VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

3rd to 8th Semester BE Mechatronics

Scheme of Teaching and Examinations
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018 – 2019)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. In MECHATRONICS

Scheme of Teaching and Examination 2018 – 19

Outcome Based Education(OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2018 – 19)

III SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT31	Transform calculus, Fourier series and Numerical techniques	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18MT 32	Material science and Technology		3	0	--	03	40	60	100	3
3	PCC	18 MT 33	Mechanics of materials		3	2	--	03	40	60	100	4
4	PCC	18 MT 34	Control Systems		3	2	--	03	40	60	100	3
5	PCC	18 MT 35	Analog and Digital Electronics		3	0	--	03	40	60	100	3
6	PCC	18 MT 36	Computer Organization		3	0	--	03	40	60	100	3
7	PCC	18 MT L37	Machine shop and material Testing lab		--	2	2	03	40	60	100	2
8	PCC	18 MT L38	Analog and digital electronics lab		--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Vyavaharika Kannada (Kannada for communication)/	HSMC	--	2	--	--	100	--	100	1
		18KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		18CPC39/49	Constitution of India, Professional Ethics and Cyber Law		1	--	--	02	40	60		
					Examination is by objective type questions							
				TOTAL	**17 OR 18**	**10 OR 12**	**04**	**24 OR 26**	**420 OR 360**	**480 OR 540**	**900**	**24**

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39 Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and 18KAK39 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	NCMC	18MATDIP31	Additional Mathematics - I	Mathematics	02	01	--	03	40	60	100	0

The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B. Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/ fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the students have to fulfil the requirements during subsequent semester/s to appear for SEE.

These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE Activity Points to be earned by students admitted to BE/B. Tech/B. Plan day college programme (For more details refer to Chapter 6,AICTE Activity Point Programme, Model Internship Guidelines):

Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eighth semester Grade Card.

The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.

In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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B.E. In MECHATRONICS
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IV SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT41	Complex analysis, probability and statistical methods	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18MT42	Fluid mechanics and machines		3	2	--	03	40	60	100	4
3	PCC	18 MT 43	Microcontroller		3	2	--	03	40	60	100	3
4	PCC	18 MT 44	Manufacturing technology		3	0	--	03	40	60	100	3
5	PCC	18 MT 45	Theory of Machines		3	2	--	03	40	60	100	3
6	PCC	18 MT 46	Instrumentation and measurements		3	0	--	03	40	60	100	3
7	PCC	18 MT L47	FM and pneumatic - Laboratory		--	2	2	03	40	60	100	2
8	PCC	18 MT L48	Microcontroller – Laboratory(BV)		--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Vyavaharika Kannada (Kannada for communication)	HSMC	--	2	--	--	100	--	100	1
		18KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		18CPC39/49	Constitution of India, Professional Ethics and Cyber Law		1	--	--	02	40	60		
					Examination is by objective type questions							
				TOTAL	**17**	**12**	**04**	**24**	**420**	**480**	**900**	**24**
					OR	**OR**		**OR**	**OR**	**OR**		
					18	**14**		**26**	**360**	**540**		

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39/49 Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and 18KAK39/49 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	NCMC	18MATDIP41	Additional Mathematics – II	Mathematics	02	01	--	03	40	60	100	0

((a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B. Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/ fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the student have to Fulfill the requirements during subsequent semester/s to appear for SEE.
(b) These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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V SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	**HSMC**	**18MT51**	**Technological Innovation Management And Entrepreneurship**		3	0	--	03	40	60	100	3
2	PCC	18 MT52	Design and analysis of Machine Elements		3	2	--	03	40	60	100	4
3	PCC	18 MT53	Virtual Instrumentation		3	2	--	03	40	60	100	4
4	PCC	18 MT54	Hydraulics and Pneumatics		3	--	--	03	40	60	100	3
5	PCC	18 MT55	Micro and Smart Systems Technology		3	--	--	03	40	60	100	3
6	PCC	18 MT56	Wireless Networks & Communication		3	--	--	03	40	60	100	3
7	PCC	18 MTL57	Virtual Instrumentation-Laboratory		--	2	2	03	40	60	100	2
8	PCC	18 MTL58	MSST -Laboratory		--	2	2	03	40	60	100	2
9	HSMC	18CIV59	Environmental Studies	Civil/ Environmental [Paper setting: Civil Engineering Board]	1	--	--	02	40	60	100	1
				TOTAL	**19**	**08**	**04**	**26**	**360**	**540**	**900**	**25**

Note: PCC: Professional Core, HSMC: Humanity and Social Science.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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VI SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory /	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18 MT61	PLC & SCADA		3	2	--	03	40	60	100	4
2	PCC	18 MT62	Power Electronics		3	2	--	03	40	60	100	4
3	PCC	18 MT63	Computer Aided Machine Drawing		1	0	4	03	40	60	100	4
4	PEC	18 MT64X	Professional Elective -1		3	--	--	03	40	60	100	3
5	OEC	18XX65X	Open Elective –A		3	--	--	03	40	60	100	3
6	PCC	18 MTL66	PLC and SCADA- Laboratory		--	2	2	03	40	60	100	2
7	PCC	18 MTL67	Power electronics - Laboratory		--	2	2	03	40	60	100	2
8	MP	18MTM,P68	Mini-project		--	--	2	03	40	60	100	2
9	Internship	--	Internship	To be carried out during the vacation/s of VI and VII semesters and /or VII and VIII semesters.								
				TOTAL	**13**	**08**	**10**	**24**	**320**	**480**	**800**	**24**

Note: PCC: Professional core, PEC: Professional Elective, OE: Open Elective, MP: Mini-project.

Professional Elective -1

Course code under 18MT64X	Course Title
18 MT641	Modeling And Simulation
18 MT642	Rapid Prototyping
18 MT643	Artificial neural network
18 MT644	Satellite Communication
18 MT645	Computer Integrated Manufacturing

Open Elective –A

18 MT651 Robotics and Automation, 18 MT652 Process Instrumentation

Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department (Please refer to the list of open electives under 18XX65X).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the program.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the program

Registration to electives shall be documented under the guidance of Program Coordinator/ Advisor/Mentor.

Mini-project work:
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guidesof the college.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belongs to.

Internship: All the students admitted to III year of BE/B. Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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VII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18MT71	Industrial Robotics		3	--	--	03	40	60	100	3
2	PCC	18 MT72	Thermal Engineering		3	2	--	03	40	60	100	3
3	PEC	18 MT73X	Professional Elective - 2		3	--	--	03	40	60	100	3
4	PEC	18 MT74X	Professional Elective - 3		3	--	--	03	40	60	100	3
5	OEC	18 MT75X	Open Elective -B		3	--	--	03	40	60	100	3
6	PCC	18 MTL76	Robotics Lab		--	2	2	03	40	60	100	2
7	PCC	18 MTL77	Thermal -Laboratory		--	2	2	03	40	60	100	2
8	Project	18 MTP78	Project Work Phase - 1		--	--	2	--	100	--	100	1
9	Internship	--	Internship	(If not completed during the vacation of VI and VII semesters, it shall be carried out during the vacation of VII and VIII semesters)								
				TOTAL	**15**	**04**	**06**	**21**	**380**	**420**	**800**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective - 2

Course code under 18MT73X	Course Title
18 MT731	Automation In Process Control
18 MT732	Signal Process
18 MT733	Real Time Systems
18 MT734	OOPS using C++
18 MT735	Analytical Instrumentation

Professional Electives - 3

Course code under 18MT74X	Course Title
18 MT741	Finite element analysis.
18 MT742	Machine Learning
18 MT743	Artificial Intelligence
18 MT744	Digital Image Processing
18 MT745	Mechanical vibration

Open Elective –B

(i) 18 MT751 Biomedical Signal Processing

(ii) 18 MT752 Mechatronics system design

Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department (Please refer to the list of open electives under 18MT75X).

Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the program.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the program.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Project work:

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

CIE procedure for Project Work Phase - 1:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the Project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

Internship: All the students admitted to III year of BE/B. Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship Requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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VIII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18MT81	Automotive Electronics & Hybrid Vehicles		4	--	--	03	40	60	100	3
2	PEC	18MT82X	Professional Elective - 4		3	--	--	03	40	60	100	3
3	Project	18MTP83	Project Work		--	--	2	03	40	60	100	8
4	Seminar	18MTS84	Technical Seminar		--	--	2	03	100	--	100	1
5	Internship	18MTI85	Internship	Completed during the vacation/s of VI and VII semesters and /or VII and VIII semesters.)				03	40	60	100	3
TOTAL					**06**	**--**	**04**	**15**	**260**	**240**	**500**	**18**

Note: PCC: Professional Core, PEC: Professional Elective.

Professional Electives - 4

Course code under 18XX82X	Course Title
18 MT821	Operation Research.
18 MT822	Communication system
18 MT823	Digital Control System
18 MT824	Management Information Systems
18 MT825	Radar Engineering

Project Work

CIE procedure for Project Work Phase - 2:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Project Work Phase - 2:

(i) Single discipline: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belongs to.

Internship: Those, who have not pursued /completed the internship, shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

Activity points of the students who have earned the prescribed AICTE activity Points shall be sent the University along with the CIE marks of 8th semester. In case of students who have not satisfied the AICTE activity Points at the end of eighth semester, the column under activity Points shall be marked NSAP (Not Satisfied Activity Points).

VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELAGAVI

3rd to 8th Semester BE Mechatronics

Scheme of Teaching and Examinations

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

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B.E: Mechatronics Engineering

Program Outcomes (POs)

At the end of the B.E program, students are expected to have developed the following outcomes.

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes (PSOs)

At the end of the B.E Electronics & Communication Engineering program, students are expected to have developed the following program specific outcomes.

PSO1: Have a thorough knowledge of design, analysis and modeling of mechanical components, concepts of fluid and thermal engineering, conventional and advanced manufacturing technology in engineering applications.

PSO2: Be able to analyze, design and prototyping of electronics, communication and embedded systems.

PSO3: Be able to apply domain knowledge and demonstrate technical competency in virtual instrumentation, PLC, SCADA, smart systems, artificial intelligence to integrate and interface electro-mechanical systems.

Note

1. The Course Outcomes and RBT levels indicated for each course in the syllabus are indicative/suggestive. The faculty can set them appropriately according to their lesson plan.

2. The Question Paper format for the theory courses is as follows:

Question Paper Pattern for Theory Courses (2018 Scheme):

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60

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III SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT31	Mathematics (Title as per the decision of BoS in Sciences)	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18MT 32	Material science and Technology		3	0	--	03	40	60	100	3
3	PCC	18 MT 33	Mechanics of materials		3	2	--	03	40	60	100	4
4	PCC	18 MT 34	Control Systems		3	2	--	03	40	60	100	3
5	PCC	18 MT 35	Analog and Digital Electronics		3	0	--	03	40	60	100	3
6	PCC	18 MT 36	Computer Organization		3	0	--	03	40	60	100	3
7	PCC	18 MT L37	Machine shop and material Testing lab		--	2	2	03	40	60	100	2
8	PCC	18 MT L38	Analog and digital electronics lab		--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Vyavaharika Kannada (Kannada for communication)/	HSMC	--	2	--	--	100	--	100	1
		18KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		18CPC39/49	Constitution of India, Professional Ethics and Cyber Law		1	--	--	03	40	60		
					Examination is by objective type questions							
TOTAL					17 OR 18	10 OR 12	04	24 OR 27	420 OR 360	480 OR 540	900	24

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39 Vyavaharika Kannada (Kannada for communication) is for non-kannada speaking, reading and writing students and 18KAK39 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write kannada.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	NCMC	18MATDIP31	Additional Mathematics - I	Mathematics	02	01	--	03	40	60	100	0

The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/ fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the students have to fulfill

the requirements during subsequent semester/s to appear for SEE.
These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and
Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE Activity Points to be earned by students admitted to BE/B.Tech/B. Plan day college programme (For more details refer to Chapter 6,AICTE Activity Point Programme, Model Internship Guidelines):
Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eighth semester Grade Card.
The activities can be can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

MATERIAL SCIENCE AND TECHNOLOGY
SEMESTER – III (MTE)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT32**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: This course will enable students to:

1. gain knowledge of Mechanical behavior of metals, composite materials and smart materials
2. Understand the mechanism of metallurgical process, manufacturing process of composites and working of smart sensors
3. Know applications of metallurgical process, production process of composites and smart materials for various engineering solutions.

Modules	RBT Level
Module – 1	
Mechanical Behavior : Stress- Strain diagram showing ductile and brittle behavior of materials, Liner and non-linear elastic behavior and properties, mechanical Properties in plastic range, Yield strength offset yield strength, ductility, ultimate tensile strength, toughness plastic deformation of single crystal by slip and twinning. Atomic diffusion, flick's laws of Diffusion, Factors attaching the Diffusion **Fracture:** Types, creep: Description of the phenomenon with examples, 3 stages of	**L1, L2, L3, L4**

creep properties, stress relaxation fatigue: types of fatigue lauding with examples, Mechanism of fatigue, Fatigue properties, Fatigue testing and S-N diagram.	
Module – 2	
Heat Treating of metals: TTT curves, Continuous cooling curves, Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austemparing, hardenability, Surface hardening methods like Carburizing, Cyaniding Nitriding, flame hardening and induction hardening, age hardening of aluminum and copper alloys. **Ferrous and non ferrous materials:** Properties composition and use of grey cush iron, malleable iron, SG iron and steel. Copper alloys- brasses and bronzes, aluminum alloys Al-Cu, Al-Si, Al-Zn alloys.	**L1, L2, L3, L4**
Module – 3	
Solidification and phase diagram: Mechanism of solidification, Homogenous and Heterogeneous nucleation. Cristal Growth, Cast metal strictures, Phase diagram. Solid solutions Substitution and Interstitial solid solution, Hume rothary rule, Intermediate phase, construction of equilibrium diagram involving complete and partial solubility, lever rule, Gibb's phase rule.	**L1 , L2 , L3**
Module – 4	
Composite materials: Definition, classification, type of matrix materials and reinforcements, advantages and application of composites. **Processing of FRP Composites:** Layup and curing, fabricating process, open and closed mould process, hand layup technique; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding. **Metal Matrix Composites:** Reinforcement materials, types, characteristics and selection, base metals selection. Need for MMC's and its application.	**L1, L2, L3, L4**
Module – 5	
Smart Materials: Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magnetoelectric Materials. Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Materials, Fiber-Optic Sensors**.** **Smart Sensor, Actuator and Transducer Technologies:** Smart Sensors: Accelerometers; Force Sensors; Load Cells; Torque Sensors; Pressure Sensors; Microphones; Impact Hammers	**L1, L2, L3, L4**

Course Outcomes: At the end of the course, the students will be able to

CO1: have knowledge of -Mechanical behavior of metals, Smart materials, composite materials, Alloys, Heat treatment process & phase diagrams.

CO2: understand the mechanism of various Metallurgical process & manufacturing process of composite materials & working of smart sensors,. CO3: application of metallurgical process, production process of composite & working principle of smart sensor for various engineering solutions.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
2. Mechanics of Composite Materials, Second Edition, Autar K. Kaw, CRC Press, 2005.
3. Smart Materials and Structures - M. V. Gandhi and B. So Thompson - Chapman & Hall, London; New York - 1992 (ISBN: 0412370107).
4. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001
5. Materials Science, Shackleford.,& M. K. Muralidhara, Pearson Publication – 2007.
6. "Material Science & Metallurgy For Engineers", Dr. V.D. Kodgire& S. V. Kodgire, Everest Publication.
7. "Mechanical Behavior & Testing Of Materials", A. K. Bhargava, C.P. Sharma.P H I Learning Private Ltd.

Reference Books:

1. An Introduction to Metallurgy; Alan Cottrell, Universities Press India Oriental Longman Pvt. Ltd., 1974.
2. Engineering Materials Science, W.C.Richards, PHI, 1965
3. Physical Metallurgy; Lakhtin, Mir Publications
4. Materials Science and Engineering, V.Raghavan,PHI, 2002
5. Elements of Materials Science and Engineering, H. VanVlack, Addison- Wesley Edn., 1998
6. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
7. The Science and Engineering of Materials, Donald R. Askland and Pradeep.P. Phule, Cengage Learning, 4th Ed., 2003.

MECHANICS OF MATERIALS
SEMESTER – III (MTE)
[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT33**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**05**	**SEE marks**	**60**
Total Number of Lecture Hours	**60(12 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 04

Course Objectives: Students will be able to

1. gain knowledge of linear elastic properties stress strain relations
2. Derive the stress strain equations in bars, beams, shafts, cylinders, columns subjected to external load.
3. compute the stress strain for bars, beams, shafts, and column

Modules	**RBT Level**
Module – 1	

Simple Stress and Strain: Introduction, Concept of Stress and Strain, Linear elasticity, Hooke's Law and Poisson's ratio. Extension / Shortening of a bar, bars with varying cross sections (step and tapering circular and rectangular), Elongation due to self weight, Principle of super position, St. Venant's Principle**.** **Simple shear stress and Shear strain. Volumetric strain:** expression for volumetric strain, Elastic Constants and relations. Stresses in Composite Section	**L1, L2, L3,**
Module – 2	
Compound Stresses: Introduction, Concept of Plane stress, Stress tensor for plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.	**L1, L2, L3,**
Module – 3	
Bending Moment and Shear Force in Beams: Introduction, Sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for Cantilever, simply supported and overhanging beams subjected to concentrated loads, uniformly distributed load (UDL), uniformly varying load (UVL) and couple, simple numerical.	**L1 , L2 ,L3,**
Module – 4	
Bending and Shear Stresses in Beams: Introduction, Theory of simple bending, assumptions in simple bending. General equation for bending. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, symmetrical I and T sections. (Composite / notched beams not included). **Deflection of Beams:** Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and Macaulay's method for simply supported beams for point load, UDL and Couple. (Simple Numericals)	**L1, L2, L3,**
Module – 5	
Torsion of Circular Shafts: Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts. **Elastic Stability of Columns:** Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.	**L1, L2, L3,**

Course Outcomes: At the end of the course, the students will be able to

CO1: Have knowledge of stress-strain relations in linear elastic members

CO2: Describe stress- strain equation for axial, bending and torsion loads.

CO3: Determine the stress & strain for simple stresses, compound stresses, beams, shafts & columns

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. "Mechanics of Materials", by R.C.Hibbeler, Prentice Hall. Pearson Edu., 2011.
2. "Mechanics of materials", James.M.Gere, Thomson, Eighth edition2013.

3. "Mechanics of materials", in SI Units, Ferdinand Beer & Russell Johston, 5th Ed., TATA McGraw Hill- 2003.
4. "Mechanics of Materials", K.V. Rao, G.C. Raju, Subhash Publication, Fourth Edition,

Reference Books:

1. "Strength of Materials", S.S. Rattan, Tata McGraw Hill, 2009.
2. "Strength of Materials", S.S.Bhavikatti, Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
3. "Engineering Mechanics of Solids", Egor.P. Popov, Pearson Edu. India, 2nd, Edition, 1998.
4. "Strength of Materials", W.A. Nash, 5th Ed., Schaum's Outline Series, Fourth Edition-2007.

CONTROL SYSTEMS
B.E, III Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS)

Course Code	**18MT34**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P)	**(3:2:0)**	**SEE Marks**	**60**
Credits	**04**	**Exam Hours**	**03**

Credits – 04

Course Objectives: Students will have to

- Students will have to the knowledge of fundamental concepts of Control systems, mathematical modeling of the system and to study
- Students will expose to the knowledge of the concept of time response and frequency response of the system and teach the basics of stability analysis time response and frequency response of the system of the system.
- Will be able to study stability of System

Module – 1	**RBT Level**
Modelling of Systems and Block diagram: Introduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modelling of physical systems- Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems, Analogous systems based on force voltage analogy and force current analogy. Introduction to Block diagram algebra. Numerical problems on all topics.	**L5**
Module – 2	
Signal Flow graph: Introduction to Signal Flow graph, Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula. **Time response analysis**: Introduction. Standard test signals, response of first order & second order systems for unit step input. Steady state errors & Error constants. Numerical problems on all topics.	L3

Module – 3	
Concepts of stability: The Concept of stability. Necessary conditions for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis using RH Criterion. **Frequency domain Analysis:** Introduction to frequency domain analysis, Correlation between time & frequency response	**L4**
Module – 4	
The Root Locus Technique: Introduction. Root locus concepts. Construction of root loci. Stability analysis using Root locus Technique Numerical problems on all topics**.** **Frequency domain Analysis**:Introduction to frequency domain analysis Bode plots	**L4**
Module – 5	
State space Analysis: Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase variables. Derivation of transfer functions from the state model. Numerical problems on all topics. **Solution of state equations:** Solutions of homogeneous and Nonhomogeneous state equations. Properties of state transition matrix, computation of state transition matrix by matrix exponential andLaplace transform method. Numerical problems	**L3**

Course outcomes:

students will:

1. Demonstrate the concepts of Control systems and its Specifications for mathematical modelling, feedback control and stability analysis in Time and Frequency domains
2. Express and solve system equations in state-variable form (state variable models), Identify open and closed loop control system to Solve Signal Flow graph and reduction of Block diagram
3. Apply root-locus and Routh–Hurwitz stability criterion technique to analyse and design control systems
4. Determine the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs Formulate mathematical modelling of physical systems(Mechanical and Electrical System)

TEXT BOOKS:

1. “Control Systems Engineering”, I.J. Nagarath and M. Gopal ,New Age International (P) Limited, Publishers, Fifth edition – 2012.
2. “Modern Control Engineering “, K. Ogata, Pearson Education Asia/ PHI, 4th Edition, 2002.

REFERENCE BOOKS:

1. “Automatic Control Systems”, Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008. 2. “Feedback and Control System”, Joseph J Distefano III et al., Schaum’s Outlines, TMH, 2nd Edition 2007.

B.E MECHATRONICS ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER - III

ANALOG & DIGITAL ELECTRONICS

Course Code	**18MT35**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P)	**(3:0:0)**	**SEE Marks**	**60**
Credits	**03**	**Exam Hours**	**03**

Course objectives: student will be able to

- Gain knowledge of Analog & Digital Electronic Circuits.
- Understand the behavior of Electronic Circuits.
- Derive the relations for Voltage Gain ,Frequency of Various Electronics Circuits
- Design Electronics Systems for various Applications.

Module-1	RBT level
Diode Applications: Positive ,negative and double ended shunt Clippers , Positive and negative Clampers .RC Coupled BJT Amplifier **Op-Amp active filters** : Introduction, Active filters, I order low pass filter: Design, frequency scaling, II order low pass filter: Design, I order high pass filters: Design, II order high pass filters: Design, wide Band pass filter, Narrow band pass filter, and Band reject filter: wide Band reject filter, Narrow band reject filter, All pass filter.	L1,L4
Module-2	
Oscillators and Comparators: Principles, Types, Frequency Stability**,** phase shift oscillator, wein bridge oscillator. **Comparators:** Basic comparators, zero crossing detector, Schmitt trigger, problems.	L1,L4
Module-3	
555 timers and Its applications: Introduction, the 555 timer pin diagram, architecture of 555 timers, 555 timer as monostable multivibrator, 555 timer as astable multivibrator, applications of astable multivibrator. Problems.	L1,L4
Module-4	
Combinational Logic: Introduction to K-Maps: 2,3 and 4 variable maps, Adders: Half adder and Full adder, subtractor: half subtractor and full subtractor multiplexers: 4:1 multiplexer, quadruple 2 to 1 line multiplexer, Boolean function implementation, demultiplexers: 1:4 demux, implementation using decoder, encoders: Octal to binary encoder, decoders: 3 to 8 line decoder, BCD to Decimal	L1,L4

decoder.	
Module-5	
Sequential Logic: Introduction, Flip flops: Basic circuits, RS flip flop, D-flip-flop, clocked D-flip-flop, JK flip flop, clocked JK flip-flop, T-flip-flop, clocked T flip-flop, Counters: Binary Ripple counter, BCD ripple counter, synchronous counter: Binary up-down counter, Binary counter.	L1,L4

Course outcomes:

By the end of the course the student will

1. have knowledge of Analog & Digital Electronic Circuits.
2. understand the characteristics & operation of Electronic Circuits.
3. formulate the relations for Voltage Gain ,Frequency of Various Electronics Circuits.
4. design the Electronics Systems for Required Specifications

TEXT BOOKS:

1. “Opamp and Linear Integrated Circuits”, Ramakant A Gayakwad 3 rd edition, PHI.

2. “Digital Logic and Computer Design”, M Morris Mano, 2000 edition, PHI.

REFERENCE BOOKS:

1. “Digital Electronics: Principles and Integrated cir cuits”, Anil K Maini, 2008, wiley India.

2. “Linear Integrated Circuits”, D. Roy Choudhury and Shail B Jain, 2 nd edition, Reprint 2006, New Age International.

3. “Digital Principles and applications”, Malvino & Leach, Tata Mc. Graw Hill**.**

COMPUTER ORGANIZATION AND ARCHITECTURE
SEMESTER – III (MT)

[As per Choice Based Credit System (CBCS) Scheme]

Course Code	**18MT36**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (08Hours per Module)**	**Exam Hours**	**03**
CREDITS– 03			

Course Objectives: This course will enable students to:

- Explain the basic sub systems of a computer, their organization, structure and operation.
- Illustrate the concept of programs as sequences of machine instructions.
- Demonstrate different ways of communicating with I/O devices
- Describe memory hierarchy and concept of virtual memory.
- Illustrate organization of simple pipelined processor and other computing systems.

Module 1	**RBT Level**
Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation **(upto 1.6.2 of Chap 1 of Text).** **Machine Instructions and Programs:** Numbers, Arithmetic Operations and Characters, number representations, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing **(upto 2.4.6 of Chap 2 of Text).**	**L1, L2, L3**
Module 2	
Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions **(from 2.4.7 of Chap 2, except 2.9.3, 2.11 & 2.12 of Text).**	**L1, L2, L3**
Module 3	
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access **(upto 4.2.4 and 4.4 except 4.4.1 of Chap 4 of Text).**	**L1, L2, L3**
Module 4	
Memory System: Basic Concepts, Semiconductor RAM Memories- Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Virtual Memories, Secondary Storage-Magnetic Hard Disks **(5.1, 5.2, 5.2.1,5.2.2, 5.2.3, 5.3, 5.5 (except 5.5.1 to 5.5.4), 5.7 (except 5.7.1), 5.9, 5.9.1 of Chap 5 of Text).**	**L1, L2, L3**

Module 5	
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Micro programmed Control **(upto 7.5 except 7.5.1 to 7.5.6 of Chap 7 of Text).**	**L1,L2, L3**

Course Outcomes: After studying this course, students will be able to:

- Explain the basic organization of a computer system.
- Explain different ways of accessing an input / output device including interrupts.
- Illustrate the organization of different types of semiconductor and other secondary storage memories.
- Illustrate simple processor organization based on hardwired control and micro programmed control.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.

Reference Books:

1. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier, 2009.
2. William Stallings: Computer Organization & Architecture, 7th Edition, PHI, 2006.
3. Vincent P. Heuring & Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

Machine shop and Material Testing Lab SEMESTER – III (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MTL37**	**CIE Marks**	**40**
Number of Lecture Hours/Week	04 (2T+2P)	**SEE marks**	**60**
		Exam Hours	**03**

CREDITS – 02

Course objectives: This course will enable students to:

- Understand the characteristics and behavior of Engineering materials used for engineering applications.
- To provide training to students to enrich their practical skills.

Parts	**RBT Level**
Part A	
1. Tensile, shear and compression tests of metallic specimens using Universal Testing machine. 2. Torsion Test. 3. Bending Test on Non metallic specimens. 4. Izod and Charpy tests on M.S Specimen. 5. Brinell and rockwelll hardness test. 6. Study of Microstructure of Metal.	**L1, L2, L3**
Part B	
1. Preparation of two models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling.	**L1, L2, L3**

Course Outcomes: At the end of the course, the students will be able to,

CO1: Understand how to conduct/operate material testing experiments. Demonstrate milling and shaper operation.

CO2: Perform machining operations on lathe to produce the model. Taper turning calculation and gear setting for thread cutting.

CO3: Determine the mechanical properties of given materials such as Young's modulus, rigidity modulus Bulks modulus, ultimate strength by conducting tensile, compression, torsion, and bending experiments.

CO4: Determine hardness and toughness of given material by conducting hardness and impact test.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing two questions, each of 40marks, one is from part A another from part B. Viva voce marks is 20.
- The total marks will be proportionally reduced to 60 marks as SEE marks. CIE marks is 40, out of which 20 marks for record and IA test each.

B.E MECHATRONICS ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - III

ANALOG AND DIGITAL ELECTRONICS LAB

Course Code	**18MTL38**	CIE Marks	40
Teaching Hours/Week (L:T:P)	04 (2T+2P)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

Students will able

1) To understand the characteristics and working of analog and digital components.

2) To design and develop analog and digital applications

Sl.NO	**Experiments**

PART-A:

1. Clipper circuits and Clamper circuits using diodes.

2. Single stage RC coupled amplifier using BJT and its frequency respons.

3. Inverting Amplifier, Non Inverting Amplifier, and Voltage Follower using Op-amp.

4. Astable and Monostable multivibrator using timer 555.

5. RC phase shift Oscillator using BJT.

PART-B:

6. Simplification and realization of Boolean expression using logic gates/ universal gates.

7. Half adder and Full Adder using logic gates.

8. Decoder and Encoders 9. Multiplexers and demultiplexers. 10. Realization of counters.	
Revised Bloom's Taxonomy Level	Understand ,Analyze ,Create
Course outcomes: At the end of the course the student will be able to: 1. Demonstrate the operation of wave shaping networks, amplifiers& clampers. 2. Analyze the performance of 555 timer as monostable & a stable multi vibrator. 3. Design the oscillator & multi vibrator for desired frequency. 4. Construct the combinational & sequential circuits for real time applications.	
Conduct of Practical Examination: 1. All laboratory experiments are to be included for practical examination. 2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners. 3. Students can pick one experiment from the questions lot prepared by the examiners. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.	

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

IV SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT41	Mathematics (Title as per the decision of BoS in Sciences)	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18MT42	Fluid mechanics and machines		3	2	--	03	40	60	100	4
3	PCC	18 MT 43	Microcontroller		3	2	--	03	40	60	100	3
4	PCC	18 MT 44	Manufacturing technology		3	0	--	03	40	60	100	3
5	PCC	18 MT 45	Theory of Machines		3	2	--	03	40	60	100	3
6	PCC	18 MT 46	Instrumentation and measurements		3	0	--	03	40	60	100	3
7	PCC	18 MT L47	FM and pneumatic - Laboratory		--	2	2	03	40	60	100	2
8	PCC	18 MT L48	Microcontroller – Laboratory(BV)		--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Vyavaharika Kannada (Kannada for communication)	HSMC	--	2	--	--	100	--	100	1
		18KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		18CPC39/49	Constitution of India, Professional Ethics and Cyber Law		1	--	--	03	40	60		
					Examination is by objective type questions							
				TOTAL	**17**	**12**	**04**	**24**	**420**	**480**	**900**	**24**
					OR	**OR**		**OR**	**OR**	**OR**		
					18	**14**		**27**	**360**	**540**		

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39/49 Vyavaharika Kannada (Kannada for communication) is for non-kannada speaking, reading and writing students and 18KAK39/49 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write kannada.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	NCMC	18MATDIP41	Additional Mathematics – II	Mathematics	02	01	--	03	40	60	100	0

((a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/ fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the student have to Fulfill the requirements during subsequent semester/s to appear for SEE.

(b) These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

FLUID MECHANICS AND MACHINES

SEMESTER – IV (MT)
[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT42**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03 + 2 (Tutorial)**	**SEE marks**	**60**
		Exam Hours	**03**

CREDITS – 04

Course objectives: This course will enable students to:

- Gain fundamentals knowledge of fluid physical properties, and its measurements, fluid at rest and motion and turbines.
- understand the concepts of Fluid statics, Fluid dynamics, Fluid kinematics, Dimensional analysis, Hydraulic turbines & steam turbines
- Apply the techniques of fluid mechanics and machines.

Modules	RBT Level
Module – 1	
Physical properties of fluids: Introduction, Types of fluids, Properties of fluids, viscosity, surface tension, vapor pressure and cavitation. **Fluid pressure and its Measurement:** Intensity of pressure, Pascal's law, Hydrostatic law,atmospheric, gauge and vacuum pressures, Piezometer, U-tube and differential manometers. **Fluid Statics:** Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces submerged in liquid.	**L1, L2, L3,**
Module – 2	
Fluid Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function, problems. **Fluid Dynamics:** Introduction, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation, problems.	**L1, L2, L3, L4**
Module – 3	
Dimensional Analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham's π-theorem, dimensionless numbers, similitude, types of similitudes. **Fluid Flow Measurements:** Venturimeter, orificemeter, pitot-tube, V-Notch and rectangular notches (Derivations Venturimeter and V-Notch only), Problems.	**L1 , L2 , L3, L4**
Module – 4	
Turbomachines: Definition of a Turbomachine, parts of a Turbomachine, Comparison with positive displacement machine; Classification. **Energy transfer in turbo machine:** Euler Turbine equation, alternate form of Euler turbine equation, components of energy transfer, Degree of reaction, general analysis of a Turbo machine – effect of blade discharge angle on energy transfer and degree of reaction.	**L1, L2, L3, L4**
Module – 5	
Hydraulic Turbines: Classification; Constructional features, Velocity triangles and Efficiencies of Pelton Turbine, Francis Turbine and Kaplan Turbine, and simple problems. Function of a Draft tube, types of draft tubes. **Steam Turbines:** Classification, Single stage impulse turbine - Condition for maximum blade efficiency, stage efficiency, Compounding, need for	**L1, L2, L3, L4**

compounding, methods of compounding. Reaction turbine - Parson's reaction turbine, condition for maximum blade efficiency, reaction staging, simple problems.	

Course Outcomes: At the end of the course, the students will be able to,

CO1: Describe concept of turbo machines, fluid properties, fluid at statics and motion (kinematics and dynamics).

CO 2: Measurement of fluid flow through pipe and open channel. Apply momentum/energy equation to fluid flow problems.

CO 3: Determine the properties of fluid and their effect, fluid statics and its application to monometers. Determine the performance of hydraulic turbines & steam turbines.

CO 4: Analyze kinematics and dynamics of fluid flow. Classification of fluid types, fluid flow, turbo machines, and it's compounding. Deduce performance of turbo machines.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Fluid Mechanics, Oijush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Fluid Mechanics and Fluid Machines, Dr. Bansal, R.K.Lakshmi Publications, 2004.
3. Textbook of Turbo machines, M S Govinde Gowda, M M Publishers, 2011

Reference Books:

1. Fluid Mechanics and hydraulics, Dr.Jagadishlal: MetropolitanBook Co-Ltd., 1997.
2. Fluid Mechanics (SI Units), Yunus A. Cengel John M.Oimbala, 2ndEd., Tata McGraw Hill, 2006.
3. Fluid Mechanics, John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006
4. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons., 2004
5. Fluid Mechanics -. Merle C. Potter, Elaine P.Scott. Cengage learning.
6. An Introduction to Energy Conversion, Volume III, Turbomachinery, V. Kadambi and Manohar Prasad, New AgeInternational Publishers,reprint 2008

MICROCONTROLLER
IV Semester (MT)
[As per Choice Based Credit System (CBCS) Scheme]

Course Code	**18MT43**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03+2**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: This course will enable students to:

- Understand the difference between a Microprocessor and a Microcontroller and embedded microcontrollers.
- Familiarize the basic architecture of 8051 microcontroller.
- Program 8051microprocessor using Assembly Level Language and C.
- Understand the interrupt system of 8051 and the use of interrupts.
- Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051.
- Interface 8051 to external memory and I/O devices using its I/O ports.

Module-1	**RBT Level**
8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	**L1, L2**
Module -2	
8051 Instruction Set: Addressing Modes and Operations: Introduction, Addressing modes, External data Moves, Code Memory, PUSH and POP Opcodes, Data exchanges, Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic. Jump and Call Instructions: The JUMP and CALL Program range, Jumps, calls and Subroutines, Interrupts and Returns.	**L1, L2,L3**

Module-3	
8051 programming in C and Timers: Data types and time delays in 8051C, I/O programming, logic operations, data conversion programs, data serialization. Timer / Counter Programming in 8051: Programming 8051 Timers, Counter Programming.	**L1, L2, L3**
Module -4	
8051 Serial Communication and Interrupts: Basics of serial Communication, 8051 connections to RS-232, 8051 Serial communication Programming, Serial port programming in C. **Interrupts Programming 8051**: Interrupts, Programming timer Interrupts and Serial communication Interrupts, Interrupt Priority**.**	**L1, L2, L3**
Module -5	
Interfacing and Applications: Interfacing of 8051 to Keyboard, LCD, Stepper motor, DC motor, ADC, DAC and temperature sensors.	**L1, L2, L3**

Course Outcomes: After studying this course, students will be able to:

- Describe the architecture of 8051 Microcontroller, microprocessor and internal memory organization, types of memory architecture, Concept of Addressing modes and Assembly and C instruction set.
- Apply various instruction set of assembly and C language programming for different software and hardware applications.
- Calculate time delays, baud rates and analyze Timer. Counter operation and Transmission of data serially for different modes of operation.
- Design the hardware interface between microcontroller, memories of different sizes and external peripherals.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

- 1. “The 8051 Microcontroller Architecture, Programming & Applications”, 2e Kenneth J. Ayala Penram International, 1996 / Thomson Learning 2005
- 2.“The 8051 Microcontroller and Embedded Systems – using assembly and C ”-, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006

Reference Books:

- “Programming and Customizing the 8051 Microcontroller” Predko ;–, TMH
- Microcontrollers: Architecture, Programming, Interfacing and System Design”, Raj Kamal, “Pearson Education, 2005

- "Microcontrollers- Theory and Applications", Ajay V.Deshmukh; TMH,2005
- "Microcontroller and its applications", Dr.Ramani Kalpathi and Ganesh Raja; Sanguine Technical publishers, Bangalore-2005.

Manufacturing technology

SEMESTER – IV (MTE)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT44**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40(10 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course objectives: This course will enable students to:

1. Gain fundamental knowledge of manufacturing process.
2. Understand the Techniques used in Traditional, Non Traditional Machining process, advanced Welding Process & CNC Machines
3. know the applications of various Traditional , Non Traditional manufacturing process & CNC machines

Modules	**RBT Level**
Module – 1	

Introduction to Manufacturing Process: Concept of Manufacturing process, its importance. Classification of Manufacturing processes. **Casting:** Introduction to Casting process &steps involved. Various components produced by casting process, Advantages & Limitations. **Patterns**: Definition and types. **Sand Moulding:** Binders and Additives: Definition, Need and Types. Types of base sand, requirements of base sand. Types of Sand Moulding. Cores: Definition, Need and Types. Concept of Gating & Risers: Principle and types. Introduction to Die Casting and injection moulding.	**L1, L2, L3, L4**
Module – 2	
Introduction to metal working: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metalworking processes. **Forging:** Classification, Forging machines & equipment. Die-design parameters. Forging defects, Residual stresses in forging, Applications of forging. **Rolling:** Classification, Types of rolling mills, Defects in rolled products. Rolling variables, Applications of Rolling. **Drawing**: Drawing equipment & dies, drawing variables, Tube drawing, classification of tube drawing, Application	**L1, L2, L3, L4**
Module – 3	
Extrusion: Types of extrusion processes, extrusion equipment & dies, Extrusion of seamless tubes, lubrication & defects in extrusion, Extrusion variables, Applications. **Sheet & Metal Forming:** Forming methods dies & punches, progressive die, compound die, combination die. Rubber forming. Open back inclinablepress (OBI press), piercing, blanking, bending, deep drawing, defects of drawn products, stretch forming, Roll bending & contouring, Applications. **Advanced Welding processes:** Classification, Advantages & limitations of welding. Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes (AHW), Resistance welding, Applications.	**L1 , L2 , L3**
Module – 4	
Non-traditional Machining Processes: Need for non-traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.	**L1, L2, L3, L4**
Module – 5	
Introducing to CNC machines: Basics of Turning tool Geometry, ATC, Programming methods. – Manual part programming, Milling, Turning, (Simple Programs), Computer Aided part programming (Simple problems, DNC, Types, Applications, Types of CNC Programming Software's, Over view CNC machining centers, Turning centre.	**L1, L2, L3, L4**

Course Outcomes: At the end of the course, the students will be able to

CO1: have knowledge of -Mechanical behavior of metals, Smart materials, composite materials, Alloys, Heat treatment process & phase diagrams.

CO2: understand the mechanism of various Metallurgical process & manufacturing process of composite materials & working of smart sensors,.

CO3: application of metallurgical process, production process of composite & working principle of smart sensor for various engineering solutions.

Question paper pattern:

Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.

Each full question can have a maximum of 4 sub questions.

There will be 2 full questions from each module covering all the topics of the module.

Students will have to answer 5 full questions, selecting one full question from each module.

The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

Manufacturing Technology, Serope Kalpakjain, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006.

Manufacturing Technology Vol 1&2, PN Rao, Tata McGraw Hill, 2001 NC Machine Programming and Software Design, ChnoHwachang, Michel. A. Melkanoff, Prentice Hall, 1989

Reference Books:

1. Process and Materials of Manufacturing, Roy A Lindberg, 4th Ed. Pearson Ed. 2006.

2. Workshop technology, Hazara Choudhry, Vol-I &II, Media Promoters & Publishers Pvt Ltd. 2004.

3. Production technology, HMT, Tata McGraw Hill, 2001.

4. Manufacturing Science, AmitabhGhosh and Mallik, affiliated East West press, 2003. 5. Fundamentals of metal Machining and machine Tools, G. Boothroyd, McGraw Hill. 2000.

6. Automation Production system and Computer Integrated Manufacturing Mikell. O. Grover, PHI, New Delhi, 2002.

THEORY OF MACHINES SEMESTER – IV (MTE) [As per Choice Based Credit System (CBCS)			
Course Code	**18MT45**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03+02**	**SEE Marks**	**60**
Total Number of Lecture Hours	**50 (10 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: This course will enable students to:

1. To gain knowledge of Kinematics and Dynamics associated with machine elements.
2. To understand the techniques for studying motions and forces of machines and their components.
3. To calculate mobility, power loss due to friction, balancing mass and its position, stability of a governor and effect of gyroscopic couple.
4. To Construct different cam profiles.

Module-1	**RBT Level**
Introduction: Definitions Link or element, Kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanisms (with problems), Inversion, Machine. Inversion of single slider and four bar mechanisms. Intermittent Motion - Geneva wheel mechanism and Ratchet and Pawl mechanism. Steering gear mechanism, Ackerman steering gear	**L1, L2, L3**
Module -2	
Gears and Gear Trains: Gear terminology, law of gearing, Path of contact Arc of contact, Contact ratio of spur gears, simple numerical on spur gear. Simple gear trains, Compound gear trains for large speed. Reduction, Epicyclic gear trains. Tabular methods of finding velocity ratio of epicyclic gear trains.	**L1, L2, L3**
Module-3	
Cams: Types of cams, Types of followers. Displacement, Velocity and, Acceleration time curve for cam profiles. Disc cam with reciprocating follower having knife-edge, roller follower, Disc cam with oscillating roller follower. Follower motions including SHM, Uniform acceleration and retardation and Cycloidal motion.	**L1, L2, L3**
Module -4	
Balancing of Rotating Masses: Static and dynamic balancing. Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. **Belt Drivers: Belt Drives:** Flat Belt Drives, Ratio of Belt Tensions, Centrifugal Tension, power	**L1, L2, L3**

Transmitted and simple numerical	
Module -5	
Gyroscope: Vectorial Representation of Angular Motion, Gyroscopic Couple. Effect of Gyroscopic Couple on Ship, Plane Disc, Aircraft, Stability of Two Wheelers. **Governors:** Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness,	**L1, L2, L3**

Course Outcomes: At the end of the course, students will be able to:

1. Have fundamental knowledge of Kinematics and Dynamics of Machines.
2. Understand the geometry and the motion of the parts of a machine and forces that produces this motion.
3. Determine the mobility, power loss due to friction in various machine elements, balancing mass and its position, stability of a governor and effect of gyroscopic couple on plane disk, Aircraft, stability of two wheelers and ship.
4. Construction of different types of cam profiles for a given data.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

1. Theory of Machines: Sadhu Singh, Pearson Education, 2nd edition, 2007.
2. Theory of Machines: Rattan S.S Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2006.
3. Theory of Machines, R. S. Khurmi, J. K. Gupta, Eurasia Publishing House, 2008 Revised Edition.

Reference Books:

1. Theory of Machines and Mechanisms, John Joseph Uicker, G. R. Pennock, Joseph Edward Shigley, Oxford University Press, 2003.
2. Theory of Machines and Mechanisms, Amitabha Ghosh and Mallick, East West Press, 3rd Edition 2006.
3. Theory of Machines, Thomas Bevan, CBS Publication 1984.
4. Mechanism and Machine Theory, Ashok G Ambekar, Fourth printing 2012, PHI Learning Private limed, New Delhi

INSTRUMENTATION AND MEASUREMENTS

SEMESTER – IV (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT46**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
		Exam Hours	**03**

CREDITS – 03

Course objectives: This course will enable students to:

- Students will have to the knowledge of fundamental concepts of Measurements using various physical instruments.
- Students will expose to the knowledge of the concept of digital instruments using for measurements systems
- Will be able to study Various types of Transduces and display devices

Modules	**RBT Level**
Module – 1	
Classification and Functional Elements of Instrument/ measurement system: Measurement, significance of measurement, instruments and measurement systems, mechanical, electrical and electronic instruments, Deflection & Null type instruments and their comparison, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs. 10 Hrs	**L1, L2, L3, L4**

Module – 2	
Digital Instruments: Digital Voltmeters – Introduction DVM's based on V-T, V-F and Successive, Approximation principles, Resolution and sensitivity, General specifications, Digital Multi-meters, Digital frequency meters. Digital measurement of time. 10Hrs.	**L1, L2, L3, L4**
Module – 3	
Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram and working of each block. Typical CRT connections. Dual beam and dual trace CROs, Electronics switch. Special Oscilloscopes: delayed time-base oscilloscopes, Analog storage, Sampling and Digital storage oscilloscopes.10 Hrs.	**L1 , L2 , L3**
Module – 4	
Measurement of resistance, induction and capacitance: Whetstone's bridge, Kelvin Bridge; AC bridges, Capacitance Comparison Bridge, Maxwell's bridge, wein's bridge, Wagner's earth connection.10 Hrs.	**L1, L2, L3, L4**
Module – 5	
Transducers – I: Introduction, Electrical transducers, Selecting a transducer, Resistive transducers, (Resistive position transducer, Resistance thermometer, Thermistor), Inductive transducer-LVDT. Transducers – II: Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer, Semiconductor photo devices, Temperature transducers Thermocouple. Display Devices: Digital display system, classification of display, Display devices, LEDs, LCD displays 10 Hrs	**L1, L2, L3, L4**

Course Outcomes: At the end of the course, the students will be ableto

- Apply knowledge of Instrumentation to measure Strain, Pressure, Force, Displacement, and Level.
- Use their skill set to measure resistance, Capacitance and Inductance using various bridge control circuits.
- Choose various transducers to measure different physical quantities.
- Analyze the Static and Dynamic Characteristics and Various Measurement instruments.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), DhanpatRai& Co. Pvt. Ltd., 2004. (Module 1 & 2)
2. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3-Displacement measurement, Module 4,
3. Process Measurement Instrument Engineers Handbook- Bela G. Liptak, Revised Edition, Chilton Book Company, 1982. (Module 3 – Level measurement,)
4. "Electronics Instrumentation", H.S. Kalsi, TMH, 2004-Module 5

Reference Books:

1. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
2. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
3. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.
4. Measurement Systems Application and Design- Ernest O.Doeblin and Dhanesh N Manik, 5th Edition, McGraw Hill, 2007

Fluid Mechanics and Pneumatic Lab SEMESTER – IV (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MTL47**	**CIE Marks**	**40**
Number of Lecture Hours/Week	04 (2T+2P)	**SEE marks**	**60**
		Exam Hours	**03**

CREDITS – 02

Course objectives: This course will enable students to:

- To understand the flow measurement in a pipe flow.
- To measure the discharge in an open channel flow.
- To study the characteristic of turbines.
- To understand the working principle of hydraulic components & hydraulic circuit.

Parts	**RBT Level**
Part A	
1. Calibration of flow measuring devices: a. Orifice Plate meter, b. Venturimeter, c. V-notch 2. Performance testing of Turbines a. Pelton wheel b. Francis Turbine c. Kaplan Turbine	**L1, L2, L3**
Part B	
1. Speed Control Circuit on Hydraulic/Pneumatic Trainer 2. Sequencing Circuit on Hydraulic/Pneumatic Trainer 3. Regenerative Circuit on Hydraulic/Pneumatic Trainer 4. Synchronizing Circuit on Hydraulic/Pneumatic Trainer	**L1, L2, L3**

Course Outcomes: At the end of the course, the students will be able to,

CO1: Apply principles of fluid mechanics, machines, and pneumatics.

CO2: Determine the coefficient of discharge of flow measuring devices and performance of turbines.

CO3: Select the type of turbine required with reference to available head of water and discharge.

CO4: Design pneumatic circuit for speed control single acting, double acting and sequencing operation.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing two questions, each of 40marks, one is from part A another from part B. Viva voce marks is 20.
- The total marks will be proportionally reduced to 60 marks as SEE marks. CIE marks is 40, out of which 20 marks for record and IA test each.

MICROCONTROLLER LABORATORY

SEMESTER – IV(MT)

[As per Choice Based Credit System (CBCS) scheme]

Laboratory Code	**18MTL48**	**CIE Marks**	**40**
Number of Lecture Hours/Week	04 (2T+2P)	**SEE Marks**	**60**
RBT Levels	**L1, L2, L3**	**Exam Hours**	**03**

CREDITS – 02

Course objectives: This laboratory course enables students to

- Understand the basics of microcontroller and its applications.
- Have in-depth knowledge of 8051 assembly language programming.
- Understand controlling the devices using C programming.
- The concepts of I/O interfacing for developing real time embedded systems.

Laboratory Experiments

I. PROGRAMMING

1. Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.
2. Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube (16 bits Arithmetic operations – bit addressable).
3. Counters.
4. Boolean & Logical Instructions (Bit manipulations).
5. Conditional CALL & RETURN.
6. Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX.
7. Programs to generate delay, Programs using serial port and on-Chip timer / counter.

II. INTERFACING

1. Alphanumeric LCD panel and Hex keypad input interface to 8051.
2. External ADC and Temperature control interface to 8051.
3. Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface to 8051; change the frequency and amplitude.
4. Stepper motor control interface to 8051.
5. DC motor control interface to 8051.

Course Outcomes: On the completion of this laboratory course, the students will be able to:

- Develop an interface between 8051 and external peripherals for various applications using C and Assembly Programming.
- Design microcontroller based circuits for real time applications
- Develop a microcontroller program for industrial applications**.**

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY,
BELAGAVI
Scheme of Teaching and Examination 2019 – 20
Outcome Based Education(OBE) and Choice Based Credit System
(CBCS) (Effective from the academic year 2019 – 20)

V SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory	Tutorial	Practical/	Duration in	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HSMC	18MT51	Technological Innovation Management And Entrepreneurship		3	0	--	03	40	60	100	3
2	PCC	18 MT52	Design and analysis of Machine Elements		3	2	--	03	40	60	100	4
3	PCC	18 MT53	Virtual Instrumentation		3	2	--	03	40	60	100	4
4	PCC	18 MT54	Hydraulics and Pneumatics		3	--	--	03	40	60	100	3
5	PCC	18 MT55	Micro and Smart Systems Technology		3	--	--	03	40	60	100	3
6	PCC	18 MT56	Wireless Networks & Communication		3	--	--	03	40	60	100	3
7	PCC	18 MTL57	Virtual Instrumentation-Laboratory		--	2	2	03	40	60	100	2
8	PCC	18 MTL58	MSST -Laboratory		--	2	2	03	40	60	100	2
9	HSMC	18CIV59	Environmental Studies	Civil/ Environmental [Paper setting: Civil Engineering Board]	1	--	--	02	40	60	100	1
TOTAL					**19**	**08**	**4**	**26**	**360**	**540**	**900**	**25**

Note: PCC: Professional Core, HSMC: Humanity and Social Science.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the
required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

TECHNOLOGICAL INNOVATION MANAGEMENT AND ENTREPRENEURSHIP
SEMESTER – V (MT)
[As per Choice Based Credit System (CBCS) Scheme

Course Code	18MT51	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (08 Hours / Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Objectives: This course will enable students to:

- Understand basic skills of Management
- Understand the need for Entrepreneurs and their skills
- Identify the Management functions and Social responsibilities
- Understand the Ideation Process, creation of Business Model, Feasibility Study and sources of funding

Module-1	**RBT Level**
Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought- early management approaches – Modern management approaches. Planning: Nature, importance and purpose of planning process Objectives -Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans.	**L1,L2**
Module-2	
Organizing and Staffing: Organization- Nature and purpose of organization Principles of organization - Types of organization - Departmentation Committees Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning Only) Nature and importance of staffing--Process of Selection & Recruitment (in brief). Directing & Controlling: Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief).	**L1,L2**
Module-3	
SocialResponsibilitiesofBusiness: MeaningofSocialResponsibility,Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance **(Selected topics from Chapter 3, Text 1).** **Entrepreneurship**: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of	**L1,L2**

Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship **(Selected topics from Chapter 2, Text2).**	
Module-4	
Family Business: Role and Importance of Family Business, Contributions of Family Business in India, Stages of Development of a Family Business, Characteristics of a Family-owned Business in India, Various types of family businesses **(Selected topics from Chapter 4,(Page 71-75) Text 2). Idea Generation and Feasibility Analysis-** Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities. **(Selected topics from Chapter 6(Page No. 111-117)&** **Chapter 7(Page No. 140-142), Text 2)**	**L1,L2**
Module-5	
Business model – Meaning, designing, analyzing and improvising; Business Plan – Meaning, Scope and Need; Financial, Marketing, Human Resource and Production/Service Plan; Business plan Formats; Project report preparation and presentation; Why some Business Plan fails? **(Selected topics from Chapter 8 (Page No 159-164, Text 2)** **Financing and How to start a Business?** Financial opportunity identification; Banking sources; Nonbanking Institutions and Agencies; Venture Capital – Meaning and Role in Entrepreneurship; Government Schemes for funding business; Pre launch, Launch and Post launch requirements; Procedure for getting License and Registration; Challenges and Difficulties in Starting an Enterprise**(Selected topics from Chapter 7(Page No 147-149), Chapter 5(Page No 93-99) & Chapter 8(Page No. 166-172) Text 2)** **Project Design and Network Analysis:** Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences**. (Selected topics from Chapters 20, Text 3).**	**L1,L2, L3**

Course Outcomes: After studying this course, students will be able to:

CO1: Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup abusiness

CO2: Describe the functions of Managers, Entrepreneurs and their social responsibilities

CO3: Understand the components in developing a business plan.

Text Books:

1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017.ISBN-13:978-93-5260-535-4.
2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education 2008, ISBN978-81-7758-260-4.

3. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN:978-81-8488-801-2.
4. Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, "Entrepreneurship", 8th Edition, Tata Mc-graw Hill Publishing Co.ltd.-new Delhi,2012
5. Management Fundamentals- Concepts, Application, Skill Development – Robers Lusier – Thomson.

Reference Book:

1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.

Design and analysis of Machine Elements

SEMESTER – V (MTE)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	18MT52	CIE Marks	40
Number of Lecture Hours/Week	05	SEE marks	60
Total Number of Lecture Hours	50(10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

1. gain knowledge of theories of failures, stress concentration and machine elements.
2. understand the techniques in machine elements
3. Determine the parameters of machine elements subjected to various load condition.
4. design of various machine elements

Modules	RBT Level
Module – 1	
Introduction: Machine design, classification of machine design, design consideration, Tri axial stresses, Stress Tensor. Codes and Standards. Factor of Safety, design procedure for simple and combined stresses (No Numerical). Introduction to Stress Concentration, Stress concentration Factor and its effects (Simple problems). **Introduction to Theories of failure:** Maximum Normal Stress Theory, Maximum Shear Stress Theory, Distortion Energy Theory.	**L1, L2, L3,**
Module – 2	
Design for Fatigue Loads: Endurance limit, S-N Diagram, Low cycle fatigue, High cycle fatigue, modifying factors: size effect, surface effect. Stress concentration effects, Notch sensitivity, fluctuating stresses, Goodman and Soderberg relationship, stresses due to combined loading, cumulative fatigue damage.	**L1, L2, L3, L4**
Module – 3	

Power Screws: Stresses in Power Screws, Efficiency and Self-locking, torque requirement for lifting and lowering the load, Design of Power Screws,(No problems on screw jack). **Design of springs:** Types of springs - stresses in Helical coil springs of circular cross sections. Tension and compression springs only, numerical on helical coil springs only (No concentric springs).	**L1 , L2 ,L3,L4**
Module – 4	
Design of Spur Gears: Beam strength of spur gear, Stresses in gear teeth (Lewis equation), dynamic tooth load, design for wear **Design of helical gears:** Beam strength of helical gear, Stresses in gear teeth (Lewis equation), dynamic tooth load, and design for wear.	**L1, L2, L3, L4**
Module – 5	
Introduction to Finite element analysis : Need for use of FEM, Advantages and disadvantages of FEM, Engineering Applications of FEM, Steps involved in FEM, Discretization process – types of elements (1D,2D,3D), size of the elements, location of nodes, node numbering scheme, Derivation of stiffness matrix for bar elements and Problems on bar and stepped bars (only point load)	**L1, L2, L3, L4**

Course Outcomes: At the end of the course, the students will be able to

1. Have knowledge of theories of failures, stress concentration, shafts, keys, couplings, gears, bearings and springs, Finite element analysis, elements and nodes.
2. Understand the technique of theories of failure, stress concentration, fatigue strength etc.
3. Calculate the stresses; parameters of machine elements subjected to various loads also make proper assumptions with respect to material, FOS for various machine components.
4. Design machine elements like, gears, power screws, springs and other simple machine elements.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6thEdition 2009.
2. Design of Machine Elements, V.B. Bhandari, Tata McGrawHill Publishing Company Ltd., New Delhi, 3rdEdition 2010. 3. Machine Design, by Dr. P C Sharma and Dr. D K Aggarwal, S. K. Kataria& Sons, 11th Edition 2009.

3. Chandrupatla T. R., Finite Elements in engineering, 2nd Edition, PHI, 2013.
4. Rao, S. S., Finite element method in engineering, 5th Edition, Pergaman Int. Library of Science, 2010.

DESIGN DATA HANDBOOK:

1. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBSPublication.
2. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2ndEdition.
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010.

Reference Books:

1. Machine Design, Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education,2006.
3. Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008
4. J.N.Reddy, "Finite Element Method"- McGraw -Hill International Edition.Bathe K. J. Finite Elements Procedures, PHI.

B.E MECHATRONICS ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER - V

VIRTUAL INSTRUMENTATION

Course Code	**18MT53**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P)	**(3:2:0)**	**SEE Marks**	**60**
Credits	**04**	**Exam Hours**	**03**

Course objectives:

- Gain knowledge to learn the concepts of developing basic skills necessary for importance Virtual Instrumentation and Lab View
- Understand the basic programming concepts and various Operation using DAQ Devices used in Virtual Instrumentation and Lab View.
- Diagnosis the problem related types of I/O module, Data Acquisition System and Communication Networks (Bus Systems) using Standard Protocol.

Module-1

CONCEPT OF VIRTUAL INSTRUMENTATION – Concepts of Instrumentation and	L5

Measurements Historical perspective – Need of VI – Advantages of VI – Define VI – Block diagram & Architecture of VI – Data flow techniques – Graphical programming in data flow – Comparison with conventional programming. PC based data acquisition – Typical on board DAQ card – Resolution and Sampling , Sampling Theorem sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card	
Module-2	
DATA ACQUISITION BASICS: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution Data acquisition interface requirements.	L3
Module-3	
GRAPHICAL PROGRAMMING ENVIRONMENT IN VI Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI ,Loops(While Loop and For Loop) , Structures(Case, Formula node, and sequence structures) Arrays Operations, Strings Operations, and file I/O. Examples on each.	
Module-4 **CLUSTER OF INSTRUMENTS IN VI SYSTEM** Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.	L4
Module-5	
USE OF ANALYSIS TOOLS AND APPLICATION OF VI Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.	L3

Course outcomes:

1. Understand the structured LabVIEW programming concepts in developing Virtual Instrumentation.
2. Build applications employed in various debugging techniques, simulating and analyzing the data and use general purpose interface bus and Serial communication Interface.
3. Create applications that uses plug in DAQ boards and built in analysis functions to process the data.

4 .Design and analyse various applications on Real time monitoring using DAQ boards
TEXT BOOKS: 1. “Virtual Instrumentation using LabVIEW” Jovitha Jerome, PHI publication 2 Virtual Instrumentation, LABVIEW", Sanjay Gupta, TMH,NewDelhi,2003
REFERENCE BOOKS 1 PC Interfacing for Data Acquisition and Process Control & S.Gupta and JP Gupta InstrumentSocietyofAmerica,1994 2. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.

HYDRAULICS AND PNEUMATICS

SEMESTER – V (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT54**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total number of hours	40(08 hours/module)	**Exam Hours**	**03**

CREDITS – 03

Course objectives: This course will enable students to:

- Gain knowledge of basics of hydraulic and pneumatic systems.
- understanding the working principles of hydraulics and pneumatics components
- Engineering application of hydraulic and pneumatic systems.

Modules	**RBT Level**
Module – 1	
Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law. **The source of Hydraulic Power:** Pumps Classification of pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps.	**L1, L2, L3,**
Module – 2	

Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors). **Control Components in Hydraulic Systems:** Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.	**L1, L2, L3, L4**
Module – 3	
Hydraulic Circuit Design And Analysis: Control of Single and Double -Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits. **Maintenance of Hydraulic System:** Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid - particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting.	**L1 , L2 , L3, L4**
Module – 4	
Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System,fluid conditioners and FRL unit. Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols. **Pneumatic Control Valves:** DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.	**L1, L2, L3, L4**
Module – 5	
Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle, Construction, practical applications.	**L1, L2, L3, L4**

Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) usingcascading method (using reversing valves). **Electro- Pneumatic Control:** Principles - signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.	

Course Outcomes: At the end of the course, the students will be able to,

CO1: Have knowledge of hydraulic and pneumatic system and its components.

CO2: Understand the working principle of various hydraulic and pneumatic components.

CO3: Apply working principles of Hydraulic and Pneumatic Systems for various applications.

CO4: Determine cause for hydraulic and pneumatic system break down and performance of hydraulic pumps, motors.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. “Fluid Power with Applications”, Anthony Esposito, Sixth edition, Pearson Education, Inc, 2000. 2. 'Pneumatics and Hydraulics', Andrew Parr, Jaico Publishing Co

Reference Books:

1. 'Oil Hydraulic systems', Principles and Maintenance S. R. Majurr, Tata McGraw Hill Publishing Company Ltd. - 2001
2. 'Industrial Hydraulics', Pippenger, Hicks'' McGraw Hill, New York
3. 'Hydraulic & Pneumatic Power for Production', HarryL. Stewart
4. 'Pneumatic Systems', S. R. Majumdar, Tata McGraw Hill Publish 1995
5. 'Hydraulic & Pneumatics' CMTI Data Book.

B.E MECHATRONICS ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER - V

MICRO & SMART SYTEMS TECHNOLOGY

Course Code	**18MT55**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P)	**(3:0:0)**	**SEE Marks**	**60**
Credits	**03**	**Exam Hours**	**03**

Course objectives: student will be able to

1. Gain knowledge of Smart Materials, Sensors & Actuators, Microsystems.
2. Understand the Operation of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing.

Module-1	**RBT level**
Introduction to Micro and Smart systems : Miniaturization, Microsystems versus MEMS, Micro-fabrication, Smart Materials, Structures & Systems, IntegratedMicrosystems ,Application of Smart Materials & Microsystems**. 10Hours**	**L1,L3**
Module-2	
Micro and Smart Devices and Systems: Principles and Materials: Definitions and salient features of sensors, actuators, and systems. Sensors: silicon capacitive accelerometer, piezo resistive pressure sensor, Portable blood analyzer, conduct metric gas sensor. Actuators: Micro mirror Array for Video Projection, Piezoelectric based inkjet print head, electrostatic comb-drive, and Magnetic micro relay.	**L1,L3**
Module-3	
Micromachining Technologies: Silicon as a Material for Micromachining, Silicon wafer preparation, thin-film deposition techniques, Lithography, Etching, Siliconmicromachining:surface micromachining, bulk micromachining. Specialized Materials for Microsystems.	**L1,L3**

Module-4	
Electronics Circuits for Micro and Smart Systems. Semiconductor devices: Diode, Schottky diode,Tunnel diode,BJT ,MOSFET,CMOS circuits ,Electronics Amplifiers ,Op-Amp based circuits .	**L1,L3**
Module-5	
Implementation of Controllers for MEMS & Case Studies of Integrated Microsystems. Design Methodology, PID controller, Circuit Implementation, Digital controller, Microcontroller & PLC. Case Studies of Integrated Microsystems: BEL pressure sensor, design considerations, performance parameters, and Smart Structure in vibration control.	**L1,L3**

Course outcomes:

By the end of the course the student will

1. Have knowledge of Smart Materials, Sensors &Actuators ,Microsystems.

2. Understand the Working Methodology of Smart Devices & Systems, Electronic Circuits & Control

for MEMS, Methodology of Micro-manufacturing

TEXT BOOKS:

1. Micro and Smart Systems: G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat,

V.K.Aatre,Wiley India 2010.

REFERENCE BOOKS

1. Design and Development Methodogies, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Goplakrishnan, Wiley.

2. MEMS- Nitaigour Premchand Mahalik, TMH 2007.

MEMS & Microsystems: Design and Manufacture, Tai-Ran Hsu, Tata Mc-Graw-Hill.

WIRELESS NETWORKS AND COMMUNICATION

V Semester (MT)

[As per Choice Based credit System (CBCS) Scheme}

Course Code	**18MT56**	**IA Marks**	**40**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**60**
Total Number of Lecture Hours	**40 (08 Hours per Module)**	**Exam Hours**	**03**

CREDITS –03

Course Objectives:

- Analyze the concepts of Different wireless communication systems , wireless networks and technologies.
- Explain the working principles of WBAN, LAN,WPAN,WMAN,WWAN and different wireless technologies.
- Illustrate the concepts of adhoc networks, mobile adhocs, Vanets and Mesh networks.
- Explain Different issues in designing various Wireless networks and wireless communication.

Module 1	**RBT Level**
Review of fundamentals of wireless communication and networks: Wireless communications, Wireless communication channel specifications, wireless communication problems, wireless networks, switching technology, wireless network issues and standard.	**L1,L2**
Module 2	
Wireless body area networks (WBAN), :Properties, network architecture, components, technologies, design issues, protocols Wireless personal area networks: components, requirements, technologies and protocols, Bluetooth and Zig bee	**L1,L2**
Module 3	
Wireless modulation: Wireless modulation techniques and hardware, characteristics of air interface, path loss models, wireless coding techniques, digital modulation techniques, Diversity techniques, GSM hardware.	**L1,L2**
Module 4	
Wireless LANs, WMAN, WWAN: WLAN architecture, components, requirement, WLAN protocols, Applications WMAN, architecture, components, requirement, WMAN protocols, Applications WWAN, architecture, components, requirement, WMAN protocols, applications.	**L1,L2**
Module 5	

Wireless adhoc networks: Mobile adhoc networks, Sensor Networks, Mesh networks, VANETs.	**L1,L2**

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- Thetotalmarkswillbeproportionallyreducedto60marksasSEEmarksis

Text Book:

1. SS Manvi, MS Kakkasageri, "Wireless and Mobile Network concepts and protocols".Willy, first edition.2010.

2. Wireless Telecom systems and networks, Mullet: Thomson Learning 2006.

REFERENCE BOOKS

1. P Kavesh, Krishnamurthy, "Principals of wireless networks: A unified approach', PHI, 2006.
2. Iti Saha Mishra, "Wireless communication and networks 3G and beyond", MGH, 2009.
3. Mullet, "Introduction to wireless telecommunication systems and networks",cengage, 2009.
4. DP Agarwal, Qing An Zeng, "Introduction to wireless and mobile systems", Cengage,2008.
5. Ivan Stojmenovic, "Handbook of wireless networks and mobile computing', Willy,2009.

B.E MECHATRONICS ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - V

VIRTUAL INSTRUMENTATION LABORATORY

Course Code	**18MTL57**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

- To introduce the fundamental concepts of Scientific Programming using Lab View

  Analog and digital measurements principles
- Data Acquisition operation - basics skills and Creating Virtual Instruments for practical works

Sl. NO	Experiments
1	Creating Virtual Instrumentation for simple applications- Invert The State Of Boolean Indicator Twice A See Until Program Is Stopped By User.
2	Programming exercises for loops-Continuous Monitoring of Temperature (Generated using Random no 0<t<100). for every 250 ms.
3	Programming exercises for graphs- Display Random Number Into 3 different CHARTS (STRIP, SLOPE, and SWEEP).
4	Programming Exercises on case and sequence structures:-Design the simple Calculator.
5	Programming Exercises on Arrays
6	Programming Exercises on File Input output System.
7	Real time temperature control using Virtual Instrumentation.
8	Developing voltmeter using DAQ cards
9	Developing Signal Generator using DAQ Card
10	Data acquisition through Virtual Instrumentation.
11	Design and Development of Filter Analysis using DAQ card
12	Real time sequential control of any batch process
RBT LEVEL	Design , Create , Apply

Course outcomes:

At the end of the course the student will be able to:

1. Develop LabVIEW programming which employs simulating and analyzing the data for real time automation
2. Engage in designing, implementing, analyzing and demonstrating an application using tools in available in LabVIEW through an open ended experiment.
3. Design applications that uses plug in DAQ boards and built in analysis functions to process the data.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.

2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.

3. Students can pick one experiment from the questions lot prepared by the examiners.

4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

B.E MECHATRONICS ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - V

MICRO & SMART SYSTEMS TECHNOLOGY LABORATORY

Course Code	18MTL58	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

- Analyse the behaviour of Mechanical Components for various kinds of loads.
- Analyse the behaviour of Pressure Sensor for various kinds of Pressures applied

Experiments

PART-A

1. Static structural analysis

   a) 2 D Mechanical Components.

   b) 3 D Mechanical Components.

2. Piezoelectric analysis: cantilever beam

PART-B

1. Pressure sensor experiment
2. a) Raw pressure sensor
3. b) compensated pressure sensor

RBT LEVEL	Design , Create , Apply

Course outcomes:

At the end of the course the student will be able to:

4. Understand, Analyze & gain ability to choose Materials for desired applications.
5. Understand, Analyze & gain ability to choose Sensors for desired applications.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.

2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.

3. Students can pick one experiment from the questions lot prepared by the examiners.

4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018– 19
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

VI SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18 MT61	PLC & SCADA		3	2	--	03	40	60	100	4
2	PCC	18 MT62	Power Electronics		3	2	--	03	40	60	100	4
3	PCC	18 MT63	Computer Aided Machine Drawing		1	0	4	03	40	60	100	4
4	PEC	18 MT64X	Professional Elective -1		3	--	--	03	40	60	100	3
5	OEC	18XX65X	Open Elective –A		3	--	--	03	40	60	100	3
6	PCC	18 MTL66	PLC and SCADA- Laboratory		--	2	2	03	40	60	100	2
7	PCC	18 MTL67	Power electronics - Laboratory		--	2	2	03	40	60	100	2
8	MP	18MTM,P68	Mini-project		--	--	2	03	40	60	100	2
9	Internship	--	Internship	To be carried out during the vacation/s of VI and VII semesters and /or VII and VIII semesters.								
				TOTAL	**13**	**08**	**10**	**24**	**320**	**480**	**800**	**24**

Note: PCC: Professional core, PEC: Professional Elective, OE: Open Elective, MP: Mini-project.

Professional Elective -1

Course code under 18MT64X	Course Title
18 MT641	Modeling And Simulation
18 MT642	Rapid Prototyping
18 MT643	Artificial neural network
18 MT644	Satellite Communication
18 MT645	Computer Integrated Manufacturing

Open Elective –A

18 MT651 Robotics and Automation, 18 MT652 Process Instrumentation

Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department (Please refer to the list of open electives under 18XX65X).

Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the program.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the program

Registration to electives shall be documented under the guidance of Program Coordinator/ Advisor/Mentor.

Mini-project work:

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guidesof the college.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

B.E MECHATRONICS ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER - VI

PLC AND SCADA

Course Code	**18MT61**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P)	**(3:2:0)**	**SEE Marks**	**60**
Credits	**04**	**Exam Hours**	**03**

Course objectives:

- Gain knowledge to learn the concepts of developing basic skills necessary for importance PLC & SCADA
- Understand the basic programming concepts and various Operation using RELAY LOGIC Devices used in PLC and SCADA
- Diagnosis the problem related types of I/O module, Data Acquisition System and Communication Networks (Bus Systems) using Standard Protocol.

Module-1	RBT LEVEL
what is A PLC, Technical Definition of PLC, What are its advantages, characteristics functions of A PLC, Chronological Evolution of PLC, Types of PLC, Unitary PLC, Modular PLC, Small PLC, Medium PLC, Large PLC, Block Diagram of PLC: Input/output (I/O) section, Processor Section, Power supply, Memory central Processing Unit: Processor Software / Executive Software, Multi asking, Languages, Ladder Language. **10 Hrs**.	**L1, L2, L3**
Module-2	
Bit Logic Instructions: introduction: Input and Output contact program symbols, Numbering system of inputs and outputs, Program format, introduction to logic: Equivalent Ladder diagram of AND gate, Equivalent ladder diagram of or Gate, equivalents Ladder Diagram of NOT gate, equivalent ladder diagram of XOR gate, equivalent ladder diagram of NAND gate, equivalent ladder diagram of NOR gate, equivalent ladder diagram to demonstrate De Morgan theorem. Ladder design. Examples: Training Stopping, Multiplexer, DE multiplexers	**L1, L2, L3**
Module-3	

PLC Timers and Counters: On Delay and OFF delay timers, Timer-on Delay, Timer off delay, Retentive and non-retentive timers. Format of a timer instruction. PLC Counter: Operation of PLC Counter, Counter Parameters, Counters Instructions Overview Count up (CTU) Countdown (CTD).Advanced instructions: Introduction: Comparison instructions, discussions on comparison instructions, "EQUAL" or "EQU" instruction, "NOT EQUAL" or "NEQ" instruction, "LESS THAN" or "LESS" instruction, "LESS THANOR EQUAL' or "LEQ" instruction, GREATER THAN" OR "GRT" instruction, "GREATER THAN OR EQUAL TO" or "GRO" instruction, "MASKED COMPARISON FOR EQUAL" or "MEQ" instruction, "LIMIT TEST" or "LIM" instruction.	**L1, L2, L3**
Module-4	
PLC input output (I/O) modules and power supply: Introduction: Classification of I/O, I/O system overview, practical I/O system and its mapping addressing local and expansion I/O, input-output systems, direct I/O, parallel I/O systems serial I/O systems. Sinking and sourcing. Discrete input module. Rectifier with filter, threshold detection, Isolation, logic section, specifications of discrete input module, types of analog input module, special input modules, analog output module, I/O modules in hazardous locations power supply requirements, power supply configuration, filters. **10 Hrs.**	**L1, L2, L3**
Module-5	
Introduction, definition and history of Supervisory Control and Data Acquisition, typical SCADA System Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture(First generation-Monolithic, Second Generation-Distributed, Third generation-Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation, Petroleum Refining Process, Water Purification System, Chemical**.**	**L1, L2, L3**

Course outcomes:

1. Demonstrate the concepts of basic programming skills of PLC using logical instructions
2. Apply the architecture process involved in programmable logic controller and basic programming skills of PLC using logical instructions
3. Examine the various operation involved in the PLC input/output module and SCADA system
4. Construct the ladder diagram for PLC using logical instructions, timer and counters, Data Handling instructions and Build the SCADA System for Real time industrial process.

TEXT BOOKS:

1. "PLC and Industrial application", Madhuchhandan Gupts and SamarjitSen Gupta,

pernram international pub. (Indian) Pvt. Ltd., 2011.

2.Ronald L Krutz, “Securing SCADA System”, Wiley Publication

REFERENCE BOOKS

1.1.GaryDunning,”Introduction to Programmable Logic Controllers”, Thomson,2 nd Edition.

2.John W Webb, Ronald A Reis,”Programmable Logic Controllers: Principles and Application”, PHI Learning, Newdelhi, 5 th Edition

3.Stuart A Boyer, “SCADA Supervisory Control and Data Acqusition”, ISA, 4 th Revised edition

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module.

Power Electronics
B.E, VI Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme 2018-2019]

Subject Code	**18MT62**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**04**	**SEE marks**	**60**
CREDITS	04	**Exam Hours**	**03**

Course Objectives:

1. Gain the knowledge of various conversion techniques of electrical energy using power electronic components.
2. Understand the link between efficient usage of power and conservation of energy resources of the world
3. use various power electronic converters for different applications in industry

Modules	**RBT Level**
Module – 1	
Introduction, Power semiconductor Devices: Applications of Power Electronics, Power semiconductor devices, Control Characteristics, Types of power electronics circuits, Peripheral effects. Power MOSFETs – switching characteristics, gate drive, IGBTs, di/dt and dv/dt limitations, Isolation of gate and base drives, Simple design of gate and base drives.	**L1, L2, L3**
Module – 2	

Thyristors: Introduction, characteristics, Two Transistor Model. Turn-on and turn-off, di/dt and dv/dt protection, Thyristor types, Thyristors firing circuits, Simple design of firing circuits using UJT. **Commutation Techniques:** Introduction. Natural Communication, Forced commutation: self-commutation, impulse commutation, resonant pulse commutation and complementary commutations.	**L1, L2, L3**
Module – 3	
AC Voltage Controllers: Introduction. Principle of ON-OFF and phase control. Single-phase bidirectional controllers with resistive and inductive loads. Controlled **Rectifiers:** Introduction. Principle of phase controlled converter operation. Single phase semi-converters. Full converters. Three-phase half-wave converters. Three-phase full-wave converters.	**L1 , L2 , L3**
Module – 4	
DC Choppers: Introduction. Principle of step-down and step-up chopper with R-L load. Performance parameters. Choppers classification. Analysis of impulse commutated thyristor chopper (only qualitative analysis)	**L1, L2, L3**
Module – 5	
Inverters: Introduction, Principle of operation. Performance parameters. Single-phase bridge inverters. Three phase inverters. Voltage control of single-phase Inverters single pulse width, multiple pulse width, and sinusoidal pulse width modulation.	**L1, L2, L3**

Course outcomes: On completion of the course student will

• **CO1:** have knowledge of power semiconductor devices, thyristors, AC voltage controllers, choppers and inverters.

• **CO2:** understand the characteristics and working principle of thyristors, AC voltage controllers, choppers and inverters.

• **CO3:** apply control techniques to meet desired switching objectives.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from eachmodule.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

TEXT BOOKS:

1. “Power electronics”, m h. Rashid 2nd edition, p. H.i/pearson, new delhi, 2002.

Reference Books:
1. "Power Electronics – converters, Application and Design", Net Mohan, Tore M.
2. Undeland, and William P. Robins, Third Edition, John Wiley and Sons.
3. "Thyristorised Power Controllers", G. K. Dubey, S. R. Doradla, A. Joshi and R M K.
4. Sinha, New Age International Publishers.
5. "Power Electronics", M. D. Singh and Khanchandani K.B. T.M.H., 2001.
6. "Power Electronics", Cyril Lander, 3rd Edition, McGraw-Hill.
7. "Power Electronics: Principles and Applications", J.M. Jacob, Thomson-VikasPublicaions. "Power Electronics: A Simplified Approach", R.S. Ananda Murthy and V. Nattarasu, Sanguine Technical Publisher.

Computer Aided Machine Drawing

SEMESTER – VI (MTE)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT63**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**2+4(Practical)**	**SEE marks**	**60**
Total Number of Lecture Hours	**50(10 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 04

Course objectives: This course will enable students to:

1. To acquire the knowledge of CAD software and its features.
2. To inculcate understanding of the theory of projection and make drawings using orthographic projections and sectional views
3. To familiarize the students with Indian Standardson drawing practices.
4. To impart knowledge of thread forms, fasteners, keys, joints and couplings.
5. To make the students understand and interpret drawings of machine components so as to prepare assembly drawings either manually and using CAD packages.
6. To acquire the knowledge of limits, tolerances and fits pertaining to machine drawings.

Modules	**RBT Level**
PART-A	
Sections of Solids: Sections of Pyramids, Prisms, Cones and resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections. **Orthographic Views:** Conversion of pictorial views into orthographic projections of simple machine parts without sections. (Bureau of Indian Standards conventions are to be followed for the drawings). **Thread Forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External) square**,** Acme **Fasteners:** Hexagonal headed bolt and nut with washer (assembly).	**L1, L2, L3, L4**
PART-B	

Keys & Joints : Parallel key, Taper key, Feather key, Gib head key and Woodruff key (Only Practice) Cotter joint, knuckle joint for two rods. **Couplings:** Protected type flanged coupling, flexible coupling	**L1, L2, L3, L4**
PART-C	
Assembly Drawings (Part drawings should be given) 1. Plummer block (Pedestal Bearing) 2. Screw jack (Bottle type) 3. Connecting rod of an IC Engine. **Geometric Dimensioning and Tolerances (Not for Exam):** Types of Geometric tolerances, terminology for geometrical deviations, representation of geometrical tolerance on a drawing, dimensional tolerances, terminology for dimensional tolerances, selection of tolerances, representation of dimensional tolerances on a drawing.	**L1 , L2 , L3**

Course Outcomes: At the end of the course, the students will be able to

1. Sections of pyramids, prisms, cubes, cones and cylinders resting on their bases in 2D
2. Orthographic views of machine parts with and without sectioning in 2D.
3. Sectional views for threads with terminologies of ISO Metric, square and acme, threads in 2D.
4. Hexagonal headed bolt and nut with washer, assemblies in 2D
5. Parallel key, Taper key, and Woodruff Key as per the ISO standards in 2D
6. Sketch split muff, protected type flanged, pin type flexible assemblies from the part drawings with limits ,fits and tolerance given for Plummer block, Screw Jack, Tailstock of lathe, in 2D and 3D

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat&V.M.Panchal, Published by Charotar Publishing House, 1999.
3. 'Machine Drawing', N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2006.

Reference Books:

1. "A Text Book of Computer Aided Machine Drawing", S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2007.
2. 'Machine Drawing', K.R. Gopala Krishna, Subhash publication. Machine Design, Hall,

B.E MECHATRONICS ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER - VI

PLC AND SCADA LABORATORY

Course Code	**18MTL66**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P)	**(2:2:0)**	**SEE Marks**	**60**
Credits	**02**	**Exam Hours**	**03**

Course objectives:

- To introduce the fundamental concepts of Scientific Programming using PLC & SCADA Analog and digital measurements principles
- Data Acquisition operation - basics skills and Creating Industrial application for practical works

Sl. NO	Experiments
1	Study of various logic Execution in ladder diagram.
2	Interfacing of Lamp & button with PLC for ON&OFF Operation. Verify all logic gates.
3	PLC based thermal ON/OFF Controller.
4	Develop ladder logic to develop MUX and DE-MUX
5	Combination of counter &timer for lamp ON/OFF Operation.
6	Study& implement ON delay timer in PLC
7	Study& implement OFF delay timer in PLC
8	To study & implement of counter in PLC programming.(counter-up)
9	To study& implement of counter in PLC programming.(counter-down)
10	PLC based temperature sensing using RTD
11	Parameter reading of PLC in SCADA
12	Temperature sensing using SCADA

Revised Bloom's Taxonomy Level	Design , Create , Apply

Course outcomes:

At the end of the course the student will be able to:

1. Develop the logical instructions involved in Development of programmable logic controller for various operations
2. Construct the Ladder Logic for various operation using PLC and SCADA for industrial Environment.
3. Design the SCADA System for industrial Environment.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.

2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.

3. Students can pick one experiment from the questions lot prepared by the examiners.

4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

POWER ELECTRONICS LABORATORY
B.E, VI Semester, Mechatronics Engineering

Subject Code	**18MTL67**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03 (1 Hour Instruction+ 2 Hours Laboratory)**	**SEE marks**	**60**
RBT Levels		**Exam Hours**	**03**

CREDITS – 02

Course objectives: Students will be able to

• verify the characteristics of different power electronic devices.

• understand the usage of power devices to control the operation of electronic systems.

List of Experiments

1. Static characteristics of SCR and DIAC.

2. Static characteristics of MOSFET and IGBT

3. Controlled HWR and FWR using RC triggering circuit.

4. SCR turn off using i) LC circuit and ii) Auxiliary Commutation

5. SCR turn-on circuit using synchronized UJT relaxation oscillator.

6. SCR Digital triggering circuit for a single-phase controlled rectifier

7. Single-phase full-wave rectifier with R and R-L loads.

8. A.C. voltage controller using TRIAC and DIAC combination connected to R and R-L loads.

9. Speed control of a separately excited D.C motor using an IGBT or MOSFET chopper.

10. MOSFET OR IGBT based single-phase full-bridge inverter connected to R load.

Course outcomes: On the completion of the course students will

• understand and verify the characteristics of different power electronic devices.

• use the power devices to control the operation of electronic systems.

Scheme for Examination:

One Question from Part A - 40Marks (10 Write up +30)

One Question from Part B - 40 Marks (10 Write up +30)

Viva-Voce - 20 Marks

Total 100 Marks

PROFESSIONLA ELECTIVE –I

MODELING AND SIMULATION

B.E, VI Semester, Mechatronics Engineering

[As per Choice Based Credit System (CBCS) scheme 2018-2019]

Course Code	**18MT641**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

Credits – 03

Course Objectives: Students will be able to

3. gain Knowledge of basics concepts and methodologies of modeling and simulation
4. understand the concepts of discrete event simulation, random number generation, test for random numbers & random varieties used in simulation study.
5. develop simulation model by simulation package for queuing system, production system and maintenance system

Module - 1

System and system environment: Component of a system – Continuous and discrets systems – Types of model; Steps in Simulation study; simulation of an event occurrence using random number table – Single server queue- two server queue- inventory systems.

Discrets Event Simulation: Concepts in discreet event simulation, manual simulation using event scheduling, single channel queue, two server queue, and simulation of inventory problem.

Module - 2

Random number generations: Properties of random numbers – Generation of Pseudo – Random numbers – techniques of generating pseudo random numbers; Test for random number; the Chisquare test-the kolmogrov smimov test – Runs test – Gap test – poker test. FCV, symbolic representation.	
Module - 3	
Random – Viriate Generation: Inverse transform technique for Exponential, Uniform. Triangular, weibull, empirical, uniform and discrete distribution. Acceptance rejection method for Poisson and gamma distribution; Direct Transformation for normal distribution.	
Module - 4	
Analysis of simulated Data: Data collection, identifying the distribution, parameter estimations, and goodness of fit tests, verification and validation of simulation models.	
Module - 5	
Comparison and selection of GPSS, SIMSCRIPT, SLAM: Arena simulation languages: development of simulation models using arena simulation package for queuing system, Productions systems, maintenance system.	

TEXT BOOKS:

1. **Discrete, Event system Simulation,** Banks J., Carson J.S. and Nelson B.L., 3rd Edition, Pearson education, Inc 2004 (ISBN 81-7808-505-4).
2. **System Simulation,** Geoffrey Gorden, Prentice Hall of India, 2003.

REFERENCE BOOKS

1. System Simulations, Geoffery Gorden, Prentice Hall of India, 2003.
2. System Simulations and Modeling,. Narsingh deo., Prentice Hall of India 2003.
3. Computer simulations and Modeling, Francis Neelamkovil, , john Wiley & Sons, 1987
4. Simulation Modeling with Pascal, Rath M.Davis & Robert M O Keefe, Prentice Hall Inc.1989.

RAPID PROTOTYPING
B.E, VI Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme 2018-2019]

Course Code	**18MT642**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**
Credits – 03			

Course Objectives: Students will be able to

1. gain knowledge of Selective Laser Sintering , Fusion Deposition Modeling Solid Ground Curing, 3D Printers,
2. understand the working Principles of various Rapid Prototyping Manufacturing process,
3. know the applications of RP Technology

Module – 1

Introduction: Need for the compression in product development, history of RP systems, Growth of RP industry, and classification of RP systems. Stereo Lithography Systems: Principle, Process parameter, data files and machine details, Application.

Module - 2

Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications.

Solid Ground Curing: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: LOM materials. application.

Module - 3

Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Thermal jet printer,3-D printer

Module - 4

Rapid Tooling: Indirect Rapid tooling, Silicon rubber tooling, Aluminium filled epoxy tooling, Spray metal tooling, 3Q keltool, etc. Direct Rapid Tooling**,** Quick cast process, Sand casting tooling, Laminate tooling soft Tooling vs. Hard tooling.

Module - 5

Software for RP: STL files, Overview of Solid view, magics, imics, magic-communicator, etc. Internet based software Rapid Manufacturing Process Optimization: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing. .

Course outcomes: On completion of course students will

CO 1: Have fundamental knowledge of Rapid Prototyping process, Selective Laser Sintering, Fusion Deposition Modelling, Solid Ground Curing, 3D Printers, Rapid Tooling, Software and Errors.

CO 2: understand the working Principles of Selective Laser Sintering, Fusion Deposition Modelling Solid Ground Curing, 3D Printers,.

CO 3: Know the applications of Selective Laser Sintering, Fusion Deposition Modelling, Solid Ground Curing, 3D Printers, also software tools like Magic, MMIC.

TEXT BOOKS:

1. Stereo Lithography and other RP & M Technologies, Paul F.Jacobs: SME, NY 1996.
2. Rapid Manufacturing, Fulham D.T & Dinjoy S.S Verlog London2001.

REFERENCE BOOKS

1. Rapid Prototyping, Terry Wohlers Wohler's Report 2000"Wohler's Association 2000.
2. Rapid Prototyping Materials, Gurumurthi, IISc Bangalore.
3. Rapid Automated, Lament wood. Indus press New York

ARTIFICIAL NEURAL NETWORKS

B.E, VII Semester, Mechatronics Engineering

[As per Choice Based Credit System (CBCS) scheme 2018-19]

Subject Code	**18MT643**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course objectives:

- To provide adequate knowledge about architecture of different Artificial Neural Networks.
- To describe the different learning algorithms of neural networks.
- To find the solutions for non-linear separability, noise cancelling, image classification, vector quantization etc., by applying neural networks

Modules	**RBT Level**
Module – 1	
Introduction: Biological Neuron – Artificial Neural Model - Types of activation functions – Architecture: Feed forward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks. Learning: Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perception Learning Algorithm, perception Convergence Theorem.	**L1, L2, L3**
Module – 2	
Supervised Learning: Perception learning and Non Separable sets,α-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, μ-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Back propagation Learning Algorithm, Practical consideration of BP algorithm.	**L1, L2, L3**
Module – 3	
Support Vector Machines and Radial Basis Function: Learning from Examples, Statistical Learning Theory,Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.	**L1 , L2 , L3**
Module – 4	
Attractor Neural Networks: Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory	**L1, L2, L3**

Module – 5	
Self-organization Feature Map: Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps, Application of SOM, Growing Neural Gas.	**L1, L2, L3,**

Course Outcomes: At the end of the course, the students will be able to:

- Demonstrate the artificial neural network architecture, illustrate its learning methods
- Describe the different learning algorithms of neural networks.
- Apply ANN algorithms for classification, function approximation and time series prediction problems.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Neural Networks A Classroom Approach– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition.

Reference Books:

2. Introduction to Artificial Neural Systems-J.M. Zurada, Jaico Publications 1994.
3. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.

SATELLITE COMMUNICATION
B.E, VI Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme 2018-2019]

Course Code	**18MT644**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**
Credits – 03			

Course Objectives: Students will be able to

1. gain Knowledge of various kinds of Satellites, Satellite Subsystems & Orbits, Trajectory, Multiple Access Techniques .
2. understand the Operation of Satellites in space for various applications.

Module - 1	RBT level

SATELLITE ORBITS AND TRAJECTORIES: Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectories, Types of Satellite orbits.	**L1,L2,L4**
Module - 2	
SATELLITE SUBSYSTEM: Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. Earth Station: Types of earth station, Architecture, Design considerations.	**L1,L2,L4**
Module - 3	
NAVIGATION SATELLITES: Introduction**,** Development of Satellite Navigation Systems, Global Positioning System, Working Principle of GPS, GLONASS Satellite System, Applications.	**L1,L2,L4**
Module - 4	
COMMUNICATION SATELLITES: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio,	**L1,L2,L4**
Module - 5	
REMOTE SENSING SATELLITES: Introduction, Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications.	**L1,L2,L4**

Course outcomes:

On completion of course students will

CO 1: have Knowledge of various kinds of Satellites, Satellite Subsystems & Orbits, Trajectory.

CO 2: understand the Operation of Satellites in space for various applications

TEXT BOOKS:

1. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.

References:

1. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017, ISBN: 978-81-265-0833-4

Computer Integrated Manufacturing
B.E, VI Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme 2018-2019]

Course Code	**18MT645**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**
Credits – 03			

Course Objectives: Students will be able to

1. gain Knowledge of basics concepts of CIM
2. understand the concepts of high volume production, flow line analysis and line balancing, automated. assembly system, computerized manufacturing planning & CNC centers .
3. apply CIM technology for providing manufacturing solutions.

Module - 1

Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, High Volume Production Introduction Automated flow line-symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Rachet & Pawl, Geneva wheel, Buffer storage, control functions-sequence, safety, Quality, Automation for machining operation.

Module - 2

Analysis Of Automated Flow Line & Line Balancing Properties General terminology and analysis, Analysis of Transfer Line without storage upper bound approach, lower bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with simple problem, Partial automation with numerical problems, flow lines with more than two stages, Manual Assembly lines, Minimum Rational Work Element Work station process time, Cycle time, precedence constraints. Precedence diagram, Balance delay methods of line balancing-largest Candidate rule, Kilbridge and Westers method, Ranked positional weight method

Module - 3

Automated Assembly Systems Design for automated assembly systems, types of automated assembly system, Parts feeding devices-elements of parts delivery system-hopper, part feeder, Selectors, feedback, escapement and placement analysis of Multistation Assembly Machine analysis of single station assembly. Automated Guided Vehicle System: Introduction, Vehicle guidance and routing, System management, Quantitative analysis ofAGV\'s with numerical problems and application.

Module - 4

Computerized Manufacturing Planning System Introduction, Computer Aided Process Planning, Retrieval types of process planning, Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning.

Module – 5

CNC Machining Centers: Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning.

Course outcomes: On completion of the course student will

CO 1: have fundamental knowledge of CIM

CO 2: understand the concepts of high volume production, flow line analysis and line balancing, automated, assembly system, computerized manufacturing planning & CNC centers.

CO 3: apply CIM technology for providing manufacturing solutions

TEXT BOOKS:

1. Automation, Production system & Computer Integrated manufacturing, M. P. Groover Person India, 2007 2nd edition.
2. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India.

REFERENCE BOOKS
1. Computer Integrated Manufacturing, J. A. Rehg & Henry. W. Kraebber. 2. CAD CAM by Zeid, Tata McGraw Hill.

OPEN ELECTIVE-A

ROBOTICS & AUTOMATION
B.E, VI Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme 2018-2019]

Course Code	18MT651	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Objectives: Students will be able to

1. gain fundamental knowledge of Robotics and Automation

2. describe Control system, different motions of robots and Material handling system

Module - 1

Basic Concepts:

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

Module - 2

Power Sources And Sensors:

Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

Module - 3

Manipulators, Actuators And Grippers:

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

Module - 4

Industrial Automation:
• List basic Devices in Automated Systems • Distinguish Different Controllers Employed In Automated Systems.
Identify Safety in Industrial Automation

Module - 5

Material handling and Identification Technologies:
Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic
Identification Methods.

Course outcomes: On completion of course students will
CO1: have the knowledge of Joints, Links, Sensors, Control units, Actuators. and elements of Automation
CO2: describe motions and control system of Robots.

TEXT BOOKS:
1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1996.
3. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied
4. Publishers, Chennai, 1998.

REFERENCE BOOKS
1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

Process Instrumentation
B.E, VI Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme 2018-2019]

Course Code	**18MT652**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**
Credits – 03			

Course Objectives:

1. Gain the Knowledge of basic principles of transducers systems.
2. Understand the significant material on important specific areas such as pressure, temperature, measurement, Heat-flux sensors, flow meters etc.
3. Use the Instrumentation & Controls for various industrial applications.

Module – 1

Generalized Configuration, Functional Description & Performance Characteristics Of Measuring Instruments: Functional elements of an instrument: analog & digital modes of operation: null & deflection methods: I/O configuration of measuring instruments & instrument system- methods of correction for interfering & modifying inputs. Measurement Of Displacement: Principle of measurement of displacement, resistive potentiometers, variable inductance & variable reluctance pickups, LVDT, capacitance pickup.

Module – 2

Measurement Of Force, Torque & Shaft Power: Principle of measurement of Force, Torque, Shaft power standards and calibration: basic methods of force measurement; characteristics of elastic force transducer- Bonded strain gauge, differential transformer, piezo electric transducer, variable reluctance/ FM- Oscillator digital systems, loading effects; torque measurement on rotating shafts, shaft power measurement (dynamometers).

Module – 3

Temperature Measurement: Standards & calibration: thermal expansion methods- bimetallic thermometers, liquid-in-glass thermometers, pressure thermometers; thermoelectric sensor (thermocouple)- common Thermocouples, reference junction consideration, special materials, configuration & techniques; electrical resistance sensors- conductive sensor (resistance thermometers), bulk semiconductors sensors (thermistors); junction semiconductor sensors; digital thermometers.

Module – 4

Pressure Measurement: Standards & calibration: basic methods of pressure measurement; dead weight gauges & manometer, manometer dynamics; elastic transducers, high pressure measurement; low pressure (vacuum) measurement- McLeod gauge, Knudsen gauge, momentum-transfer (viscosity) gauges, thermal conductivity gauges, ionization gauges, dual gauge technique.

Module - 5

Flow Measurement: Local flow velocity, magnitude and direction. Flow visualization. Velocity magnitude from pitot static tube. Velocity direction from yaw tube, pivoted vane, served sphere, dynamic wind vector indicator. Hot wire and hot film anemometer. Hot film shock-tube velocity sensors.

Course outcomes: On completion of the course students will

CO1: have the knowledge of design instruments with good precision and Calibrate the designed instruments.

CO2: understand measurement as applied to research & development operations & also to monitoring & control of industrial & military systems & processors.

CO3: illustrate the various applications in the field of DCS & SCADA.

TEXT BOOKS:

1. **Measurement systems application and design-** ERNEST O DOEBELIN, 5th Edition Tata McGraw Hill.

REFERENCE BOOKS

1. Instrumentation Devices & Systems- Rangan, Mani and Sharma 2nd Edition, Tata McGraw Hill.
2. Process Instruments & Controls Hand Book Considine- D.M. Mc Graw Hill.
3. Transducers & Instrumentation- DVS Murthy, Prentice Hall of India.
4. Instrumentation & Process Measurements- W.Bolton,Universities Press.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY,
BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education(OBE) and Choice Based Credit System
(CBCS) (Effective from the academic year 2018– 19)

VII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18MT71	Industrial Robotics		3	--	--	03	40	60	100	3
2	PCC	18 MT72	Thermal Engineering		3	2	--	03	40	60	100	3
3	PEC	18 MT73X	Professional Elective - 2		3	--	--	03	40	60	100	3
4	PEC	18 MT74X	Professional Elective - 3		3	--	--	03	40	60	100	3
5	OEC	18 MT75X	Open Elective -B		3	--	--	03	40	60	100	3
6	PCC	18 MTL76	Robotics Lab		--	2	2	03	40	60	100	2
7	PCC	18 MTL77	Thermal -Laboratory		--	2	2	03	40	60	100	2
8	Project	18 MTP78	Project Work Phase - 1		--	--	2	--	100	--	100	1
9	Internship	--	Internship	(If not completed during the vacation of VI and VII semesters, it shall be carried out during the vacation of VII and VIII semesters)								
				TOTAL	**15**	4	**6**	**21**	**380**	**420**	**800**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective - 2

Course code under 18MT73X	Course Title
18 MT731	Automation In Process Control
18 MT732	Signal Process
18 MT733	Real Time Systems
18 MT734	OOPS using C++
18 MT735	Analytical Instrumentation

Professional Electives - 3

Course code under 18MT74X	Course Title
18 MT741	Finite element analysis.

18 MT742	Machine Learning
18 MT743	Artificial Intelligence
18 MT744	Digital Image Processing
18 MT745	Mechanical vibration

Open Elective –B

(i) 18 MT751 Biomedical Signal Processing
(ii) 18 MT752 Mechatronics system design

Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department (Please refer to the list of open electives under 18MT75X).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the program.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the program.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Project work:

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

CIE procedure for Project Work Phase - 1:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the Project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.
The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship Requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

INDUSTRIAL ROBOTICS
SEMESTER – VII (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT71**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
		Exam Hours	**03**

CREDITS – 03

Course objectives: student will be able to

1. Gain knowledge of Robotics and automation.

2. Understand the working methodology of robotics and automation.

3. Write the program for robot for various applications

Modules	**RBT Level**
Module – 1	
Fundamentals of Automation: Automation and robotics, Robotics in Science Fiction , Brief history of robotics, robotics market and the future prospects**.10Hours**	**L1, L2, L4**
Module – 2	
Fundamentals of Robotics: robot anatomy, work volume, robot drive systems, control systems, precision of movement, end effectors, robotic sensors, robot programming and work cell control, robot applications.**10Hours**	**L1, L2, L4**
Module – 3	
Basic control systems and components: Basic control systems concepts and models, Controllers, control system analysis, robot sensors :Position& Velocity Sensors ,Actuators: Pneumatic & Hydraulic Actuators, Electric Motors, Stepper Motors& AC Servomotors.10Hours	**L1 , L2 , L4**
Module – 4	
Sensors in Robotics: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics. **Machine Vision** :Introduction to machine vision, sensing and digitizing function in machine vision, robotic applications.10Hours	**L1, L2, L4**
Module – 5	
Robot Programming: Methods of robot programming, lead -through programming methods,a robot program as a path in space, motion interpolation, wait, signal and delay commands,branching, capabilities and limitations of lead-through methods.**10Hours**	**L1, L2, L3, L4**

Course outcomes:

By the end of the course the student will

CO1: have knowledge of Robotics, automation, robotics motion, sensors and control, machine vision, robotic programming and roles of robots in industry.

CO2: understand the working methodology of robotics and automation, motion and control, machine vision and programming, application of robots in industry.

CO3: write the program for robot for various applications.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from eachmodule.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, "Industrial Robotics: Technology, Programming and Applications", 2 nd Edition, Tata McGraw Hill, 2012.

2. Roland Siegwart, Illah R. Nourbakhsh, an d Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", 2 nd Edition, PHI, 2011

Thermal Engineering

SEMESTER – VII (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT72**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03 + 2 (Tutorial)**	**SEE marks**	**60**
		Exam Hours	**03**

CREDITS – 04

Course objectives: This course will enable students to:

- Gain fundamental knowledge of thermodynamics, and heat transfer.
- Understand the laws of thermodynamics and heat transfer.
- Formulate and determine thermodynamic and heat transfer parameters.

Modules	**RBT Level**
Module – 1	
Thermodynamics - Fundamental Concepts & Definitions: Thermodynamics: definition and scope, Microscopic and Macroscopic approaches. Engineering thermodynamics: definition, some practical applications of engineering thermodynamic. System (Closed system) and Control Volume (open system): Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process,	**L1, L2, L3**

quasi-static process, cyclic and non-cyclic presses; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium. Statement of Zeroth law of thermodynamics. (No Numericals). **Work and Heat:** Thermodynamic definition of work; examples, sign convention. Displacement work: at part of a system boundary, at whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work, Electrical work. Other types of work, Heat; definition, units and sign convention, simple problems.	
Module – 2	
First Law of Thermodynamics: Statement of the First law of thermodynamics, extension of the First law to non-cyclic process, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, simple problems. **Second Law of Thermodynamics:** Thermal Reservoir, Concepts of Heat Engine, Heat Pump, coefficients of performance. Keivin – Planck statement of the Second law of Thermodynamics; PMM II and PMM I, Claussius statement of second law of Thermodynamics, equivalence of the two statements; reversible hat engines, Carnot cycle, Carnot principles. Thermodynamic temperature scale, simple problems.	**L1, L2, L3, L4**
Module – 3	
Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, Comparison of Otto, Diesel and dual cycles, simple problems. **Heat Transfer - Introductory Concepts and Definitions:** Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanics. Boundary conditions of 1st, 2nd and 3rd Kind, simple problems.	**L1 , L2 , L3, L4**
Module – 4	
Conduction: Derivation of general three dimensional conduction equations in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance, Simple problems. **Free or Natural Convection:** Application of dimensional analysis for free convection- physical significance or Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Simpleproblems.	**L1, L2, L3, L4**
Module – 5	
Forced Convections: Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers, Simple problems. **Radiation Heat Transfer:** Thermal radiation; definitions of various terms used in radiation heat transfer, Stefan-Boltzman law, Kircoff's law. Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surface, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle, Simple problems.	**L1, L2, L3, L4**

Course Outcomes: At the end of the course, the students will be able to,

- CO1: Understand the concepts of system, properties, energy interaction, laws of thermodynamics, and heat transfer, and boundary conditions.
- CO2: Apply laws of thermodynamics and laws of heat transfer to engineering system. Define the thermodynamic process and cycle. Determine the energy interaction.
- CO3: Develop heat conduction and temperature distribution equation and describe thermal resistance concept. Determine the rate of heat transfer and temperature at any point in the heat transfer domain.
- CO4: Dimensional analysis of heat transfer and use of dimensional number. Study the effect of contact resistance and addition of insulation.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Basic and applied Thermodynamics, P. K. Nag, Tata McGraw Hill Pub. 2002.
2. Heat & Mass transfer, Tirumaleshwar, Pearson education 2006.

Reference Books:

1. Engineering Thermodynamics, J. B. Jones and G. A. Hawkins, John Wiley and Sons.
2. Basic Engineering Thermodynamicsdata hand book by B. T. Nijaguna. (To be supplied in the examination)
3. Thermodynamics, An Engineering approach, Yunus a. Cenegal and Michael a.Boles, Tata McGraw Hill publications, 2002.
4. Heat transfer-A basic approach, Ozisik, Tata McGraw Hill 2002.
5. Heat transfer, P. K. Nag, Tata Mc Graw Hill 2002.
6. Heat transfer, a practical approach, Yunus a- Cengel Tata Mc Graw Hill.

B.E MECHATRONICS ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VII

ROBOTICS LABORATORY

Course Code	18MTL76	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

1. Understand the Importance & Applications of Robots in Virtual Environment.

2: Design the Robots system for Real-time Applications.

Sl.NO	LIST OF EXPERIMENTS

PART-A

1. Design the Robot programming for Point to Point using two Cubes.
2. Design the Robot programming for Drilling Operation using Cube and Cylinder.
3. Design the Robot programming using Smart Components.
4. Design the Robot programming for Multimove Operation.
5. Design the Robot programming for Conveyor Tracking System.
6. Design the Robot programming for Continuous Path Operation on Cylinder

PART-B

1. Design a Robot System for Pick and Place Operation.
2. Design a Robot System for Point to Point operation.[Cube]
3. Design a Robot System for Continuous Path Operation.
4. Design a Robot System for Circle Path Operation.
5. Design a Robot System for Drilling Operation of Cube.
6. Design a Robot System for Continuous Path Operation for any 3 Objects [Cube, Box, Circle]

Revised Bloom's Taxonomy Level	**L1,L2,L3,L4,L5**

Course outcomes:

At the end of the course the student will be able to:

CO1: Analyse the design parameters of Robot for Industrial applications on Robo studio.

CO2: Develop Robotics Model & workbench prototype for required specifications on Robo studio.

CO3: Develop & Implement the programs on Industrial Robot for various Real time applications.

CO4: Evaluate the performance of industrial robot for various application programs.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

HEAT TRANSFER LABORATORY

SEMESTER – VII (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MTL77**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
		Exam Hours	**03**

CREDITS – 02

Course objectives: This course will enable students to:

- The primary objective of this course is to provide the fundamental knowledge necessary to understand the behavior of thermal systems.
- This course provides a detailed experimental analysis, including the application and heat transfer through solids, fluids, and vacuum. Convection, conduction, and radiation heat transfer in one and two dimensional steady and unsteady systems are examined.

Parts	RBT Level
Part A	
1. Determination of Thermal Conductivity of a Metal Rod. 2. Determination of Overall Heat Transfer Coefficient of a Composite wall. 3. Determination of Effectiveness on a Metallic fin. 4. Determination of Heat Transfer Coefficient in a free Convection on a vertical tube. 5. Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.	**L1, L2, L3**
Part B	
1. Determination of Emissivity of a Surface. 2. Determination of Steffan Boltzman Constant. 3. Determination of LMDT and Effectiveness in a Parallel Flow Heat Exchangers 4. Determination of LMDT and Effectiveness in a Counter Flow Heat Exchangers	**L1, L2, L3**

Course Outcomes: At the end of the course, the students will be able to,

CO1: Perform experiments to determine the thermal conductivity of a metal rod.

CO2: Conduct experiments to determine convective heat transfer coefficient for free and forced convecti and correlate with theoretical values.

CO3: Estimate the effective thermal resistance in composite slabs and efficiency in pin-fin

CO4: Determine surface emissivity of a test plate

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing two questions, each of 40marks, one is from part A another from part B. Viva voce marks is 20.
- The total marks will be proportionally reduced to 60 marks as SEE marks. CIE marks is 40, out of which 20 marks for record and IA test each.

PROFESSIONLA ELECTIVE -2

AUTOMATION IN PROCESS CONTROL
SEMESTER –VII (MT)

[As per Choice Based Credit System (CBCS) scheme]

Course Code	**18MT731**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (08 Hours per Module)**	**Exam Hours**	**03**

Credits – 03

Course Objectives: This Course will enable students to:

- gain knowledge of developing basic skills necessary for importance Process controller (Digital and Analog Controller) Using in Various Industry.
- understand the concepts and various Operation using Automation Process System by using various Process Control System.
- determine and Diagnosis the Principles of Various Digital and Analog Controller and ADC, DAC.

Module-1	**RBT Levels**
INTRODUCTION TO PROCESS CONTROL: process control block diagram, control system evolution. Final control: introduction to finalcontrol operation, signal conversions, actuators, control elements. Alarm and annunciators, control drawing: P & ID symbols and diagrams, flow sheet symbols, inter logic symbols, graphic symbols.	**L1, L2**
Module-2	
Introduction, process characteristics, control system parameters, discontinuous control modes, continuouscontrol modes, and composite control modes	**L1, L2**
Module-3	
DISCRETE-STATE PROCESS CONTROL: Introduction, definition and characteristics of discrete state process control. Control-loopcharacteristics: Introduction, control system configuration, multivariable control systems, control system quality, stability, and process loop tuning.	**L1,L2, L3**
Module-4	
ANALOG CONTROLLERS: Introduction, general features, electronic controllers, pneumatic controllers, designs considerations	**L1, L2**
Module-5	
DIGITAL–TO-ANALOG CONVERTERS: V-F, and F-V converters, performance specifications, D-A conversion techniques (R-2R & binary weighted) multiplying DACapplications. A-D conversion techniques (flash, successive approximation, single slope, dual slope), over sampling converters.	**L1, L2, L3**

Course Outcomes: At the end of the course, students should be able to:

- have a knowledge of Process Control System on various Process Parameter (P,PI,PID) and Converte
- understanding the concepts of Automation in Process Control Involved in Measurement System and Controller used in Industry.
- Application of Digital and Analog Controller used in various Automated Application based on Controller Parameters

Text Book:

Process Control Instrumentation Technology-C D Johnson

Reference Books:

1. Design with operational amplifiers and analog integrated circuits-3rd Edition, SERGIO FRANCO, Tata McGraw Hill.

SIGNAL PROCESSING

SEMESTER – VII (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	**18MT732**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
		Exam Hours	**03**

CREDITS – 03

Course objectives: This course will enable students to:

- gain knowledge of signal, system, transformation and filter.
- understand time domain, frequency domain signals, analog and digital systems.
- operate on signals and systems to bring out its characteristics and desired information.
- design analog and digital filers and implement discrete time systems.

Modules	**RBT Level**
Module – 1	
Introduction: Definitions of a signal and a system, classification of signals, basic Operations on signals, Basic elementary signals, properties of systems.	**L1, L2, L3, L4**
Module – 2	
Time-domain representations for LTI systems: Convolution, impulse response representation, Convolution Sum and Convolution Integral. Properties of impulse response representation.	**L1, L2, L3, L4**
Module – 3	
Discrete Fourier Transforms (DFT): Introduction to DFT, multiplication of two DFTs- the circular convolution, use of DFT in linear filtering, overlap-save and overlap-add method. Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and Decimation-in-frequency algorithms.	**L1 , L2 , L3**
Module – 4	
FIR filter design: Characteristics of commonly used analog filters – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR filters from analog filters (Butterworth and Chebyshev) - impulse invariance method. Mapping of transfer functions: Approximation of derivative (bilinear transformation) method,	**L1, L2, L3, L4**
Module – 5	
FIR filter design: Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Hanning. **Implementation of discrete-time systems:** Structures for IIR systems-direct form I and direct form II, cascade, lattice and parallel realization and FIR systems- direct from, linear phase, cascade and lattice.	**L1, L2, L3, L4**

Course Outcomes: At the end of the course, the students will be able to

1. Have knowledge of signal, system, transformation, and filter design.
2. Apply the knowledge to extract the information form signals and systems.
3. Transform the signals from one domain to other domain using transformation techniques.
4. design analog and digital filters for specific applications

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Digital signal processing – Principles Algorithms & Applications, Proakis&Monalakis, Pearson education, 4th Edition, New Delhi, 2007.
2. "Signals and Systems", Simon Haykin and Barry Van Veen John Wiley & Sons, 2001.

Reference Books:

1. Discrete Time Signal Processing, Oppenheim & Schaffer, PHI, 2003.
2. Digital Signal Processing, S. K. Mitra, Tata Mc-Graw Hill, 2nd Edition, 2004.
3. Digital Signal Processing, Lee Tan: Elsivier publications, 2007
4. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002
5. H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006
6. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005.
7. Ganesh Rao and SatishTunga, "Signals and Systems", Sanguine Technical Publishers, 2004.

REAL TIME SYSTEM
SEMESTER – VII (EC/TC)

[As per Choice Based Credit System (CBCS) scheme]

Course Code	**18MT733**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (08 Hours per Module)**	**Exam Hours**	**03**
Credits – 03			

Course Objectives: This Course will enable students to:

- Understand the fundamentals of Real-time systems and its classifications.
- Describe the concepts of computer control and hardware components for Real-Time Application.
- Discuss the languages to develop software for Real-Time Applications.
- Explain the concepts of operating system and RTS development methodologies.

Module-1	**RBT Levels**

Introduction to Real-Time Systems: Historical background, Elements of a Computer Control System, RTS- Definition, Classification of Real-time Systems, Time Constraints, Classification of Programs. **Concepts of Computer Control:** Introduction, Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control, Hierarchical Systems. **(Text: 1.1 to 1.6 and 2.1 to 2.6)**	**L1, L2**
Module-2	
Computer Hardware Requirements for Real-Time Applications: Introduction, General Purpose Computer, Single Chip Microcomputers and Microcontrollers, Specialized Processors, Process-Related Interfaces, Data Transfer Techniques, Communications, Standard Interface. **(Text: 3.1 to 3.8).**	**L1, L2**
Module-3	
Languages for Real-Time Applications: Introduction, Syntax Layout and Readability, Declaration and Initialization of Variables and Constants, Cutlass, Modularity and Variables, Compilation of Modular Programs, Data types, Control Structures, Exception Handling, Low-level facilities, Co-routines, Interrupts and Device Handling, Concurrency, Real-Time Support, Overview of Real-Time Languages. **(Text: 5.1 to 5.14).**	**L1,L2, L3**
Module-4	
Operating Systems: Introduction, Real-Time Multi-Tasking OS, Scheduling Strategies, Priority Structures, Task Management, Scheduler and Real-Time Clock Interrupt Handler, Memory Management, Code Sharing, Resource Control, Task Co-Operation and Communication, Mutual Exclusion.**(Text: 6.1 to 6.11).**	**L1, L2**
Module-5	
Design of RTS – General Introduction: Introduction, Specification	**L1, L2, L3**
Document, Preliminary Design, Single-Program Approach, Foreground/Background System. **RTS Development Methodologies:** Introduction, Yourdon Methodology, Ward and Mellor Method, Hately and Pirbhai Method. **(Text: 7.1 to 7.5 and 8.1, 8.2, 8.4, 8.5).**	

Course Outcomes: At the end of the course, students should be able to:

- Explain the fundamentals of Real time systems and its classifications.
- Understand the concepts of computer control and the suitable computer hardware requirements for real-time applications.
- Describe the operating system concepts and techniques required for real time systems.
- Develop the software algorithms using suitable languages to meet Real time applications.
- Apply suitable methodologies to design and develop Real-Time Systems.

Text Book:

Real-Time Computer Control, by Stuart Bennet, 2nd Edn. Pearson Education. 2008.

Reference Books:

2. C.M. Krishna, Kang G. Shin, "Real –Time Systems", McGraw –Hill International Editions,1997.
3. Real-Time Systems Design and Analysis, Phillip. A. Laplante, second edition, PHI,2005.
4. Embedded Systems, Raj Kamal, Tata McGraw Hill, India, third edition,2005.

B.E MECHATRONICS ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER - VII

OBJECT ORIENTED PROGRAMMING USING C++

Course Code	**18MT734**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P)	**(3:0:0)**	**SEE Marks**	**60**
Credits	**03**	**Exam Hours**	**03**

Course objectives: student will be able to

• Gain Knowledge of fundamentals of C++, classes, objects, constructors & destructors, function prototypes, private and public accessand class implementations with inheritance and polymorphism.

• Understand the C++ Programming using classes, objects, constructors & destructors, function prototypes, private and public accessand class implementations with inheritance and polymorphism.

Module-1	RBT LEVEL
Beginning with C++ and its features: What is C++, Applications and structure of C++ program, Different Data types, Variables, Different Operators, expressions, operator overloading and control structures in C++ (Topics from Chapter's -2,3 of Text)10Hours	L2 ,L4
Module-2	
Functions, classes and Objects: Functions, Inline function, function overloading, friend and virtual functions, Specifying a class, C++ program with a class, arrays within a class, memory allocation to objects, array of objects, members, pointers to members and member functions (Selected Topics from Chap-4,5 of Text).**10Hours**	L2,L4
Module-3	
Constructors, Destructors and Operator overloading: Constructors, Multiple constructors in a class, Copy constructor, Dynamic constructor, Destructors, Defining operator overloading, Overloading Unary and binary operators, Manipulation of strings using operators (Selected topics from Chap-6, 7 of Text).10Hours	L2,L4
Module-4	
Inheritance, Pointers, Virtual Functions, Polymorphism: Derived Classes, Single, multilevel, multiple inheritance, Pointers to objects and derived classes, this pointer, Virtual and pure virtual functions (Selected 6 topics from Chap-8, 9 of Text).10Hours	L2,L4
Module-5	

Streams and Working with files: C++ streams and stream classes, formatted and unformatted I/O operations, Output with manipulators, Classes for file stream operations, opening and closing a file, EOF (Selected topics from Chap-10, 11 of Text)	L2,L4

Course outcomes:

By the end of the course the student will

CO1: have Knowledge of fundamentals of C++, classes, objects, constructors & destructors, function prototypes, private And public access and class implementations with inheritance and polymorphism.

CO2: understand the C++ Programming using classes, objects, constructors & destructors, function prototypes, private and public access and class implementations with inheritance and polymorphism

Text Books:

1. Object Oriented Programming with C++, E.Balaguru swamy, TMH, 6th Edition, 2013

Reference Books:

1.Object Oriented Programming using C++, Robert Lafore, Galgotia publication 2010.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module.

ANALYTICAL INSTRUMENTATION
B.E, VII Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme 2017-18]

Course Code	**18MT735**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8Hours per Module)**	**Exam Hours**	**03**

Credits –03

Course objectives: Students will be able to

- gain knowledge of developing basic skills necessary for importance Analytical Instrumentation
- understand the basic concepts and various Operation using Analytical Devices used in Biomedical Industry.

Module - 1	**RBT LEVEL**
Visible ultraviolet spectrophotometers: Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, spectrophotometers, infrared spectroscopy theory, instrument and its types.	**L1 , L2**
Module - 2	
Chromatography: Gas chromatograph- basic concepts, parts of gas chromatograph. Method of peak areas, liquid chromatography- basic concepts, types if liquid chromatography, the liquid chromatograph.	**L1 , L2**
Module - 3	
Mass spectrometer & NMR spectrometer: Basic concept, types of mass spectrometer, components of mass spectrometer, resolution and applications. Principle of NMR, constructional details, sensitivity enhancement for analytical NMR spectroscopy. Use of computers with NMR spectrometers.	**L1 , L2**
Module - 4	
Fluorimeters & phosphorimeters: Principle of fluotrscence, measurement of fluotrscence, spectro fluotrscence, microprocessor based spectro fluotrscence, Measurement of Phosphorescence	**L1 , L2**
Module - 5	
Blood gas analyzer: Principle of pH measurement, electrode of pH measurement, Blood pH measurement, measurement of Blood pCO2, measurement of Blood pO2, complete Blood gas analyzer, commercially available Blood gas analyzers..	**L1 , L2**

Course outcomes: On completion of the course the student will

CO 1: have knowledge of Analytical Instrumentation on various Biomedical Module and Different Types of Measurement Meters and Measurement System

CO 2: understanding the basic concepts of Analytical Instrumentation and various Measurement Meters and Measurement System used in Biomedical Industry.

Text Books:

1. Hand book of analytical Instruments by R. S. Khandpur, TMH Publications 1st Ed 1989, New Delhi

Reference Books:

1. Instrumental methods of analysis by H. H. Willard, L. L. Merritt & J. A. Dean, CBS Publications 7th Ed 1988
2. Principles of Instrumental analysis by S. J. Holler & T. A. Nilman Saunders college Publications 5st Ed 1998

PROFESSIONAL ELECTIVE- 3

FINITE ELEMENT ANALYSIS

SEMESTER – VII (MT)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	18MT741	CIE Marks	40
Number of Lecture Hours/Week	04	SEE marks	60
Total number of Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- To learn basic principles of finite element analysis procedure.
- To learn the theory and characteristics of finite elements that represent engineering structures.
- To learn and apply finite element solutions to structural, thermal problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

Modules	RBT Level
Module – 1	
Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, and stress-strain relations for plane stress and plane strains. General description of Finite Element Method, Application and limitations. Types of elements based on geometry. Node numbering, Half band width.	**L1, L2, L3,**
Module – 2	
Basic Procedure: Euler - Lagrange equation for bar, beam (cantilever / simply supported fixed) Principle of virtual work, principle of minimum potential energy, Raleigh's Ritz method. Direct approach for stiffness matrix formulation of bar element. Galerkin's method.	**L1, L2, L3, L4**
Module – 3	
Solution of 1-D Bars: Solutions of bars and stepped bars for displacements, reactions and stresses by using penalty approach and elimination approach. Guass-elimination technique.	**L1 , L2 , L3, L4**
Module – 4	
Higher Order Elements: Langrange's interpolation, Higher order one dimensional elements-Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadric element Isoparametric, Sub parametric and Super parametric elements. numerical integration : 1, 2 and 3 gauge point for 1D and 2D cases.	**L1, L2, L3**
Module – 5	
Heat Transfer: Steady state heat transfer, 1D heat conduction governing equations. Functional approach for heat conduction. Galerkin's approach for heat conduction. 1D heat transfer in thin fins.	**L1, L2, L3, L4**

Course Outcomes: At the end of the course, the students will be able to,

CO1: Understand the concepts behind formulation methods in FEM.

CO2:Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.

CO3:Develop element characteristic equation and generation of global equation.

CO4: Able to apply suitable boundary conditions to a global equation for bars, beams, heat transfer, axi symmetric problems and solve them displacements, stress and strains induced.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Logan, D. L., A first course in the finite element method,6th Edition, Cengage Learning, 2016.

2. Rao, S. S., Finite element method in engineering, 5th Edition, Pergaman Int. Library of Science, 2010.

3. Chandrupatla T. R., Finite Elements in engineering, 2nd Edition, PHI, 2013.

Reference Books:

1. J.N.Reddy, "Finite Element Method"- McGraw -Hill International Edition.Bathe K. J. Finite Elements Procedures, PHI.

2. Cook R. D., et al. "Conceptsand Application of Finite Elements Analysis"- 4th Edition, Wiley & Sons, 2003.

3. "Finite Element Methods for Engineers" U.S. Dixit, Cengage Learning, 2009

4. Finite Element Methods, Daryl. L. Logon, Thomson Learning 3rd edition, 2001.

MACHINE LEARNING

B.E, VII Semester, Mechatronics Engineering

[As per Choice Based Credit System (CBCS) scheme 2018-19]

Subject Code	18MT742	CIE Marks	40
Number of Lecture Hours/Week	03	SEE marks	60
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives:

- To gain Knowledge of Machine Learning, Decision Tree Learning, Artificial Neural Networks, Bayesian Learning, Evaluating Hypothesis.
- To understand the working methodology of Machine Learning, Decision Tree Learning, Artificial Neural Networks, Bayesian Learning, evaluating Hypothesis

Modules	RBT Level

Module – 1	
Introduction: Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space.	**L1, L2, L3**
Module – 2	
Plasticity effects: Irwin plastic zone correction. Dugdale's approach. The shape of the plastic zone for plane stress and plane strain cases. T \he plate thickness effect, numerical problems. Determination of Stress intensity factors and plane strain fracture toughness: Introduction ,estimation of stress intensity factors. Experimental method- Plane strain fracture toughness test, The Standard test,sizerequirements,etc.	**L1, L2, L3**
Module – 3	
Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Backpropagation algorithm.	**L1 , L2 , L3**
Module – 4	
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier.	**L1, L2, L3**
Module – 5	
Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.	**L1, L2, L3,**

Course Outcomes: At the end of the course, the students will be able to:

- Have Knowledge of Machine Learning, Decision Tree Learning, Artificial Neural Networks, Bayesian Learning, Evaluating Hypothesis.
- Understand the working methodology of Machine Learning, Decision Tree Learning , Artificial Neural Networks, Bayesian Learning, Evaluating Hypothesis.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, springer series in statistics.
2. EthemAlpaydın, Introduction to machine learning, second edition, MIT press.

ARTIFICIAL INTELLIGENCE

B.E, VII Semester, Mechatronics Engineering

[As per Choice Based Credit System (CBCS) scheme 2018-19]

Subject Code	**18MT743**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course objectives:

- To gain Knowledge of Artificial Intelligence, Production Rules, Search algorithms, Expert System & its architectures, Machine Learning.
- To understand the working methodology of Search Algorithms, Expert System & Machine Learning.

Modules	**RBT Level**
Module – 1	
Artificial Intelligence: Introduction, History of AI, defining, Importance of AI, Early Work in AI, Scope of AI, AI and Related fields, AI Techniques, Alan Turing Machine, Intelligent Agents	**L1, L2, L3**
Module – 2	
Space Representation: Defining the Problem, Production Rules for water jug problem, Breadth-First Search Algorithm, Depth-First Search Algorithm, Generate & Test Algorithm, Hill Climbing Algorithms: Simple Hill Climbing Algorithm, Steepest-Ascent Hill Climbing Algorithm.	**L1, L2, L3**
Module – 3	
Expert Systems: Introduction, Characteristics of Expert System, Need of an Expert System, Expert System Architecture, Steps to develop an Expert System ,case studies: MYCIN, DENDRAL **Neural Nets:** Introduction, Network Structures, Application of Neural Nets.	**L1 , L2 , L3**
Module – 4	
Expert Systems Architectures: Introduction ,Rule-Based System Architectures ,Non-Production system Architectures: Semantic Network Architectures, Frame Architectures ,Decision Tree Architectures, Blackboard System Architectures, Analogical Reasoning Architectures, Neural Network Architectures.	**L1, L2, L3**
Module – 5	
Introduction to Machine Learning: Introduction**,** Perceptrons, Perceptron Learning Algorithm, Checkers Playing Examples, Learning automata: Automaton model, Temperature Control Model, CLA representation of NIM game, Genetic Algorithms, Intelligent editors.	**L1, L2, L3,**

Course Outcomes: At the end of the course, the students will be able to:

- Have Knowledge of Artificial Intelligence, Production Rules, Search Algorithms, Expert System & its architectures, Machine Learning.
- Understand the working methodology of Search Algorithms, Expert System & Machine Learning.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Artificial Intelligence, Elaine Rich & Kevin Knight, M/H 2004.
2. Introduction to AI & ES, Dan W. Patterson, Prentice Hall of India, 2012.
3. Artificial Intelligence A Practical Approach, Er.Rajiv Chopra, S.Chand& Company Ltd,2012.Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

Reference Books:

1. Principles of Artificial intelligence, Springer Vertag, Berlin, 1981.
2. Artificial intelligence in business, Science & Industry, Wendy B, Ranch
3. A guide to Expert systems, Waterman, D. A. Addison – Wesley inc. 1986.
4. Building Expert Systems, Hayes, Roth, Waterman, D. A. Addison Wesley, 1983.

DIGITAL IMAGE PROCESSING

B.E, VII Semester, Mechatronics Engineering

[As per Choice Based Credit System (CBCS) scheme 2018-19]

Subject Code	18MT744	CIE Marks	40
Number of Lecture Hours/Week	03	SEE marks	60
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives:

- To gain knowledge of image, sampling, quantization, enhancement, and restoration of image.
- To understand different methods of image enhancement and restoration.
- To transform image using different transformations.

Modules	RBT Level

Module – 1	
Digital image fundamentals: What is Digital image processing? Fundamental steps in digital image processing, components of an imageprocessing system, elements of Visual Perception.	**L1, L2, L3**
Module – 2	
Images sensing and Acquisition: images sampling and Quantization's, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.	**L1, L2, L3**
Module – 3	
Image Transforms: Two-dimensional orthogonal & unitary transforms, properties of unitary transforms, two dimensional discrete Fourier transform. Discrete cosine transform, Hadamard transform, Haar transform.	**L1 , L2 , L3**
Module – 4	
Image Enhancement: Image Enhancement in Spatial domain, Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/Logic Operations. Basics of Spatial Filtering Image enhancement in the Frequency Domain filters, Smoothing Frequency Domain filters, Sharpening Domain filters, homo morphic filtering.	**L1, L2, L3**
Module – 5	
Model of image degrading/restoration process: noise models, Restoration in the Present of Noise, Linear Position-Invariant Degradations, inverse filtering, minimum mean square error (Weiner) filtering. Color Fundamentals. Color Models, Pseudo color. Image Processing., processing basics of full color image processing	**L1, L2, L3,**

Course Outcomes: At the end of the course, the students will be able to:

- have knowledge of different images, enhancement and restoration.
- understand how images are formed, sampled, quantized and represented digitally.
- process the images by applying different operations and transformation.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1 "Digital Image Processing", Rafael C. Gonzalez and Richard e. Woods, Pearson Education, 2001, 2nd edition.

Reference Books:

1. "Fundamentals of Digital Image Processing", Anil K, Jain, Pearson Edun, 20010
2. "Digital Image Processing and Analysis", B. Chanda and D. Dutta Majumdar, PHI, 2003

Mechanical Vibrations
B.E, VI Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme 2018-2019]

Course Code	**18MT745**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

Credits – 03

Course Objectives: Students will be able to

1. gain knowledge of different vibrations, degrees of freedom, damping systems.
2. understand the mobility of different vibration systems.
3. determine the mobility of single, double and multi degree vibrations using different methods

Module - 1

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats. Un damped Free Vibrations (Single DOF): Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, simple problems.

Module - 2

Damped free vibrations (Single DOF): Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement, simple problems.

Module - 3

Forced Vibrations (Single DOF): Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping, simple problems.

Module - 4

Systems with two DOF: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, Problems.

Module – 5

Numerical Methods for Multi DOF systems: Introduction, Maxwell's reciprocal theorem, influencecoefficients, Rayleigh's method, Dunkerley's method, Stodola method, method of matrix iteration (up totwo iterations) and Problems.

Course outcomes: On completion of course students will

CO1: have knowledge of different vibrations, degrees of freedom, damping systems, magnification factor and transmissibility etc.

CO2: understand the mobility of different vibration systems.

CO3: determine the mobility of single, double and multi degree vibrations using different methods.

TEXT BOOKS:

1. Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4th edition, 2003.
2. Mechanical Vibrations, G. K. Grover, Nemchand and Bros, 6th edition, 1996.
3. Mechanical Vibrations, V. P. Singh, Dhanpat Rai & Company, 3d edition, 2006.

REFERENCE BOOKS

1. Theory of Vibration with Applications, W. T. Thomson, M. D. Dahleh and C. Padmanabhan, Pearson Education Inc, 5th edition, 2008.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's outline Series, Tata McGraw Hill, Special Indian Edition, 2007.
3. Theory and Practice Mechanical Vibrations: J. S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.
4. Mechanical Vibrations: Dr. A. R. K Swamy & Prof. Y. Krishna Murthy, 1st edition 2009.

OPEN ELECTIVE –B

BIOMEDICAL SIGNAL PROCESSING

B.E, VII Semester, Mechatronics Engineering

[As per Choice Based Credit System (CBCS) scheme 2018-19]

Subject Code	18MT751	CIE Marks	40
Number of Lecture Hours/Week	03	SEE marks	60
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives:

- To gain Knowledge of Biomedical Signals, ECG, Signal Conversion & Averaging, Adaptive Noise Cancellation, Data Compression Techniques, Cardiological signal processing, Neurological signal processing.
- To understand the operation of Biomedical Signal Processing ,ECG Signal Conversion & Averaging ,Adaptive Noise Cancellation, Data Compression Techniques, Cardiological signal & Neurological signal processing

Modules	RBT Level
Module – 1	
Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. **Electrocardiography:** Basic electrocardiography, ECG lead systems, ECG signal characteristics. **Signal Conversion:** Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits (Text-1)	**L1, L2, L3**
Module – 2	
Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. **Adaptive Noise Cancelling**: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering.(Text-1)	**L1, L2, L3**
Module – 3	

Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms The Fourier transform, Correlation, Convolution, Power spectrum estimation, Frequency domain analysis of the ECG (Text-1)	**L1 , L2 , L3**
Module – 4	
Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Band pass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Realtime ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor. (Text -2).	**L1, L2, L3**
Module – 5	
Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. Analysis of EEG channels: Detection of EEG rhythms, Template matchingfor EEG, spike and wave detection (Text-2).	**L1, L2, L3,**

Course Outcomes : At the end of the course, the students will be able to:

- Have Knowledge of Biomedical Signals, ECG, Signal Conversion & Averaging, Adaptive Noise Cancellation, Data Compression Techniques, Cardiological signal processing, Neurological signal processing.
- Understand the operation of Biomedical Signal Processing ,ECG Signal Conversion & Averaging ,Adaptive Noise Cancellation, Data Compression Techniques, Cardiological signal & Neurological signal processing.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Books:

1. Biomedical Digital Signal Processing- Willis J. Tompkins, PHI 2001.
2. Biomedical Signal Processing Principles and Techniques- D C Reddy, McGrawHill publications 2005

Reference Books:

1. Biomedical Signal Analysis-RangarajM. Rangayyan, John Wiley & Sons2002

MECHATRONICS SYSTEM DESIGN

SEMESTER – VII (MTE)

[As per Choice Based Credit System (CBCS)

Course Code	**18MT752**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course objectives: This course will enable students to:

1. gain knowledge of basics of Mechatronics system design .
2. understanding various techniques of Mechatronics system design for solving engineering problems.
3. determination of optimization solutions, effective decision making, Convert the data in real time interfacing

Module-1	**RBT Level**
Mechatronics System Design: Mechatronics Definition, integrated design issues in Mechatronics, the Mechatronics design process, the key elements, Application of Mechatronics.	**L1, L2, L3**
Module -2	
Modeling and Simulation of Physical Elements: Operator notation and transfer functions, Block diagrams, manipulations and simulation, block diagram modeling- Direct method and analogy approach, Electrical systems, Mechanical systems (**Rotational and Translational**), electrical-Mechanical Coupling, Fluid systems	**L1, L2, L3**
Module-3	
Actuating Devices, Signals, Systems: Direct Current Motors, Permanent magnet stepper motor, Fluid power actuation, Fluid power design elements, Piezoelectric Actuators Introduction to signals, systems and Controls, Laplace transform solution of ordinary differential equations, System representation, Linearization of Non-linear systems, Time Delays	**L1, L2, L3**
Module -4	
Signal Conditioning and Real time Interfacing: Introduction, elements of Data Acquisition and Control System, Transducers and Signal Conditioning, Devices for data conversion, Data conversion process, Application software.	**L1, L2, L3**
Module -5	
Case Studies: Comprehensive and Data acquisition case studies, data acquisition and control case studies.	**L1, L2, L3**

Course Outcomes: At the end of the course, students will be able to:

1. Discuss about modeling of Mechatronics System .
2. Explain the actuating devices and signals involved in Mechatronics.
3. Select the sensor and Actuator for a Mechatronics application.
4. Convert the data in real time interfacing.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

1. Mechatronics System Design by Devdas Shetty and Richard A Kolk, Second edition, Thomson Learning Publishing Company, Vikas publishing house, 2001.

Reference Books:

1. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.

2. Kenji Uchino and Jayne R. Giniewicz, “Mechatronics" publication: Marcel Dekker, Inc.

3. A. Smaili and F. Mrad, “Applied Mechatronics”, OXFORD university publication April 2008.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education(OBE) and Choice Based Credit System
(CBCS) (Effective from the academic year 2018 – 19)

VIII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18MT81	Automotive Electronics & Hybrid Vehicles		4	--	--	03	40	60	100	3
2	PEC	18MT82X	Professional Elective - 4		3	--	--	03	40	60	100	3
3	Project	18MTP83	Project Work		--	--	2	03	40	60	100	8
4	Seminar	18MTS84	Technical Seminar		--	--	2	03	100	--	100	1
5	Internship	18MTI85	Internship	Completed during the vacation/s of VI and VII semesters and /or VII and VIII semesters.)				03	40	60	100	3
TOTAL					**06**	--	**4**	**15**	**260**	**240**	**500**	**18**

Note: PCC: Professional Core, PEC: Professional Elective.

Professional Electives - 4

Course code under 18XX82X	Course Title
18 MT821	Operation Research.
18 MT822	Communication system
18 MT823	Digital Control System
18 MT824	Management Information Systems
18 MT825	Radar Engineering

Project Work

CIE procedure for Project Work Phase - 2:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Project Work Phase - 2:

(i) Single discipline: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

Internship: Those, who have not pursued /completed the internship shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

Activity points of the students who have earned the prescribed AICTE activity Points shall be sent the University along with the CIE marks of 8th semester. In case of students who have not satisfied the AICTE activity Points at the end of eighth semester, the column under activity Points shall be marked NSAP (Not Satisfied Activity Points).

Internship / Professional Practice: To be carried out between 6th& 7th semester vacation or 7th& 8th semester vacation

B.E MECHATRONICS ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER - VIII

AUTOMOTIVE ELECTRONICS AND HYBRID VEHICLES

Course Code	**18MT81**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P)	**(4:0:0)**	**SEE Marks**	**60**
Credits	**04**	**Exam Hours**	**03**

Course objectives:

- **Gain knowledge to learn the concepts of developing basic skills necessary for importance Automotive Electronics in Automobile**
- **Understand the basic concepts and various Operation using Sensor and Actuators usedAutomobile.**
- **Diagnosis the problem related types of, Data Acquisition System and Communication Networks (Bus Systems) Control system using Standard Technology.**

Module-1	**RBT**
Automotive Fundamentals Overview: Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System, Battery, Starting System.Air/Fuel Systems Fuel Handling, Air Intake System, Air/ Fuel Management	**LI,L2,L3, L4**
Module-2	
SENSORS AND ACTUATORS: Sensors – Oxygen (02/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP)Sensors, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor – Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor,	**LI,L2,L3, L4**

Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle Sensor. Actuators: Fuel Metering Actuator, Fuel Injector, Ignition Actuator. Exhaust After-Treatment Systems – AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR), Evaporative Emission Systems.	
Module-3	
Automotive Instrumentation and Communication: Sampling, Measurement & Signal Conversion of various parameters (Speed, fuel, pressure). Serial Data, Communication Systems, Protection, Body and Chassis is Electrical Systems, Remote Keyless Entry, GPS	**LI,L2,L3, L4**
Module-4	
Vehicle Motion Control: Cruise control, Chassis, Power Brakes, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronically controlled suspension. Automotive Diagnostics –Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems. Future Automotive Electronics Systems: Alternative Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation, Advance Driver Information System.	**LI,L2,L3, L4**
Module-5	
Introduction to Alternative Vehicles: Electric Vehicle, Hybrid Electric vehicle, Electric Hybrid Vehicle, Vehicle components, Electric and Hybrid history EV/CEV Comparison. Alternative Vehicle Architecture: Electric Vehicles, Hybrid Electric Vehicles, Plug-in Hybrid Electric Vehicles, Power Train component Sizing, Mass Analysis & Packaging, Vehicle Simulation	**LI,L2,L3, L4**

Course outcomes:

1. Understanding of Engine Parameters and a critical awareness of current problems within the automotive electronics domain using Various Measurement Technology.

2. Apply the fundamental Concepts of automotive electronics on various Engine parts, Sensor, Actuator, Communication and Measurement System.
3. Determine the extent and nature of electronic circuitry in automotive systems including monitoring and control circuits for engines, transmissions, brakes, steering, suspension
4. Analyze climate control, instrumentation and radios and accessories involved in Automotive Industry.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

TEXTBOOKs

1.Willliam B. Ribbens: Understanding Automotive Electronics, 6th Edition, SAMS/Elsevier PublishingIqbal Husain "Electric and Hybrid Vehicles: Design fundamentals". CRC Press, 2011.

REFERENCE BOOKS

1. **Robert Bosch GmbH:** Automotive Electronics Systems and Components 5th Edition, John Wiley & Sons Ltd., 2007
2. James Laminie and John Lowry. "Electric Vehicle Technology – Explained', CRC Press 2010.

Society of Automobile Engineers, "Hybrid Electric vehicles", CRC Press, 2011.

PROFESSIONAL ELECTIVE -4

OPERATIONS RESEARCH **SEMESTER – VIII (MTE)** **[As per Choice Based Credit System (CBCS)**			
Course Code	**18MT821**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course objectives: This course will enable students to:

1. gain knowledge of basics of operation research.
2. understanding various techniques of operation research for solving business decision and engineering problems.
3. determination of optimization solutions, effective decision making, model formulation and applications.

Module-1	**RBT Level**
Introduction: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method. Solution Of Linear Programming Problems: The simplex method canonical and standard form of an LP problem	**L1, L2, L3**
Module -2	
Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases.	**L1, L2, L3**
Module-3	
Pert-CPM Techniques: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.	**L1, L2, L3**
Module -4	
Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.	**L1, L2,**

	L3
Module -5	
Game Theory: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games. **Sequencing:** Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.	**L1, L2, L3**

Course Outcomes: At the end of the course, students will be able to:

1. have knowledge of linear programming, Transportation, PERT-CPM, Sequencing, Queuing Theory, and Game theory.
2. understanding the techniques of linear programming, Transportation, PERT-CPM, Sequencing, Queuing Theory, and Game theory for various engineering problems.
3. determination of optimization of solutions, effective decision making model formulation and applications that are used in solving business decision problems.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

1. Operations Research, P K Gupta and D S Hira, Chand Publications, New Delhi – 2007
2. Operations Research, Taha H A, Pearson Education.
3. Operations Research S.D. Sharma, Ledarnath Ramanath& Co, 002

Reference Books:

1. Operations Research, A P Verma, S K Kataria&Sons, 2008
2. Operations Research, Paneerselvan, PHI
3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005
4. Introduction to Operations Research, Hillier and Liberman,8th Ed., McGraw Hill
5. Operations Research, S Kalavathy, Vikas Publishing House Pvt Ltd, 2002

COMMUNICATION SYSTEMS

VIII Semester, MT

[As per Choice Based Credit System (CBCS) Scheme]

Course Code	**18MT822**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (08 Hours / Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Objectives: This course will enable students to:

- Determine the performance of amplitude modulation schemes in time and frequency domains and sampling process.
- Characterize the performance of modulation and generation and detection of modulated analog signals.
- Characterize analog signals in time domain as random processes and in frequency domain using Fourier transforms.
- Determine the performance of different coding techniques for different modulation types and multiplexers
- Understand the characteristics of communication systems, pulse amplitude modulation, pulse code modulation systems, digital multiplexers, spread spectrum modulation and its applications.

Module-1	**RBT Level**
Introduction To Communication Systems:Information, Transmitter, chanel-noise, Receiver, modulation, need for modulation, band width requirements, sine wave and Fourier series review, frequency spectra of non sinusoidal waves. Basic signal processing operations in digital communication. Sampling Principles: Sampling Theorem.	**L1, L2**
Module-2	
Amplitude Modulation: Introduction AM Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop...	**L1,L2**
Module-3	
Angle Modulation & Demodulation: Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM, Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Nonlinear effects in FM systems.	**L1,L2**
Module-4	

Waveform Coding Techniques: PAM, TDM. Waveform Coding Techniques, PCM, Quantization noise and SNR, robust quantization. DPCM, DM, applications. Line Codes : Unipolar RZ& NRZ, Polar RZ& NRZ, Bi-Polar RZ & NRZ ,Manchester.	**L1,L2**
Module-5	
Spread Spectrum Modulation: Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, coherent binary PSK, frequency hop spread spectrum, applications. Digital Multiplexers: FDM ,TDM ,Classification of Multiplexers ,T1 Carrier System	**L1, L2**

Course Outcomes: After studying this course, students will :

- Able to determine the performance of amplitude modulation schemes in time and frequency domains and sampling process.
- Able to characterize the performance of modulation and generation and detection of modulated analog signals.
- Able to Characterize analog signals in time domain as random processes and in frequency domain using Fourier transforms.
- Able to Determine the performance of different coding techniques for different modulation types and multiplexers
- Able to Understand the characteristics of communication systems, pulse amplitude modulation, pulse code modulation systems, digital multiplexers, spread spectrum modulation and its applications.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is60.

Text Book:

- Communication Systems, Simon Haykins, 3rd Edition, John Willey, 1996.
- An Introduction to Analog and Digital Communication, Simon Haykins, John Wiley, 2003.
- Digital communications, Simon Haykin, John Wiley, 2003.

Reference Books:

- Modern digital and analog Communication systems B. P. Lathi, 3rd ed 2005 Oxford University press.
- Communication Systems, Harold P.E, Stern Samy and A Mahmond, Pearson Edn, 2004.
- Communication Systems: Singh and Sapre: Analog and
- Digital and analog communication systems & An introduction to Analog and Digital Communication, K. Sam Shanmugam, John Wiley, 1996. 2.Simon Haykin, John Wiley, 2005

DIGITAL CONTROL SYSTEM
B.E, VIII Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme-2018-2019]

Subject Code	**18MT823**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per module)**	**Exam Hours**	**03**

CREDITS – 03

Course Objectives: Students will be able to

- gain knowledge to learn the concepts of developing State model , Linear and Non Linear Control System.
- understand the concepts Linear and Non Linear Digital Control System for observing the Controllability of the system
- determine and diagnosis the problem related Lead and Lag Networks using Plots.

Modules	**RBT Level**
Module – 1	
STATE SPACE ANALYSIS OF CONTROL SYSTEMS: State space representation of systems, solving the time invariant state equations, transfer matrix, linear time invariant systems, state space representation of discrete time systems and solving discrete time state equation.	**L1, L2, L3**
Module – 2	
POLE PLACEMENT: Controllability, Observability for continuous time systems, pole placement design and state observers. Problems on Each	**L1, L2, L3**
Module – 3	
OPTIMAL AND ADAPTIVE CONTROL SYSTEMS: optimal control system based on quadratic performance index, adaptive control system..	**L1, L2, L3**
Module – 4	
DESCRIBING FUNCTION ANALYSIS OF NONLINEAR CONTROL SYSTEMS: Introduction to nonlinear systems, describing function analysis of nonlinear control systems, stability of nonlinear control system	**L1, L2, L3**
Module – 5	
COMPENSATION TECHNIQUES: Lead, lag, lead lag network and compensator design using Bode/Root locus techniques.	**L1, L2, L3**

Course outcomes: On completion of the course the student will

CO1: have knowledge of State model, Linear and Non Linear Control System, Controllability and Observe viability.

CO2: understanding the concepts State model, Linear and Non Linear Control System, Controllability and Observe ability used in Digital Control System.

CO3: determine the extent and nature of Lead Lag Circuitry by Plot.

Text Books:

1. Modern Control Engineering-K. Ogata, Prentice 3rd Edition, Hall of India publication.
2. Discrete time Control Systems-K.Ogata, 2nd Edition, Prentice Hall of India publication.

Reference Books:

1. Digital control and state variable methods-Madan Gopal, 2nd Edition, Prentice Hall of India.
2. Modern Control Engineering-Roy Choudhury, Prentice Hall of India.

Management Information Systems
B.E, VIII Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme-2018-2019]

Subject Code	**18MT824**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per module)**	**Exam Hours**	**03**

CREDITS – 03

Course Objectives: Students will be able to

- gain the importance of information in business.
- understand the technologies and methods used for effective decision making in an organization.

Modules	RBT Level
Module – 1	
INTRODUCTION: Data, Information, Intelligence, Information Technology, Information System, evolution, types based on functions and hierarchy, System development methodologies, Functional Information Systems, DSS, EIS, KMS, GIS, International Information System.	**L1, L2**
Module – 2	
SYSTEM ANALYSIS AND DESIGN: Case tools - System flow chart, Decision table, Data flow Diagram (DFD), Entity Relationship (ER), Object Oriented Analysis and Design (OOAD), UML diagram.	**L1, L2**
Module – 3	

DATABASE MANAGEMENT SYSTEMS: DBMS – HDBMS, NDBMS, RDBMS, OODBMS, Query Processing, SQL, Concurrency Management, Data warehousing and Data Mart.	**L1 , L2**
Module – 4	
SECURITY, CONTROL AND REPORTING: Security, Testing, Error detection, Controls, IS Vulnerability, Disaster Management, Computer Crimes, Securing the Web, Intranets and Wireless Networks, Software Audit, Ethics in IT, User Interface and reporting.	**L1, L2**
Module – 5	
NEW IT INITIATIVES: Role of information management in ERP, e-business, e-governance, Data Mining, Business Intelligence, Pervasive Computing, Cloud computing, CMM.	**L1, L2**

Course outcomes: On completion of course students will

CO1: have knowledge on effective applications of information systems in business.

CO2: understand the technologies and methods used for effective decision making in an organization.

Text Books:

1. Management Information Systems – The Managers View, Robert Schultheis and Mary Summer, Tata McGraw Hill, 2008.

2. Management Information Systems – Managing the digital firm, Kenneth C. Laudon and Jane Price Laudon, PHI Learning / Pearson Education, PHI, Asia, 2012.

Reference Books:

1. MIS in Business, Government and Society, Rahul de, Wiley India Pvt Ltd, 2012

2. Management Information System: Conceptual Foundations, Structure and Development, Gordon Davis, Tata McGraw Hill, 21st Reprint 2008.

3. Management Information Systems for the Information Age, Haag, Cummings and Mc Cubbrey, McGraw Hill, 2005. 9th edition, 2013.

4. Information Technology for Management – Transforming Organisations in the Digital Economy, Turban, McLean and Wetherbe, John Wiley, 6th Edition, 2008.

5. Management Information Systems, Raymond McLeod and Jr. George P. Schell, Pearson Education, 2007.

6. Management Information Systems – Managing Information Technology in the E-business enterprise, James O Brien, Tata McGraw Hill, 2004. 22 .

7. Information Systems, Raplh Stair and George Reynolds, Cengage Learning, 10th Edition, 2012

8. Information Assurance for the Enterprise – A Roadmap to Information Security, Corey Schou and Dan Shoemaker, Tata McGraw Hill, 2007.

9. Information Technology Control and Audit, Frederick Gallegor, Sandra Senft, Daniel P. Manson and Carol Gonzales, Auerbach Publications, 4th Edition, 2013.

RADAR ENGINEERING
B.E, VIII Semester, Mechatronics Engineering
[As per Choice Based Credit System (CBCS) scheme-2018-2019]

Subject Code	**18MT825**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per module)**	**Exam Hours**	**03**

CREDITS – 03

Course Objectives: Students will be able to

- gain Knowledge of Radars , The Radar Equation, MTI and Pulse Doppler Radar, Tracking Radar & The Radar Antenna.
- understand the operation of Radars , MTI and Pulse Doppler Radar, Tracking Radar & the Radar Antenna.

Modules	RBT Level
Module – 1	
Basics of Radar: Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions w.r.t Pulse waveform - PRF, PRI, Duty Cycle, Peak Transmitter Power, Average transmitter Power. Simple form of the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radar, The Origins of Radar, Illustrative Problems. (Chapter 1 of Text)	**L1, L2**
Module – 2	
The Radar Equation: Prediction of Range Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation, Envelope Detector — False Alarm Time and Probability, Probability of Detection, Radar Cross Section of Targets: simple targets – sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (Qualitative treatment), Illustrative Problems. (Chapter 2, except 2.4, 2.6 2.8 & 2.11 of Text)	**L1, L2**
Module – 3	
MTI and Pulse Doppler Radar: Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweep to Sweep subtraction and Delay Line Canceler, MTI Radar with – Power Amplifier Transmitter, Delay Line Cancelers — Frequency Response of Single Delay- Line Canceler, Blind Speeds, Clutter Attenuation, MTI Improvement Factor, N- Pulse Delay-Line Canceler, Digital MTI Processing – Blind phases, I and Q Channels, Digital MTI Doppler signal processor, Moving Target Detector- Original MTD. (Chapter 3, 3.1, 3.2, 3.5, 3.6 of Text)	**L1 , L2**
Module – 4	
Tracking Radar: Tracking with Radar- Types of Tracking Radar Systems, Monopulse TrackingAmplitude Comparison Monopulse (one-and two-coordinates), Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range, Comparison of Trackers. (Chapter 4, 4.1, 4.2, 4.3 of Text)	**L1, L2**
Module – 5	

The Radar Antenna: Functions of The Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phased array Antennas. (Chapter 9: 9.1, 9.2 9.4, 9.5 of Text) Radar Receiver: The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays. (Chapter 11 of Text)	**L1, L2**

Course outcomes: On completion of course students will

CO1: have knowledge of Radars, the Radar Equation, MTI and Pulse Doppler Radar, Tracking Radar and the Radar Antenna.

CO2: understand the operation of Radars, MTI and Pulse Doppler Radar, Tracking Radar & the Radar Antenna.

Text Books:

1. Introduction to Radar Systems-Merrill I Skolnik ,3e,TMH, 2001

Reference Books:

1. Radar Principles, Technology. Applications — Byron Edde, Pearson Education, 2004.
2. Radar Principles – Peebles. Jr, P.Z. Wiley. New York, 1998.
3. Principles of Modem Radar: Basic Principles – Mark A. Rkhards, James A. Scheer, William A. HoIm. Yesdee, 2013