

Faculty of Engineering & Technology
KAKATIYA UNIVERSITY, WARANGAL-506 009
Department of Mechanical Engineering

B. Tech. (Mechanical) VIII SEMESTER

S.no	Course Code	Course Title	Scheme of Instruction			Lecture Hrs/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1.	PC4201ME	Industry 4.0	3	-	-	3	30	70	3
2.	PEC V*	Professional Elective -V	3	-	-	3	30	70	3
3.	PEC VI*	Professional Elective -VI	3	-	-	3	30	70	3
4.	PW4208ME	PROJECT WORK-II	-	-	14	14	150	100	7
5.	MC	Mandatory Non Credit course	2	-	-	2	30	-	-
		Total	11	-	14	25	270	310	16

*** (PE-V) PROFESSIONAL ELECTIVE COURSE -V**

PE4202 ME	Non Destructive Testing
PE4203 ME	Total Quality Management
PE4204 ME	Tribology

*** (PE-VI) PROFESSIONAL ELECTIVE COURSE -VI**

PE4205 ME	Automobile Engineering
PE4206 ME	Micro Electro-Mechanical Systems
PE4207 ME	Industrial Robotics

*** (HS MC) Mandatory Non Credit Course**

MC 42a HS	Yoga Practice
MC 42b HS	NSS

B. Tech. (ME) VIII SEMESTER
PC4201ME INDUSTRY 4.0
(Professional Core Course)

Course code	PC4201ME				
Category	Professional Core Course				
Course title	Industry 4.0				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Introduction to Industry 4.0: Industrial revolutions; Industry 4.0-origin concept, characteristics, challenges for transformation, drivers, the value chain, benefits, current state of industry 4.0.

Conceptual Framework for Industry 4.0: Industry 4.0- design principles, supportive technologies, framework of Industry 4.0; lean production system for industry 4.0, automated based lean production applications; Impact of industry 4.0: society, business, government, and people.

UNIT-II

Smart Factories: Smart factory, smart factories in action, importance of smart manufacturing; Real World Smart Factories - GE's brilliant factory, Airbus: smart tools and smart apps, Siemen's Amberg Electronics Plant (EWA); Industry 4.0: The way forward.

Industrial Artificial Intelligence: Artificial Intelligence (AI) -history, environment and societal influences, application, domains and tools, associated technologies, prospects of AI, challenges of industrial artificial intelligence.

UNIT-III

Introduction to Robotics: Types of robots, Overview of robot subsystems, Robot specifications, joints and its types, types of links, Degrees of freedom of robots, accuracy, precision, resolution and repeatability, Robot classification: kinematic configurations, actuators, control mechanisms, concept of workspace, End effectors and Grippers, Mechanical, Electrical, vacuum and other methods of gripping. Applications of robots, specifications of different industrial

UNIT – IV

Robotics in the Era of Industry 4.0: Recent technological components of robots-advanced sensor technologies, Internet of Robotic Things (IoRT), cloud robotics, cognitive architecture for cyber physical robotics; Industrial robotic applications- manufacturing, maintenance, and assembly.

Role of Augmented Reality (AR) in Industry 4.0: AR hardware and software technology, industrial applications of AR.

UNIT-V

Introduction to Industrial Internet of Things(IIoT): conceptual frame work, architecture, design principles and needed capabilities, IoT enabling technologies, sensing, actuation, basics of networking, M2M communication, devices and gateways, role of cloud in IoT.

Applications of IIoT: manufacturing, healthcare, education, aerospace, defense, agriculture, transportation, and logistics;

Suggested Readings:

1. Alp Ustundag and Emre Cevikcan, “*Industry 4.0: Managing the Digital Transformation* springer series in Advanced Manufacturing”, 1st edn., Springer, 2018. (Chapters 1 to 8)
2. Raj Kamal, “*Internet of Things: Architecture and Design*”, 1st edn., McGraw Hill Education (India) Private Limited, Chennai, 2018. (Chapters 1,2,7,8)

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B. Tech. (ME) VIII SEMISTER
PE4202ME Non Destructive Testing
(Professional Elective-IV)

Course code	PE4202ME				
Category	Professional Elective Course				
Course title	Non Destructive Testing				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

Unit I

Non Destructive Testing's: Introduction, Objectives, Types Of NDT.

Liquid Penetrant Inspection: Principles of penetrant inspection, characteristics of a penetrant, water –washable system, post-emulsification system, solvent-removable system, surface preparation and cleaning, Penetrant application, Development, Advantages limitations, and applications.

Unit II

Magnetic Particle Inspection: Principle, Magnetization methods, continuous and residual methods, sensitivities, Demagnetization, Magnetic particles, Applications, Advantages and limitations.

Eddy Current Testing: Principle, Lift-off factor, and edge effects, Skin effect, Inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

Unit III

Ultrasonic Testing: Generation of ultra sound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, Display systems, Probe construction, type of display, Inspection techniques, Identification of defects, Immersion testing, Sensitivity & calibration. Reference standards. Surface condition, Applications.

Unit IV

Radiography: Principle and uses of Radiography, limitations, Principle, Radiation sources, Production of X-rays, x-ray spectra, Attenuation of radiation, Radiographic equivalence, Shadow formation, enlargement and distortion, Radiographic film and paper, Xeroradiography, fluoroscopy, Exposure factors, Radiographic screens, identification markers and image quality indicators, Inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, Radiation hazard, Protection against radiation, measurement of radiation received by personnel.

Unit V

Acoustic Emission: Physical Principles, Sources of emission, instrumentation and applications.

Other NDT Techniques: Neutron radiography, Laser induced Ultrasonics, Surface analysis, Thermography.

Suggested References:

1. Barry Hull & Vernon John, "Non Destructive Testing", 1988.
2. HJ.Frissell (Editorial Co-Ordinator) - "Non-Destructive Evaluation and Quality Control"
ASM Hand Book - International Publication, USA, 1989.
3. Dove and Adams, "Experimental stress analysis and motion measurement", Prentice Hall of India, Delhi.

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B. Tech. (ME) VIII SEMISTER
PE4203ME Total Quality Management
(Professional Elective-IV)

Course code	PE4203ME				
Category	Professional Elective Course				
Course title	Total Quality Management				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Evolution of Quality-Historical Perspective: Basic Concepts of Quality, Vision, Mission and Objectives of an Organization, Corporate Structure in an Organization and Role of Quality. Quality Planning, Quality by Design, Quality Costs and Cost of Failure, Waste Control, How Quality Benefits Business.

UNIT-II

Quality and Competitiveness in Business: Zero Defects and Continuous Improvement, Role of Leadership and Commitment in Quality Deployment, Team Building, Motivation and Rewards, Total Employee Empowerment, Quality Functions-Measurement, Inspection, Testing, Calibration and Assurance.

UNIT-III

Design Control and Conformity: Tolerance and Variability, PDCA Cycle, Edward Demings, Juran, Philip Crosby approaches, Customers Requirements, Customer Supplier and Chain Links, Establishing Customer Focus, Customer Satisfaction, Measurement and Customer Retention

UNIT-IV

Total Quality Concepts: Product Liability, and CWQC, Difference in Western and Japanese Approach of TQM, Basic Philosophy and Fundamental Models of TQM, Total Quality and Ethics

UNIT-V

Internal Policies and Total Quality Management: Quality Culture, Education and Training Implementing Total Quality Management- An Integrated System Approach Total Preventive Maintenance. Self-Assessment, International/National Quality Awards: Malcolm Baldrige Award, Deming Prize, European Award, Rajeev Gandhi Award, CII Exim Award, Jamna Lal Bajaj Award, Golden Peacock Award

Suggested Reading:

1. Total Quality Management by N.V.RNaidu, G. Rajendra New Age International, First Edition Jan 2006
2. Total Quality Management by R.S Naagarazan, New Age international,3e, 2015
3. Quality Control & Application by B. L.H anson&P. M. Ghare, Prentice Hall of India, 2004.
4. Total Quality Management by V.S Bagad Technical Publications, First Edition, Jan2008
5. Total Quality Management by S. Rajaram Dreamtech Press, First Edition,Jan2008

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B. Tech. (ME) VIII SEMISTER
PE4204ME Tribology
(Professional Elective-IV)

Course code	PE4204ME				
Category	Professional Elective Course				
Course title	Tribology				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

Study of Various Parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature dependent variation, viscosity index, determination of viscosity, different viscometers used.

Hydrostatic Lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT – II

Hydrodynamic Theory of Lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro-dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing.

UNIT – III

Friction and Power Losses in Journal Bearings: Calibration of friction loss, friction in concentric bearings, bearing modulus, Sommer-field number, heat balance, practical considerations of journal bearing design

UNIT – IV

Air Lubricated Bearing: Advantages and disadvantages, application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect. Study of current concepts of boundary friction and dry friction.

UNIT- V

Types of Bearing Oil Pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. Bearing materials: General requirements of bearing materials, types of bearing materials.

Suggested Readings:

1. Engineering Tribology/ Gwidon W. Stachowiak & Andrew W. Batchelor/ Elsevier
2. Engineering Tribology/ Prasanta Sahoo / PHI
3. Tribology – B.C. Majumdar
4. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja/PHI
5. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co

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B. Tech. (ME) VIII SEMESTER
PE4205ME Automobile Engineering
(Professional Elective-VI)

Course code	PE4205ME				
Category	Professional Elective Course				
Course title	Automobile Engineering				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Automobile Body Construction: Automobile history and development, current scenario in Indian auto/ ancillary industries, Classification, types of chassis layout with reference to power source locations and drive, Vehicle frames, Various types of frames. Constructional details, Unitized frame body construction, Loads acting on vehicle frame, details of chassis material.

UNIT-II

Drive Train & Transmission: Classification of clutches: Single plate & with dual flywheel effect, Multi plate, Cone, diaphragm spring, Centrifugal. Clutch materials, Clutch plate: Electromagnetic, vacuum operated, Necessity of gear box, Manual gear box-Constant mesh, Sliding mesh, Synchromesh, Epicyclic, fluid flywheel, Torque convertor, Continuous variable transmission (CVT) , Propeller Shaft, Universal Joint, Differential and final drive

UNIT-III

Front & Rear Axle, Steering System, Wheel & Tyres Axle: Purpose and requirement of front & rear axle, live and dead axles types & arrangement, types of loads acting on rear axles, full floating, three quarter floating and semi floating rear axles. Steering System: Steering mechanism, steering geometry, cornering force, slip angle, scrub radius, steering characteristic, steering linkages & gearbox, power steering, collapsible steering, reversibility of steering, four wheel steering. Wheel and Tyres: Wheel construction, alloy wheel, wheel alignment and balancing, type of tyres, tyre construction, tyre materials, factors affecting tyre life

UNIT-IV

Suspension & Brakes System: Sprung and unsprung mass, types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydro gas, rubber suspension, interconnected suspension, self leveling suspension (active suspension), damping and shock absorbers Types of brake systems - drum, disc, operation-mechanical, hydraulic, air brakes, servo and power braking, hand brake, ABS.

UNIT-V

Alternative Energy Sources: Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles. Autonomous vehicles – current status of development

Suggested Reading:

1. Kirpal Singh, “Automobile Engineering, Vol I and II”, 12th Edition, Standard Publishers, 2011
2. S. Srinivasan, “Automotive Mechanics”, 2nd Edition, Tata McGraw Hill, 2003.
3. H. Heisler, “Vehicle and Engine Technology”, ELBS, 1965.
4. P.L. Kohli, “Automotive Electrical Equipment, Tata McGraw Hill, 1985.
5. William H. Crouse, Donald L. Anglin, “Automotive Mechanics”, 10th Ed., Tata McGraw Hill, 2007

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B. Tech. (ME) VIII SEMISTER
PE4206ME MICRO ELECTRO-MECHANICAL SYSTEMS
(Professional Elective-VI)

Course code	PE4206ME				
Category	Professional Elective Course				
Course title	Micro Electro Mechanical Systems				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT – I

Introduction to MEMS: MEMS and micro system products, evolution of micro-fabrication, micro systems and miniaturization, application of micro systems in industrial products and telecommunications

Working Principles of Microsystems: micro-sensors, micro-actuation, MEMS with micro-actuators, micro-accelerators and micro-fluidics

UNIT –II

Materials for MEMS and Microsystems: Substrates and wafers, active substrate materials, silicon compounds, silicon piezo resistors, gallium arsenide, quartz, piezoelectric crystals, polymers and packaging materials

Scaling Laws in Miniaturization: scaling- geometry, rigid-body dynamics, electrostatic forces, electromagnetic forces, electricity, fluid mechanics and heat transfer

UNIT– III

Micro System Fabrication Processes: photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition-sputtering, deposition by epitaxy, etching;

Micro manufacturing: bulk micro manufacturing, surface micromachining and LIGA (Lithographie, Galvano formung, Abformung) process

UNIT– IV

Microsystems Design: ions and ionization, doping of semiconductors, diffusion process, plasma physics, electrochemistry, and quantum physics, design considerations, design constraints, selection of materials, manufacturing processes, signal transduction, electromechanical system and Computer Aided Design of micro systems

UNIT – V

MEMS Structures and Devices: Pressure sensors-Accelerometers-Gyroscopes-RF MEMS Switch-Temperature sensors Humidity sensors.

Micro Actuators: Electrostatic–piezoelectric–SMA–Thermo electric electromagnetic. Micro pumps –micro valves.

Suggested Readings

1. Tai-Ran Hsu, MEMS and Microsystems: Design, Manufacture and nano scale engineering, 2nd ed., John Wiley & Sons, New Jersey, 2008.
2. MEMS & Microsystems Design and Manufacture/ Tai-Ran Hsu/ Tata McGraw Hill
3. Micro electro mechanical Systems / Bhattacharyya / Cengage

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B. Tech. (ME) VIII SEMISTER
PE4207 ME Industrial Robotics
(Professional Elective-VI)

Course code	PE4207ME				
Category	Professional Elective Course				
Course title	Industrial Robotics				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	3	-	-	3	External Marks = 70

UNIT-I

Introduction: Automation in robotics, Asimov's laws of robotics

Components of The Robot: Controller/logic function, teach pendant/interface, manipulator, degrees of freedom, and axis numbering, base types.

Classification of Robots: Power source, geometry of the work envelope, drive systems: classification and operation, so classification, **End-of-arm tooling:** multiple tooling, positioning of EOAT,

UNIT-II

Programming and File Management: Planning, subroutines, writing the program, testing and verifying, normal operation, file maintenance, **Automation sensors:** limit switches, proximity switches, tactile and impact sensors, temperature sensors, fluid sensors, position sensors, sound sensors, connection to the robot, sensor selection criteria; **vision systems:** components of a vision system, image analysis, lighting,

UNIT-III

Integration and Networking: Types of networks, communication protocols, integration; **Programmable Logic Controllers (PLCS) and Human-Machine Interfaces (HMIS):** Basic components of the PLC, operation of the PLC, human-machine interfaces, **Maintenance and Trouble Shooting:** Preventive maintenance, arc flash, troubleshooting, crash recovery, repair tips, parts swapping versus fixing the problem, precautions before running the robot

UNIT-IV

Robot Handling: The handling task, Robot characteristics for handling. **Robot assembly-**case studies Application characteristics. **Robot Welding-** The spot welding process, Robot spot welding, The robot task, The arc welding process , Robot MIG welding.- , **Machining with Robots. :** Application characteristics.-, Spray painting applications. The spray painting process.- Spray painting robot anatomy and characteristics.- , Programming techniques.- Innovative robot applications.in the automation of manufacturing processes., assembly automation.- applications in inspection

UNIT-V

Lean Manufacturing With Robotics for Low Volume: Small Batch Runs- Changeover for Small Batches, the Design of a Robotic Work-Cell, Automating the machining process, Automating the welding process and Automating the material removal process for small batch runs, Automating small batch runs for press tending and palletizing, automating the palletizing process for small batch runs, Tools for small batch and high changeover production

Lean Manufacturing with Robotics for High Volume: Large Batch Runs- Robotic Machine Tending for High Production, Robotic Cellular Manufacturing

Suggested Reading:

1. Keith Dinwiddie Industrial Robotics / Edition 1 by , Publisher: Cengage Learning
2. Rex Miller, Mark R. Miller Robots and Robotics: Principles, Systems, and Industrial Applications,
3. Groover MP (Author) Industrial Robotics Technology, Programming & Application, TataMcGraw Hill Education
4. Larry T. Ross, Stephen W. Fardo, and Michael F. Walach Industrial Robotics Fundamentals: Theory and Applications, 3rd Edition
5. Andrew Glaser Industrial Robotics Industrial Press publisher

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B. Tech. (ME) VIII SEMESTER
PW4208ME PROJECT WORK II
(Project Work)

Course code	PW4208 ME				
Category	Project Work				
Course title	Project Work II				
Scheme and Credits	L	T	P	Credits	Internal marks = 50
	-	-	14	7	External Marks = 100

The aim of project work -II is to implement and evaluate the proposal made as part of project - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The Department will appoint a project coordinator who will coordinate the following:

- Re-grouping of students - deletion of internship candidates from groups made as part of project work-I
- Re-Allotment of internship students to project guides
- Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 2nd week of VIII semester so that students get sufficient time for completion of the project. All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks will be awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction. Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

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B. Tech. (ME) VIII SEMESTER**MC 42a HS Yoga Practice****(Humanity Science Course)**

Course code	MC 42a HS				
Category	Humanity Science				
Course title	Yoga Practice				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	-	

UNIT – I

Introduction: Yoga definition, health definition from WHO, yoga versus health, basis of yoga, yoga is beyond science, Gist of eighteen chapters of Bhagavad-Gita, four types of yoga: Karma, Bhakti, Gnyana and Raja yoga, Internal and External yoga, elements of Ashtanga yoga (Yama, Niyama, Asana, Pranayama, Prathyahara, Dharana, Dhyana and Samadhi), Pancha koshas and their purification through Asana, Pranayama and Dhyana.

UNIT – II

Surya namaskaras (Sun Salutations): Definition of sun salutations, seven chakras (Mooladhaar, Swadhishtaan, Manipura, Anahata, Vishuddhi, Agnya and Sahasrar), various manthras (Om Mitraya, Om Ravaye, Om Suryaya, Om Bhanave, Om Marichaye, Om Khagaye, Om Pushne, Om Hiranya Garbhaye, Om Adhityaya, Om Savitre, Om Arkhaya, and Om Bhaskaraya) and their meaning while performing sun salutations, physiology, seven systems of human anatomy, significance of performing sun salutations.

UNIT – III

Asanas (Postures): Pathanjali's definition of asana, sthiram sukham asanam, 3rd limb of Ashtanga yoga, loosening or warming up exercises, sequence of perform in asanas (standing, sitting, prone, supine and inverted), nomenclature of asanas (animals, trees, rishis and so on), asanas versus chakras, asanas versus systems, asanas versus physical health, activation of Annamaya kosha.

UNIT – IV

Pranayama (Breathing Techniques): Definition of Pranayama as per Shankaracharya, 4th limb of Ashtanga yoga, various techniques of breathing, Pranayama techniques versus seasons, bandhas and their significance in Pranayama, mudras and their significance in Pranayama, restrictions of applying bandhas with reference to health disorders, Pranayama versus concentration, pranayama is the bridge between mind and body, pranayam versus mental health, activation of Pranamaya kosha through Pranayama.

UNIT – V

Dhyana (Meditation): Definition of meditation, 7th limb of Ashtanga yoga, types of mind (Conscious and Sub-Conscious), various types of dhyana. Meditation versus spiritual health, Dharana and Dhyana, extention of Dhyana to Samadhi, Dhyana and mental stress, activation of Manomaya kosha through dhyana, silencing the mind.

Suggested Readings:

1. *Light on Yoga* by BKS Iyengar.
2. *Yoga Education for Children, Vol-1* by Swami Satyananda Saraswati.
3. *Light on Pranayama* by BKS Iyengar.
4. *Asana Pranayama Mudra and Bandha* by Swami Satyananda Saraswati.
5. *Hatha Yoga Pradipika* by Swami Mukhtibodhananda.
6. *Yoga education for children, Vol-11* by Swami Niranjanananda Saraswati.
7. *Dynamics of Yoga* by Swami Satyananda Saraswati.

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B. Tech. (ME) VIII SEMESTER
MC 42b HS NSS
(Humanity Science Course)

Course code	MC 42b HS				
Category	Humanity Science				
Course title	NSS				
Scheme and Credits	L	T	P	Credits	Internal marks = 30
	2	-	-	-	

List of Activities:

1. Orientation programme about the role of NSS in societal development.
2. Swachh Bharat Program.
3. Guest lectures from eminent personalities on personality development.
4. Plantation of saplings/Haritha Haram Program.
5. Blood Donation / Blood Grouping Camp.
6. Imparting computer education to school children.
7. Creating Awareness among students on the importance of Digital transactions.
8. Stress management techniques.
9. Health Check-up Activities.
10. Observation of Important days like Voters' day, World Water Day and so on.
11. Road Safety Awareness Programs.
12. Energy Conservation Activities
13. Conducting Programs on effective communication skills.
14. Awareness programs on national integration.
15. Orientation on Improving Entrepreneurial Skills.
16. Developing Effective Leadership skills.
17. Job opportunity awareness programs in various defense, public sector undertakings.
18. Skill Development Program.
19. Creating awareness among students on the Importance of Yoga and other physical activities.
20. Creating awareness among students on various government sponsored social welfare schemes for the people.

Note: At least Ten Activities should be conducted in the Semester. Each event conducted under Swachh Bharat, Plantation and important days like Voters' day, world water day may be treated as a separate activity