YESHWANTRAO CHAVAN COLLEGE OF ENGINEERING
(An Autonomous Institution affiliated to R T M Nagpur University Nagpur)
Accredited by NAAC (1st Cycle) with 'A' Grade (Score 3.25 on 4 Point Scale)
Wanadongri, Hingna Road, Nagpur-441110

Department of Electrical Engineering
(Minor in EV)

B.E. Minor in Electric Vehicles
SoE & Syllabus 2021-22

B.E Minor in Electric Vehicles

Information Brochure of Minor Program

1. Title of Program: **Minor in Electric Vehicles**

2. Type of Program : **Minor**

3. Department offering the program: **Electrical Engineering**

4. Industry / Association / Collaboration:
   1. Skywing Tech, Pune
      Kanta Height, First floor, Office No. 102 Sr. No. 3/21, opp. Sawata Mali Mandir, Narhe, Pune, Maharashtra 411041
      Contact: 7775901215
      http://www.skywingstech.com

   2. TE connectivity Private Ltd, Bangluru.
      22B Doddenakundi, Second phase Industrial area Whitefield road, Bangluru,Karnataka,560048
      Contact:080-33195000
      www.te.com

5. Department/s eligible to opt for the program:
   The students from CE, ME, EE, ETC, CT , IT , CSE are eligible to opt for this program.
   Department of Electrical Engineering students are not permitted to opt for the program.

6. **General information about courses in program:**
   Theory courses dealt in this minor program:

   - Electrical Machinery(transformer, generator, motor, special machines)
   - Power Electronics(semiconductor devices, converters, inverters, choppers, voltage control methods)
   - Electrical Drives(Drives and Speed Control, selection of motor for traction, PLC, digital speed control)
   - Electric Vehicles(electro mobility, vehicle dynamics, energy storage system, hybrid power trains)
   - Energy Storage and Systems(, Energy storage in electric vehicles, Battery Energy Storage System)

Practical courses dealt in this Minor program:

- Electrical Machinery
- Power Electronics
- Electrical Drives

7. **Advance knowledge or research orientation of Program: NA**

8. **Employability potential of program:**

CT, IT graduates	Developing algorithms for battery management system(BMS), making IoT modules for sharing real-time data generated by EV, Use of AI to improve the efficiency of BMS
ME graduates	Design of thermal system, vehicle and parts design and manufacturing
EE and ETC graduates	Developing firmware for BMS, developing infotainment system, manufacturing and installing sensors in the vehicle, power electronics component selection as per criterion for EV)

9. **Departmental Steering committee: For proper publicity / conduct of program**

SN	Name of the Faculty Member	Post	Designation	e-mail ID	Contact Number
1	Prof. P. S. Shete	Publicity Head	Assistant Professor	pranay.shete85@gmail.com	9421779894
2	Prof. S. L. Tiwari	Member	Assistant Professor	shweta_tiwari200410@rediff.com	9422823380
3	Prof. P. B. Joshi	Member	Assistant Professor	joshi_prasad27@yahoo.com	9975052397

10. **Program Coordinator:**

SN	Name of the Faculty Member	Post	Designation	e-mail ID	Contact Number
1	Dr. S. G. Kadwane	Program coordinator	Professor	sgkadwane@gmail.com	9730459847

Scheme of Examinations
Minor in Electric Vehicles

SN	Sem	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
					L	T	P	Hrs		MSEs*	TA**	ESE	
1	5	ELM101	Electrical Machinery	**T**	3	0	0	3	3	30	30	40	3
2	5	ELM102	Lab: Electrical Machinery	**P**	0	0	2	2	1		60	40	
3	5	ELM103	Power Electronics	**T**	3	0	0	3	3	30	30	40	3
4	5	ELM104	Lab:Power Electronics	**P**	0	0	2	2	1		60	40	
5	6	ELM111	Electric Vehicles	**T**	3	0	0	3	3	30	30	40	3
6	6	ELM112	Electrical Drives	**T**	3	0	0	3	3	30	30	40	3
7	6	ELM113	Lab: Electrical Drives	**P**	0	0	2	2	1		60	40	
8	7	ELM121	Energy Storage Components and Systems	**T**	3	0	0	3	3	30	30	40	3
			TOTAL :		**15**	**0**	**6**	**21**	**18**				

MSEs* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 20 marks on lecture quizzes, 8 marks on assignments, 2 marks on class performance

TA = for Practical : MSPA will be 15 marks each**

V Semester

ELM101	Electrical Machinery			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs
Prerequisites	Basic Electrical Engineering						

Course Objective:

1. The basic principle of transfer of electrical power, operation, construction of single and three phase transformers, their classification, connections and phasor diagrams.
2. The basic principle, construction, operation, Performance characteristics, steady state analysis and applications of DC electrical machines, and induction machines.

Course Outcome

Students will be able to

1. Demonstrate the knowledge of Operation of single phase and auto-transformer. Develop, analyse and evaluate vector diagrams and performance indices of single phase and three phase transformer
2. Explain and examine principle, construction, types, operation, speed control, characteristic and applications of DC machines and evaluate performance parameters of d.c.machines
3. Explain and examine principle, construction, operation, starting, speed control ,applications and evaluate the performance indices of induction motors.
4. To study Special Machines and its applications.

UNIT I : ELECTRO MAGNETISM:

Magnetic Circuit, magnetic field due to current carrying conductor and a coil, Right hand grip rule, Force on a current carrying conductor placed in a magnetic field, Flemings Left hand Rule, Magnetization curves of magnetic materials, Magnetic hysteresis and hysteresis loss, Eddy current and loss, leakage flux and fringing, Faraday's laws of electromagnetic induction, Lenz's Law, Flemings's Right hand rule, Types of induced EMF

UNIT II : TRANSFORMER:

Single Phase Transformer: Working principle. EMF equation. Construction of single phase transformer. Ideal transformer, Practical transformer ,Transformer on load , Voltage Regulation.. Open circuit and Short circuit tests on transformer. Efficiency and condition for maximum efficiency. Autotransformer operation. All day efficiency (Only concept).

Three Phase Transformer:Types of 3 phase transformers, Construction, Polarity marking & Test, Transformer connections, Parallel operation of single and three phase transformers

UNIT III : UNIT 3: D.C. GENERATOR:

Construction, Magnetic structure, Field and Armature systems, Field and Armature windings (Both Lap and Wave Types), EMF Equation, Characteristics and applications of different types of D.C. Generators, Building of Emf in D.C. Shunt generator, Armature reaction, commutation

UNIT IV : D.C. MOTOR:

Principle, Torque Equation, Characteristics and applications of various types of D.C. Motors, Starting of D.C. Motors, Speed control of Series and Shunt motors, Power flow in DC machines, Losses and Efficiency in D.C. machines

UNIT V: INDUCTION MOTOR:

Three Phase Induction Motor:
Construction and types. Production of rotating magnetic field. Principle of operation. Torque of an induction motor. Condition for maximum torque. Torque – slip and torque speed characteristics. Applications of three phase induction motor. Starting, Speed control, Crawling and cogging,
Single Phase Induction Motor:
Double – field revolving theory of induction motor. Types of single phase induction motors. Comparison of single phase and three phase induction motor. Applications of single phase induction motor.

UNIT VI: SPECIAL MACHINES:

Induction Generator: Principle, isolated operation, double fed induction generator, applications
Special Machines:
Introduction, Basic Theory and applications of BLDC motor, Switched Reluctance Motor (SRM), Permanent Magnet Synchronous Motor (PMSM)

Text Books:

	Title	Edition	Author	Publisher
1	Electrical Machines	**2nd -1993**	Dr. P. K. Mukherjee and S. Chakravarti	DhanpatRai Publications (P) Ltd
2	Electrical Machines	**3rd -2010**	I.J.Nagrath and Dr.D.P.Kothari	Tata McGraw Hill
3	Electric Machines	**3rd -2016**	Ashfaq Husain	DhanpatRai Publications (P) Ltd.

Reference Book:

	Title	Edition	Author	Publisher
1	A textbook of Electrical Technology Volume II	2005	B.L.Theraja	S.Chand

V Semester

ELM102 :	Lab: Electrical Machinery				L= 0	T = 0	P = 2	Credits = 1
Evaluation Scheme	MSPA 1	MSPA 2	MSPA 3	MSPA 4	TA*	ESE	Total	ESE Duration
	--	--	--	-	60	40	100	
Prerequisites	Basic Electrical Engineering							

Course Objective:

1. The basic principle of transfer of electrical power, operation, construction of single and three phase transformers, their classification, connections and phasor diagrams.
2. The basic principle, construction, operation, Performance characteristics, steady state analysis and applications of DC electrical machines, and induction machines.

Course Outcome

Students will be able to

1. Demonstrate the knowledge of Operation of single phase and auto-transformer. Develop, analyse and evaluate vector diagrams and performance indices of single phase and three phase transformer
2. Explain and examine principle, construction, types, operation, speed control, characteristic and applications of DC machines and evaluate performance parameters of d.c.machines
3. Explain and examine principle, construction, operation, starting, speed control ,applications and evaluate the performance indices of induction motors.
4. To study Special Machines and its applications.

SN	NAME OF EXPERIMENT
1	To evaluate the efficiency and voltage regulation of 1-phase transformer by load test
2	To evaluate the efficiency and voltage regulation of 1-phase transformer by Open Circuit and Short Circuit tests
3	To analyze back to back test on two identical 1-phase transformers
4	To understand conversion of a 2-winding transformer into an autotransformer
5	To apply phasing out and polarity marking on a 3-phase transformer
6	To determine the voltage and current relations in a 3-phase, Delta-Star connected transformer
7	To analyze an Open Circuit and Short Circuit test on a 3-phase transformer
8	To determine the magnetization characteristic of a DC generator.

9	To analyze the speed control of a DC shunt motor by varying -- (a) field excitation and (b) armature voltage
10	To determine the load test on a DC shunt motor.
11	To determine the slip of a 3-phase induction motor by different methods
12	To analyse speed control of a 3-phase slip-ring induction motor by -- (a) variation of a rotor resistance and (b) varying supply voltage
13	To determine the load test on a 3-phase induction motor by indirect loading.
14	To determine the direct loading of 3-phase induction motor by load test .
15	To evaluate the No-Load and Blocked rotor tests on a 3-phase induction motor.
16	To evaluate the No-Load and Blocked rotor tests on a 1-phase induction motor.
17	To determine the operation of an Induction generator.

V Semester

ELM103	Power Electronics			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs
Prerequisites							

Course Objective:

1) Understand the basics of power electronics.
2) Understand SCR"s, MOSFET, UJT, IGBT, Concept of rectification, inversion and commutation

Course Outcome

Students will be able to

1) Demonstrate the learnings of various power semiconductor devices with their protection and apply them for various applications.
2) Analyse different Power Electronics Converter circuits and choose them for suitable applications.
3) Demonstrate the knowledge of chopper circuits, analyse and utilise them for different applications.
4) Analyse inverter circuits with different modulation techniques and identify their application

UNIT I : SCR construction, working and its characteristics, SCR turn off methods, ratings, protection. Construction, working and characteristics of MOSFET and IGBT (in brief) ,TRIAC, Gate driver circuits

UNIT II : Single Phase AC to DC Converters

Single phase line commutated converters, single pulse converter, single phase bridge converter, effect of source inductance, effect of freewheeling diode, single phase half controlled rectifier

UNIT III : Three phase AC to DC Converters

Three phase three pulse converter, three phase bridge converter for resistive and inductive load. Application of converter in Electric Drives

UNIT IV : **D.C. Choppers**

Step down chopper, step up chopper, Control strategies, Multiphase choppers, Application of choppers

UNIT V: Inverters

Single phase half bridge and full bridge inverter, three phase bridge inverters 120^0 and 180^0 mode of conduction, Harmonics in output voltage waveforms

UNIT VI: Inverter output voltage control

Output voltage control, Harmonic attenuation by filters, Single pulse width modulation technique, multiple pulse width modulation technique, Sinusoidal pulse width modulation technique, Harmonic reduction by pulse width modulation techniques, analysis of single pulse width modulation, working of current source inverters, applications. Brief idea of Digital Control

Textbooks:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Power Electronics Circuit"s Devices And Applications	3rd Edition,2004	M.H.Rashid	Prentice Hall Limited
2	Power Electronics		D.Y.Shingare	Electrotech Publication Engineering Series

Reference books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Power Electronics	1981	C.W.Lander	McGraw Hill
2	Thyristors Applications and their	2nd Edition 2002	Dr.M.Ramamoorty	East West Press
3	Thyristors and their Applications		Dr.G.K.Dubey, DoraldaSinha and Joshi	New Age International
4	Power Electronics	1989	Ned Mohan, T.M.Undeland, and W.P.Robbins	John Wiley and Sons

V Semester

ELM104	Lab: Power Electronics				L= 0	T = 0	P = 2	Credits = 1
Evaluation Scheme *Best Two out of three MSE's would be considered	MSPA 1	MSPA 2	MSPA 3	MSPA 4	TA*	ESE	Total	ESE Duration
	--	--	--	--	60	40	100	
Prerequisites								

Course Objective:

1) Understand the basics of power electronics.
2) Understand SCR"s, MOSFET, UJT, IGBT, Concept of rectification, inversion and commutation

Course Outcome

Students will be able to

1) Demonstrate the learnings of various power semiconductor devices with their protection and apply them for various applications.
2) Analyse different Power Electronics Converter circuits and choose them for suitable applications.
3) Demonstrate the knowledge of chopper circuits, analyse and utilise them for different applications.
4) Analyse inverter circuits with different modulation techniques and identify their application

S.N	TITLE
1	To show V-I characteristics of SCR and measure holding and latching current of SCR.
2	To estimate sensitivity of four modes operation of TRIAC
3	To evaluate average dc voltage of single phase half wave rectifier with Resistive load.
4	To show transfer and output characteristics of Power MOSFET.
5	To show speed control of DC Shunt Motor with Semi Converter.
6	To demonstrate single phase step down Cycloconverter with Resistive load.
7	To demonstrate Forced Commutation methods of SCR.
8	To evaluate RMS AC Voltage of single phase MOSFET based full Bridge inverter.

VI Semester

ELM111	Electric Vehicles			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs
Prerequisites							

Course Objective

1. To verify the impact of electric vehicle on the environment
2. To study the vehicle dynamics and Energy storage systems
3. To analyze the performance of conventional hybrid powertrains
4. To identify the size of machines and the allied power electronics converter

Course Outcome

Students will be able to

a) Understand the emission regulations and standards, drive cycles
b) Analyze the parameters involved in vehicle dynamics and energy storage systems
c) Understand the importance of hybrid electric vehicles
d) Select electric drive and suitable power electronic converter

UNIT I : Electromobility and the Environment

Introduction of IC Engines,History of Electric Powertrain, History of Electric Car, Growing of Electric Powertrain, Energy sources of propulsion and emissions, carbon emission of fuels, Regulations of emissions, Impact of greenhouse gases, Heavy duty Vehicle Regulations, Drive cycles, Battery Electric Vehicle (BEV), fuel consumption, range and miles per gallon or equivalent (MPGe), Environmental Protection Agency (EPA) drive cycles, overview of conventional, battery, hybrid and fuel cell electric system

UNIT II : Vehicle Dynamics

Vehicle load forces, basic power, energy and speed relationships, aerodynamic drag and fuel consumption (numerical), rolling resistance (numerical), vehicle road-load coefficients, gradability, downgrade force and regenerative braking (numerical), vehicle acceleration, traction motor characteristics.

BLDC Motor

Equivalent circuit, forward and reverse mode operation of permanent magnet direct current (PMDC) machine (numerical), power loss and efficiency (numerical), maximum speed using PMDC (numerical).

UNIT III : Energy Storage Systems

Battery

Introduction to batteries, types and battery packs, operation and capacity rate (numerical), battery parameters and comparisons (numerical), battery size of BEV and Hybrid Electric Vehicle (HEV), (numerical), battery protection and management system, battery charging and discharging (numerical), operating curves.

Fuel Cells

Introduction, emission regulations, no-load and on-load voltages, full-load power and efficiency, characteristic curves, size of fuel cell (numerical), boost DC-DC converter, fuel economy of fuel cell electric vehicle (numerical).

UNIT IV : **Conventional Hybrid Powertrains**

Introduction to HEVs, brake specific fuel consumption (numerical), compare conventional, series, series-parallel hybrid system, fuel economy of series and series-parallel HEVs (numerical), use of planetary gear

UNIT V: Traction Machine

Four Quadrant operation, rated parameters (numerical), characteristic curves, constant torque and power mode, maximum speed mode.

UNIT VI: Induction Machine and DC-DC Converter

Induction Machine

Magnetic field and flux density, space vector current and rotating magnetic field, machine model and steady state operation, motoring at rated speed using induction machine (numerical), variable speed operation, stall and start-up using induction machine (numerical), various tests (DC resistance, locked rotor and No-load test).

DC-DC Converter

Introduction, power conversion, basic topology, half-bridge buck-boost bidirectional converter and buck converter, buck converter in continuous conduction mode (CCM) and discontinuous conduction mode (DCM) operation (numerical), conduction losses of IGBT and diode, capacitor sizing (numerical), two-phase interleaved boost converter (numerical).

Text Books:

	Title	Edition	Author	Publisher
1	Electric Powertrain-Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles	2018	John G. Hayes	John Wiley & Sons

VI Semester

ELM112	Electrical Drives			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
*Best Two out of three MSE's would be considered	15	15	15	30	40	100	3 Hrs
Prerequisites							

Course Objective:

1. After studying Electrical machines this subject elaborates applications of different machines in industry.
2. Characteristics under starting, running braking and speed control of different motors are explained. Programmable logic controller, contactors, tractions is also explained.

Course Outcome

Students will be able to

1) Classify and compare characteristics of AC and DC motors to interpret application of motors in electrical drives.
2) Apply Selection criteria for electrical drives by adapting electrical and mechanical characteristics of motor.
3) Categorize and compare contactors and relays for application of control circuit.
4) Explain the applications of PLCs in electrical drives and compare and assess control of electrical drive.
5)Estimate and adapt different motors for traction work.

UNIT I : Introduction to Drives and Speed Control

Definition of a Drive, Classification of Drives, Brief idea about drives commonly used in industries, Types of Electrical braking, Speed Control of AC and DC motors.

UNIT II : Selection of motors

Selection of motors and bearings of motor: Power, Flywheel effect, Duty cycles of motor, transmission, enclosure systems for drives.

UNIT III : AC and DC contactor and relays

AC and DC contactor and relays: Limit Switches, magnetic structure, operation, control circuit for automatic starting and braking of DC motor and three phase induction motor

UNIT IV : Programmable Logic Controllers

Programmable Logic Controllers (PLC), programming methods, Ladder programming with few

examples, Applications of PLC's.

UNIT V: Traction motors

Traction motors: Motors in AC/DC traction and their performance and desirable characteristics, Speed time characteristics of train,. Series parallel control, Starting and braking of traction motor.

UNIT VI: Digital speed control of Electric motors

Digital speed control of Electric motors, comparison with Analog method of speed control, Block Diagram arrangement for microprocessor based speed control of AC/DC motor, Flowcharts and algorithms for speed control and speed reversal of motor. Energy conservation in Electrical Drives

Text Books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	A Course in Electrical Power	1st-2005	Soni, Gupta, Bhatnagar	Dhanpat Rai and Company
2	Magnetic control of motors	Industrial New York 1947	Heumann	Chapman and Hall
3	Introduction to Programmable Logic Controllers	3rd Edition, 2008.	Gary Dunning	Cengage Learning

Reference books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Modern Electric Traction	**4th -2005**	H. Pratap	DhanpatRai and Company
2	Modern utilization of traction motor	2003	J.B. Gupta	
3	A Textbook of Electrical Technology Volume III Transmission, Distribution, Utilization		B.L.Theraja, A.K.Theraja	S.Chand

VI Semester

ELM113	Lab: Electrical Drives				L= 0	T = 0	P = 2	Credits = 1
Evaluation Scheme	MSPA 1	MSPA 2	MSPA 3	MSPA 4	TA*	ESE	Total	ESE Duration
	--	--	--	--	60	40	100	
Prerequisites								

Course Objective:

1. After studying Electrical machines this subject elaborates applications of different machines in industry.
2. Characteristics under starting, running braking and speed control of different motors are explained. Programmable logic controller, contactors, tractions is also explained.

Course Outcome

Students will be able to

1. Evaluate and explain different types of starter and their working
2. Categorize different types AC and DC contactor
3. Explain different types limit switch, sensor
4. To design ladder programming in PLC

S.N	Name of Experiment
1	To evaluate and explain the control circuit of star delta starter.
2	To evaluate and explain control circuit of direct online starter (DOL)
3	To explain function of side rotary limit switch.
4	To categorize different types contactors.
5	To classify and explain programming logic control (PLC) M-1200, M-1400 and LOG PLC.
6	To make use of operating limit switch to turn ON contactor (output device).
7	To design ladder programming in PLC to control lamp.
8	To design ladder programming using LOGO PLC to control lamp.
9	To explain Implementation of timer using LOGO PLC.
10	To design ladder programming in PLC to Control of lamps in pre defined sequence.
11	To design a program for Reversal of synchronous motor using PLC
12	To make use of limit switch, and sensors to turn ON contactor motor, lamp.

VII Semester

ELM121	Energy Storage Systems			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme *Best Two out of three MSE's would be considered	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs
Prerequisites							

Course Objective:

- To enable students to explore about energy storage systems, its advancements and its applications.
- To Acquire knowledge pertaining to various ways to store energy, its analysis and use.

Course Outcome

Students will be able to

1. Describe the functions of energy storages, their sizing, and applications.
2. Explain electrochemical and mechanical energy storage.
3. Analyse the function and use of flywheel, fuel cells storage.
4. Illustrate battery hybridization, recycling, battery management systems=

UNIT I : Introduction to Energy Storage for Power Systems: Role of energy storage systems, applications. Overview of energy storage technologies: Thermal, Mechanical, Chemical, Electrochemical, Electrical. Efficiency of energy storage systems. Storage in the Fuel Distribution System

UNIT II : Energy storage in electric vehicles: Classification of ES systems, Mechanical Energy storage, Hybrid storage systems for vehicles, issues and challenges

UNIT III : Electromagnetic Energy Storage: Introduction, Energy storage in capacitors, electrochemical charge storage mechanisms. Transient behaviour of a capacitor modelling, super capacitor technology.

UNIT IV :

Battery Energy Storage System: Fundamental concept of batteries, battery performance, charging and discharging of a battery, storage density, energy density, and safety issues Components of a Battery Energy Storage System, Battery Chemistry, : Low power and High-power Batteries, battery charging : constant voltage and constant current;

UNIT V: Thermo-electricity, Thermo electric generators, Fuel cell, Use of power electronic converters in energy storage
UNIT VI: Energy storage systems supporting grid power and transportation, Hybrid systems, flywheel storage.

Text Books:				
	Title	**Edition**	**Author**	**Publisher**
1	Energy storage	Vol. 406.	Huggins, Robert Alan	New York: Springer, 2010
2	Energy Storage for Power Systems		Ter-Gazarian	Institution of Engineering and Technology, 1994.

*In Laboratory courses TA=MSPA 1+MSPA 2+MSPA 3+MSPA 4= 60 marks