclination, Toe in-Toe out, Understeering and Oversteering. 1.6 Construction, working and application of Steering gear box: Rack and pinion type, recirculating ball type and worm and roller type steering gear box. 1.7 Power assisted steering and its types (Hydraulic and electrical).	Model Demonstration, Video Demonstrations, Lecture Using Chalk-Board, Presentations.

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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 Explain with sketches the construction and working of the given brakes. TLO 2.2 Describe the characteristics of the friction material. TLO 2.3 Describe the various properties of the brake fluid. TLO 2.4 Suggest the relevant type of braking system for the given vehicle with justification. TLO 2.5 Describe the significance characteristic and advantages of Antilock Braking System (ABS).	Unit - II Automotive Brakes 2.1 Necessity of brakes. 2.2 Classification of brakes. 2.3 Disc brake and Drum brake -Construction, working and its Application. 2.4 Friction materials and its characteristics: Brake fade, coefficient of friction, dry friction and wet friction. 2.5 Construction and working of Braking Systems: Mechanical braking system, Hydraulic Braking system, Air braking system, Vacuum assisted braking system, parking brake, Exhaust brake, Antilock braking system. 2.6 Properties of brake fluids.	Lecture Using Chalk-Board, Presentations, Video Demonstrations, Model Demonstration.
3	TLO 3.1 Identify the various components of the given automobile suspension system. TLO 3.2 Explain with sketches the construction and working of given suspension system with application. TLO 3.3 Describe with sketches the working of the given air suspension system. TLO 3.4 Suggest relevant suspension system for the given vehicle with justification.	Unit - III Suspension Systems 3.1 Necessity of suspension system. 3.2 Classification of suspension system. 3.3 Rigid suspension system. 3.4 Independent suspension system- Front Wheel and Rear Wheel. 3.5 Damper (Shock absorber) construction and working: Telescopic and Gas filled. 3.6 Different types of spring – Leaf spring, Coil spring, Torsion bar, Anti roll bar or stabilizer bar, Air spring, Hydrodynamic spring. 3.7 Air Suspension System.	Lecture Using Chalk-Board, Presentations, Video Demonstrations, Model Demonstration.

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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 List the different types of auto bodies used for the given chassis. TLO 4.2 Describe the different materials used for the given body construction with justification. TLO 4.3 Identify the different body accessories used for a given vehicle. TLO 4.4 Describe painting and denting procedure for the given auto body with sketches. TLO 4.5 Select glass, door and body insulation trims for the given body.	Unit - IV Auto Body Engineering 4.1 Functions of auto body. 4.2 Types of Auto bodies. 4.3 Different Materials used in body construction. 4.4 Body accessories and its functions. 4.5 Protective and anticorrosive treatments, painting and denting procedure. 4.6 Streamlining of vehicle body and its effect, Resistance faced by the vehicle- Air resistance , rolling resistance, gradient resistance. 4.7 Miscellaneous Body services- Interior trim and upholstery, Glass and door service, Body insulation and sealing, Exterior trim.	Lecture Using Chalk-Board, Presentations, Video Demonstrations, Hands-on.
5	TLO 5.1 Describe the necessity safety systems in modern vehicles TLO 5.2 Identify the different Advanced Driver Assistance System used in vehicle TLO 5.3 Describe function of Advanced Driver Assistance System used in vehicle	Unit - V Safety and Advanced Driver Assistance System 5.1 Necessity of safety system 5.2 Types of safety-Active and Passive 5.3 Safety and Advanced Driver Assistance System – Air Bags, Seat Belt, Central Locking, Collapsible Steering, Keyless Entry, Traction Control, Reverse Parking Sensor and Rear View Camera, Active Suspension, Adaptive Cruise Control, Voice Alert System, Automatic Climate Control, GPRS, Tyre Pressure Warning.	Lecture Using Chalk-Board Presentations Video Demonstrations

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 Identify the different components of power steering system. LLO 1.2 Draw layout of given power steering system.	1	*Identification of the components of power steering system.	2	CO1
LLO 2.1 Use relevant tools require to dismantle steering gear box from steering system.linkages LLO 2.2 Follow safety procedure as per standard. LLO 2.3 Inspect condition of components. LLO 2.4 Reassemble the steering gear box assembly.	2	Dismantling the steering gear box and reassemble it.	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 Use relevant tools require to dismantle wheel from the axle. LLO 3.2 Follow safety procedure as per standard. LLO 3.3 Inspect condition of components. LLO 3.4 Reassemble the wheel to the axle.	3	*Dismantle the front wheel from the axle and reassemble it.	2	CO1
LLO 4.1 Operate wheel alignment machine for determining various steering geometry.parameter LLO 4.2 Interpret data display on wheel alignment machine. LLO 4.3 Set various steering geometry parameter in the given vehicle according to data display on the wheel alignment machine.	4	*Measuring steering geometry parameters using wheel alignment machine.	2	CO1
LLO 5.1 Use relevant tools require to dismantle hydraulic braking system components. LLO 5.2 Follow safety procedure as per standard. LLO 5.3 Inspect condition of components. LLO 5.4 Reassemble the hydraulic braking system components.	5	*Dismantle the major components of hydraulic braking system and reassemble it.	2	CO2
LLO 6.1 Use relevant tools require to dismantle air braking system components. LLO 6.2 Follow safety procedure as per standard. LLO 6.3 Inspect condition of components. LLO 6.4 Reassemble the air braking system components.	6	Dismantle the major components of Air braking system/vacuum assisted braking system and reassemble it.	2	CO2
LLO 7.1 Use relevant tools require to dismantle disc brake system components. LLO 7.2 Follow safety procedure as per standard. LLO 7.3 Inspect condition of components. LLO 7.4 Reassemble the disc brake system components.	7	*Dismantle the components of disc brake system and reassemble it.	2	CO2
LLO 8.1 Use relevant tools require to dismantle Mc-pherson strut type suspension system components. LLO 8.2 Follow safety procedure as per standard. LLO 8.3 Inspect condition of components. LLO 8.4 Reassemble the Mc-pherson strut type suspension system.	8	Dismantle the Mc-pherson strut type suspension system and reassemble it.	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 9.1 Use relevant tools require to dismantle semi elliptical type leaf spring. LLO 9.2 Follow safety procedure as per standard. LLO 9.3 Inspect condition of components. LLO 9.4 Reassemble the semi elliptical type leaf spring.	9	*Dismantle the semi elliptical type leaf spring rigid axle suspension system and reassemble it.	2	CO3
LLO 10.1 Use relevant tools require to dismantle telescopic type hydraulic shock absorber. LLO 10.2 Follow safety procedure as per standard. LLO 10.3 Inspect condition of components. LLO 10.4 Reassemble the telescopic type hydraulic shock absorber.	10	Dismantle the telescopic type hydraulic shock absorber and reassemble it.	2	CO3
LLO 11.1 Identify the different auto body accessories. LLO 11.2 Prepare a comparative report on different body accessories including features and specification.	11	Identification of various auto body accessories.	2	CO4
LLO 12.1 Identify types of material used in auto bodies. LLO 12.2 Identify properties of material. LLO 12.3 Select proper material as per application.	12	Auto body materials selection.	2	CO4
LLO 13.1 Identify tools require for denting and panting of vehicle. LLO 13.2 Use proper tools for step-by-step denting and painting procedure.	13	*Denting and painting of auto body parts.	2	CO4
LLO 14.1 Identify types of safety devices used in vehicle. LLO 14.2 Check the functionality of the components used in safety devices.	14	*Practice on vehicle safety devices.	2	CO5
LLO 15.1 Identify Advanced Driver Assistance Systems. LLO 15.2 Check the functionality of Advanced Driver Assistance Systems used in vehicle.	15	Demonstration of functional features of Advanced Driver Assistance System used in different vehicles.	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)

Micro project

- Develop a demonstration working model of leaf springs

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- Prepare demonstration model of different auto bodies
- Collect used shock absorbers of different vehicles from the market/garages and prepare model on wooden plywood
- Develop a demonstration working model of hydraulic braking system
- Collect used steering gear boxes of different vehicles from the market/garages and prepare model on wooden plywood
- Collect used brake shoes and brake pads of different vehicles from the market/garages and prepare model on wooden plywood

Assignment

- Draw neat label sketch of given steering system linkages.
- Explain working of electric power steering system components with layout
- Observe and prepare report on construction and working of Anti Lock Braking system
- Observe and explain function of hydraulic braking system components
- Study working principle of hydraulic shock absorber with layout
- Prepare report on different types of suspension spring used in automobiles
- Observe and explain function of various body accessories in automobile
- Describe step by step procedure of painting of new car
- Describe step by step procedure of denting and painting of accident car
- Explain working of air bag system with its advantages and disadvantages.

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 judicious 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	Front axle of LMV, HMV, transaxle of FWD car. Full size original front axles of above mentioned vehicles of Make Mahindra/TATA/ Ashok Leyland/ Maruti or alike in good working condition, mounted on powder coated M.S.Stand.	1
2	Demonstration model of power assisted steering.(Hydraulic/Electric) The complete working model of Hydraulic/Electric power assisted steering system made out of new/used original parts of Car/LMV/HCV and suitably mounted on powder coated M.S. stand and working of the same can be shown.	1

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
3	Demonstration model of automotive steering system. Cut section working model of steering of jeep/car with stub axle. The model should be made out of full size original used parts, suitably sectioned and arranged to demonstrate the internal construction details such as steering gear box, bell assembly, tie rod, linkages, stub axle and working of the same can be shown by steering the steering wheel provided. The entire model is mounted on a sturdy iron frame and be suitably painted.	1,2,3
4	Working model of telescopic type hydraulic shock absorber The working model of original used telescopic type hydraulic shock absorber of mounted on powder coated M.S. Stand.	10
5	Body of car/jeep. Body of used car/ Jeep of Make Maruti/ Mahindra/TATA etc.	11,12
6	Denting and painting tools: Technical Specifications:- Earth cable 70 mm ² (2m long cable)- Multi function gun (2m, 70 mm ² cable with connector)- inertia hammer- dent pulling with stars- welding of studs, rivets and rings- contact shrinking, graphite pen.- 4 m long mains supply cable- an accessories box with consumables- AMPS : 3800A- Voltage : 230v AC Product Specification: Phase-1 PH, Power Source-AC, Type Of Vehicle-Cars, Type-Fully Automatic Weight -14 Kg	13
7	Different types of steering gear boxes- Rack and pinion, Recirculating ball and nut type, Worm and roller type; Full size original used above mentioned types of gear boxes of any Car/LMV/HCV in good working condition, mounted on powder coated M.S.Stand.	2
8	Demonstration model of front wheel assembly of car/heavy motor vehicle. Cut section model made out of original used parts of car/heavy motor vehicle, suitably sectioned and arranged to demonstrate the internal construction details showing the minute information with suspension strut with spring and shock absorber, disc brake, calliper, wishbone drive shaft etc. , and working of the same can be shown. The entire model is mounted on a sturdy powder coated M.S.Frame.	3
9	Running model of car/jeep. Original full size used car or Jeep in good working condition of make Maruti/TATA/Mahindra or alike.	4,14,15
10	Working model of hydraulic braking system and its components. The model made out of Used TATA Indica brake aggregates which will be suitably sectioned, Left Front disc and Left rear drum will be made working, using necessary hydraulic connection from the Master cylinder, By operating the brake pedal connected to the Master cylinder through booster, the functioning of disc and drum brake can be demonstrated. The aggregates on the other side will be suitably sectioned to show the internal details and will be kept dummy. All the aggregates should be paint finished. The entire setup will be mounted on a sturdy iron frame.	5
11	Working model of air braking and its components. The model made out of original parts such as Air compressor, Unloader valve, foot valve, Booster, Wheel assembly, air tank, control valve etc The Brake system will be fitted with two front wheel assembly complete (without axle) and the drum will be suitably sectioned to show the working of the brake shoe. Other system will be mounted as it is and will be made to function (foot brake, hand brake etc will be functional). The entire system will be mounted on a sturdy iron frame. A F.H.P Single phase 220/230 V AC motor will be coupled to the compressor for generation of the air, which is used for the operation of the model.	6
12	Working model of vacuum assisted braking system and its components TATA, LEYLAND, MAHINDRA any other reputed automobile manufacturer.	6
13	Disc Brake Assembly. The Model made out of Original parts such as Two Brake disc, two Caliper assembly (one sectioned), two master cylinder (one sectioned) etc, the model is mounted on a sturdy iron frame and can be demonstrated by operating the lever provided.	7

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
14	Suspension systems - Mac-pherson, leaf spring : Mac-pherson suspension- Cut section model of complete both side macpherson suspension strut with drive shaft, disk brake. This model is made out of original used parts, will be suitably sectioned And Arranged to demonstrate the internal construction details showing the minute information With Suspension Strut with spring and shock absorber, disc brake, calipers, drive shaft etc., and working of the same can be shown, the model will be suitably painted and The entire model is mounted on a sturdy iron frame. Leaf Spring - Cut section model of complete leaf spring suspension system with rear axle. This model is made out of original used parts, will be suitably sectioned And Arranged to demonstrate the internal construction details showing the minute information With leaf spring is arranged along with shock absorber etc., and working of the same can be shown, the model will be suitably painted and the entire model is mounted on a sturdy iron frame.	8,9

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	Front Axle and Steering	CO1	15	6	4	8	18
2	II	Automotive Brakes	CO2	14	4	6	6	16
3	III	Suspension Systems	CO3	10	2	4	6	12
4	IV	Auto Body Engineering	CO4	12	2	8	4	14
5	V	Safety and Advanced Driver Assistance System	CO5	9	2	4	4	10
Grand Total				60	16	26	28	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Term work, Class Test, Self-Learning

Summative Assessment (Assessment of Learning)

- End Semester Examination Theory , End Semester Examination Practical (External)

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

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CO1	3	-	-	3	-	3	3		
CO2	3	3	3	3	2	3	3		
CO3	3	3	3	3	-	3	3		
CO4	3	2	2	3	-	3	3		
CO5	3	3	3	3	2	2	3		

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	Singh, Kirpal	Automobile Engineering	Standard Publication, New Delhi, 2008 ISBN: 9788180141034
2	Jain K.K. and Asthana R.B	Automobile Engineering	Tata McGraw Hill Publishers, New Delhi 2002 ISBN: 9780070445291
3	Chikara, Anil	Automobile Engineering	Satya Prakashan New Delhi, 2007, ISBN: 9788176843515
4	Gupta R.B.	Automobile Engineering	Satya Prakashan New Delhi, 2016 ISBN: 9788176848589
5	S. Shrinivasan	Automobile Mechanics	McGraw Hill, New Delhi, 2003 ISBN: 9780070494916
6	Crouse / Anglin	Automobile Mechanics	Tata McGraw Hill, Dallas, TX, U.S.A , 1984, ISBN : 9780070148604
7	Giri N.K.	Automobile Technology	Khanna Publication, New Delhi, 2009 ISBN: 9788174091789
8	G.B.S. Narang	Automobile Engineering	Khanna Publication, New Delhi, 2007 ISBN: 9789387394254
9	G.K.Awari, V S Kumbhar, R B Tirpude	Automotive Systems Principles and Practices	CRC Press London ISBN: 9780367498504

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=VrBeL9pp0lg	Steering System Working
2	https://www.youtube.com/watch?v=7d2K_mKgsZ0	How to Fix Car Wheel Alignment Parameter
3	https://www.youtube.com/watch?v=qD00DIGVhtk	Working of recirculating ball type steering gear box
4	https://www.youtube.com/watch?v=98DXe3uKwfc&t=5s	Antilock Brake System Working Animation
5	https://www.youtube.com/watch?v=f9fLf4UUIQE	Air Brake System Working
6	https://www.youtube.com/watch?v=21L9_ISeVAE	Car Brake Service
7	https://www.youtube.com/watch?v=PDnyfrMy1iA	Car Suspension Working
8	https://www.youtube.com/watch?v=V_g1-WHD4rw	Installation new suspension in car
9	https://www.youtube.com/watch?v=YBEYILBN8-k	Car body manufacturing
10	https://www.youtube.com/watch?v=qCIes_xJdGo	Air Bag Working
11	https://www.youtube.com/watch?v=uRaU1HMJyCo	Seat Belt Working
12	https://www.youtube.com/watch?v=EiWI5PAtfYA	Advanced Driver Assistance System

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Sr.No	Link / Portal	Description
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. 21/11/2024**Semester - 4, K Scheme**