VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

Scheme of Teaching & Examination and Syllabus
B.Tech. ROBOTICS AND AUTOMATION
III SEMESTER
(Effective from Academic year 2020-21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination (2018)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2020-21)

Programme: B. Tech. ROBOTICS AND AUTOMATION

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 (Common to all Branches)	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18ME32	Mechanics of Materials	ME/Auto/IP/ Aero/IEM	3	2	--	04	40	60	100	4
3	PCC	18RA33	Data Structure with C	CSE/ISE	3	0	--	03	40	60	100	3
4	PCC	18RA34	Manufacturing Technology	ME/Auto/IP/ Aero/IEM	3	0	--	03	40	60	100	3
5	PCC	18RA35	Analog & Digital Electronic Circuits	E & C Engg.	3	0	--	03	40	60	100	3
6	PCC	18ME36A	Computer Aided Machine Drawing	ME/Auto/IP/ Aero/IEM	1	0	4	03	40	60	100	3
7	PCC	18RAL37	Material Testing & Machine shop Lab	ME/Auto/IP/ Aero/IEM	--	2	2	02	40	60	100	2
8	PCC	18RAL38	Analog /Digital Electronics Lab	E & C Engg.	--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Samskrutika Kannada (for Kannada students)/ Balake Kannada (for non-Kannada students)	HSMC	--	2	--	--	100	--	100	1
		OR										
		18CPC39	Constitution of India, Professional Ethics and Cyber Law		1	--	--	02	40	60		
					Examination is by objective type questions							
				TOTAL	**15 OR 16**	**10 OR 08**	**08**	**26 OR 24**	**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 /49 - Samskrutika Kannada is for students who speak, read and write Kannada/ Balake Kannada is for non-Kannada students who have not studied Kannada at X class.

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

(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 fulfil 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.

Continued

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination (2018)
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2020 – 21)

Programme: B.Tech. ROBOTICS AND AUTOMATION

III SEMESTER (continued)

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.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination (2018)
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2020-21)

Programme: B.Tech. ROBOTICS AND AUTOMATION

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	18RA42	Theory of Machines	Mech. Engg.	3	2	--	03	40	60	100	4
3	PCC	18RA43	Control Systems	E&C /Mech. Engg./Aero/IP	3	0	--	03	40	60	100	3
4	PCC	18RA44	Fluid Mechanics & Fluid Machines	ME/Aero/IP/ Auto/IEM	3	0	--	03	40	60	100	3
5	PCC	18RA45	Instrumentation & Measurements	E&E	3	0	--	03	40	60	100	3
6	PCC	18RA46	Microcontroller	E&C	3	0	--	03	40	60	100	3
7	PCC	18RAL47	Microcontroller Laboratory	E&C	--	2	2	03	40	60	100	2
8	PCC	18RAL48	Instrumentation and Measurement Laboratory	E&E	--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Samskrutika Kannada (for Kannada students)/ Balake Kannada (for non-Kannada students)	HSMC	--	2	--	--	100	--	100	1
		OR										
		18CPH49	Constitution of India, Professional Ethics and Cyber Law		1	--	--	03	40	60		
					Examination is by objective type questions							
				TOTAL	**17**	**10**	**04**	**24**	**420**	**480**	**900**	**24**
					OR	**OR**		**OR**	**OR**	**OR**		
					18	**08**		**27**	**360**	**540**		

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

20KVK39/49Vyavaharika Kannada (Kannada for communication) is for non-kannada speaking, reading and writing students and 20KAK39/49Aadalitha 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	20MATDIP41	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 fulfil 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.

continued

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 2020-21)

Programme: B.Tech. ROBOTICS AND AUTOMATION

IV SEMESTER (continued)

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.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination (2018)
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2020-21)

Programme: B.Tech. ROBOTICS AND AUTOMATION

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	18RA51	Technological Innovation, Management and Entrepreneurship	ME/ MBA	2	2	--	03	40	60	100	3
2	PCC	18RA52	Design and Analysis of Machine Elements	Mechanical Engg.	3	2	--	03	40	60	100	4
3	PCC	18RA53	Virtual Instrumentation	E&C	3	2	--	03	40	60	100	4
4	PCC	18RA54	Hydraulics and Pneumatics	Mechanical Engg.	3	--	--	03	40	60	100	3
5	PCC	18RA55	Robot Programming	E&C/ Mech. Engg.	3	--	--	03	40	60	100	3
6	PCC	18RA56	Mechatronics	E&C/ Mech. Engg.	3	--	--	03	40	60	100	3
7	PCC	18RAL57	Virtual Instrumentation and Automation Laboratory	E&C Engg.	--	2	2	03	40	60	100	2
8	PCC	18RAL58	Robotic programming and simulation Laboratory	Mechanical Engg.	--	2	2	03	40	60	100	2
9	HSMC	18CIV59	Environmental Studies	Civil/Environmental [Paper setting Board: Civil Engineering]	1	--	--	02	40	60	100	1
				TOTAL	**18**	**10**	**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.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination (2018)
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2020-21)

Programme: B.Tech. ROBOTICS & AUTOMATION

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	18RA61	PLC and SCADA	E&C/ CS	3	2	--	03	40	60	100	4
2	PCC	18RA62	FINITE ELEMENT METHODS	Mech.Engg	3	2	--	03	40	60	100	4
3	PCC	18RA63	MOTORS, DRIVES & POWER ELECTRONICS	E&C/E&E	3	2	--	03	40	60	100	4
4	PEC	18RA64X	Professional Elective -1	ME/EC/CS /EE	3	--	--	03	40	60	100	3
5	OEC	18RA65X	Open Elective –A	--	3	--	--	03	40	60	100	3
6	PCC	18RAL66	PLC AND SCADA Laboratory	E&C	--	2	2	03	40	60	100	2
7	PCC	18RAL67	Computer Aided Modelling And Analysis Laboratory	Mech. Engg	--	2	2	03	40	60	100	2
8	MP	18RAMP68	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	**15**	**10**	**6**	**24**	**320**	**480**	**800**	**24**

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

Professional Elective -1

Course code under18XX64X	Course title
18RA641	Wireless Networks & Communication (E&C/ CS)
18RA642	Micro and Smart Systems Technology (E&C/ CS)
18RA643	Drives and Controls for Robots (E&E/ Mechanical)
18RA644	Artificial neural network (CS/E&C)
18RA645	Automation in Manufacturing (Mechanical)

Open Elective –A

Students can select any one of the open electives offered by other Departments expect 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 programme.
- 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 programme.

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

continued

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 2020-21)

Programme: B.TECH.ROBOTICS & AUTOMATION

VI SEMESTER (continued)

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 guides of 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.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination (2018)
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2020-21)

Programme: B.Tech. in Robotics and Automation

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	18RA71	Industrial Robotics	Mechanical/ E&C	3	--	--	03	40	60	100	3
2	PCC	18RA 72	Thermal Engineering	Mechanical Engg.	3	--	--	03	40	60	100	3
3	PEC	18RA 73X	Professional Elective - 2	ME/EC/CSE	3	--	--	03	40	60	100	3
4	PEC	18RA 74X	Professional Elective - 3	ME/EC/CSE	3	--	--	03	40	60	100	3
5	OEC	18RA 75X	Open Elective –B	----	3	--	--	03	40	60	100	3
6	PCC	18RAL76	Robotics Lab	Mechanical/ E&C	--	2	2	03	40	60	100	2
7	PCC	18RA L77	CNC Lab	Mechanical	--	2	2	03	40	60	100	2
8	Project	18RA P78	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**	**18**	**340**	**360**	**700**	**20**

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

Professional Elective – 2

Course code under 20XX73X	Course Title	Course code under 20XX73X	Course Title
18RA 731	IOT Technology(CS)	18RA 734	Analytical Instrumentation (E&E/E&C)
18RA 732	Automation In Process Control (E&C/Mechanical)	18RA 735	Non Destructive Testing & Evaluation (Mechanical)
18RA 733	OOPS using C++ (CS)		

Professional Elective – 3

Course code under 20XX74X	Course Title	Course code under 20XX74X	Course Title
18RA 741	Machine Learning (CS)	18RA 744	Artificial Intelligence (CS)
18RA 742	Digital Image Processing (E&C)	18RA 745	Composite Materials Technology (Mechanical)
18RA 743	Mechanical vibration (Mechanical)		

continued

Open Elective –B

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (Please refer to the list of open electives under 20XX75X).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- 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 programme.

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 (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.

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.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination (2018)
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2020-21)

Programme: B.Tech. in ROBOTICS AND AUTOMATION

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	18RA81	Automotive Electronics & Hybrid Vehicles	E & E/ Mechanical	3	--	--	03	40	60	100	3
2	PEC	18RA82X	Professional Elective - 4		3	--	--	03	40	60	100	3
3	Project	18RAP83	Project Work Phase - 2		--	--	2	03	40	60	100	8
4	Seminar	18RAS84	Technical Seminar		--	--	2	03	100	--	100	1
5	Internship	18RAI85	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
18RA821	Management Information Systems (CS)
18RA822	Biomedical Signal Processing (E&C)
18RA823	Big Data and Analytics (CS)
18RA824	Communication Systems (ECE
18RA825	Additive Manufacturing (Mechanical)

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.

continued

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 2020-21)

Programme: B.Tech. IN ROBOTICS AND AUTOMATION

VIII SEMESTER (continued)

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).

B.E ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES
(Common to all Branches)

Course Code	18MAT31	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

Module-1

Laplace Transforms: Definition and Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function – problems.
Inverse Laplace Transforms: Inverse Laplace transform - problems, Convolution theorem to find the inverse Laplace transform(without proof) and problems, solution of linear differential equations using Laplace transform.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-2

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis, examples from engineering field.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-3

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simple problems.
Difference Equations and Z-Transforms: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform. Simple problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-4

Numerical Solutions of Ordinary Differential Equations (ODE's): Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Range - Kutta method of fourth order, Milne's and Adam-Bashforth predictor and corrector method (No derivations of formulae), Problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-5

Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne's predictor and corrector method.(No derivations of formulae).
Calculus of Variations: Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying.

Continued

Course outcomes:

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

- CO1: Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5:Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2016
2	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Edition, 2017
3	Engineering Mathematics	Srimanta Pal et al	Oxford University Press	3rd Edition, 2016
Reference Books				
1	Advanced Engineering Mathematics	C.Ray Wylie, Louis C.Barrett	McGraw-Hill Book Co	6th Edition, 1995
2	Introductory Methods of Numerical Analysis	S.S.Sastry	Prentice Hall of India	4th Edition 2010
3	Higher Engineering Mathematics	B.V.Ramana	McGraw-Hill	11th Edition,2010
4	A Text Book of Engineering Mathematics	N.P.Bali and Manish Goyal	Laxmi Publications	2014

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

B.E ROBOTICS AND AUTOMATION
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SEMESTER - III

MECHANICS OF MATERIALS

Course Code	18ME32	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course objectives:

To know the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.

To know behaviour & properties of engineering materials.

To understand the stresses developed in bars, compounds bars, beams, shafts, and cylinders.

To understand the concepts of calculation of shear force and bending moment for beams with different supports.

To expose the students to concepts of Buckling of columns and strain energy

Module-1

Stresses and Strains:
Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them.

Module-2

Analysis of Stress and Strain:
Introduction to three dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum
shear tress, Mohr circle for plane stress conditions.
Cylinders:
Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lames equations.

Module-3

Shear Force and Bending Moment:
Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant / varying loads.
Stress in Beams:
Bending and shear stress distribution in rectangular, I and T section beams.

Module-4

Theories of Failure:
Maximum Principal stress theory, Maximum shear stress theory.
Torsion:
Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin walled sections.

Module-5

Columns: Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.
Strain Energy:
Strain energy due to axial, shear, bending, torsion and impact load. Castigliano's theorem I and
II and their applications.

Course outcomes:

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

- CO1: Understand simple, compound, thermal stresses and strains their relations and strain energy.
- CO2: Analyse structural members for stresses, strains and deformations.

- CO3: Analyse the structural members subjected to bending and shear loads.
- CO4: Analyse shafts subjected to twisting loads.
- CO5: Analyse the short columns for stability.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Mechanics of Materials	J M Gere, B J Goodno,	Cengage	Eighth edition 2013
2	Fundamentals of Strength of Materials	PN Chandramouli	PHI Learning Pvt.	2013
3	Strength of Materials	R K Rajput	S. Chand and Company Pvt. Ltd	2014
Reference Books				
1	Strength of Materials	R. Subramanian	Oxford	2005
2	Strength of Materials	S. S. Ratan	Tata McGraw Hill	2nd Edition, 2008
3	Mechanics of materials Strength of Materials	S C Pilli and N Balasubramanya	Cengage	2019
4	Mechanics of Materials	Ferdinand Beer, Russell Johston, John Dewolf, David Mazurek	McGraw Hill Education (India)	Latest edition
5	Mechanics of Materials	R C Hibbeler	Pearson	Latest edition

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SEMESTER - III

DATA STRUCTURE WITH C

Course Code	18RA33	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- Explain fundamentals of data structures and their applications essential for programming/problem solving.
- Illustrate linear representation of data structures: Stack, Queues, Lists, Trees and Graphs.
- Demonstrate sorting and searching algorithms.
- Find suitable data structure during application development/Problem Solving.

Module-1

Introduction: Data Structures, Classifications (Primitive & Non Primitive), Data structure Operations, Review of Arrays, Structures, Self-Referential Structures, and Unions. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, Dynamically allocated arrays.
Array Operations: Traversing, inserting, deleting, searching, and sorting. Multidimensional Arrays, Polynomials and Sparse Matrices.
Strings: Basic Terminology, Storing, Operations and Pattern Matching algorithms. Programming Examples.
Textbook 1: Chapter 1: 1.2, Chapter 2: 2.2 - 2.7 Text Textbook 2: Chapter 1: 1.1 - 1.4, Chapter 3: 3.1 - 3.3, 3.5, 3.7, Chapter 4: 4.1 - 4.9, 4.14 Reference 3: Chapter 1: 1.4

Revised Bloom's Taxonomy Level	RBT: L1, L2, L3

Module-2

Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression.
Recursion: Factorial, GCD, Fibonacci Sequence, Tower of Hanoi, Ackerman's function.
Queues:Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues, A Mazing Problem. Multiple Stacks and Queues. Programming Examples.
Textbook 1: Chapter 3: 3.1 -3.7 Textbook 2: Chapter6: 6.1 -6.3, 6.5, 6.7-6.10, 6.12, 6.13

Revised Bloom's Taxonomy Level	RBT: L1, L2, L3

Module-3

Linked Lists:Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples**.**
Textbook 1: Chapter 4: 4.1 – 4.6, 4.8, Textbook 2: Chapter 5: 5.1 – 5.10,

Revised Bloom's Taxonomy Level	RBT: L1, L2, L3

Module-4

Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of Expression, Programming Examples.
Textbook 1: Chapter 5: 5.1 –5.5, 5.7; Textbook 2: Chapter 7: 7.1 – 7.9

Revised Bloom's Taxonomy Level	RBT: L1, L2, L3

Module-5

Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search.
Sorting and Searching: Insertion Sort, Radix sort, Address Calculation Sort.
Hashing:Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.
Files and Their Organization:
Data Hierarchy, File Attributes, Text Files and Binary Files, Basic File Operations, File Organizations and Indexing.
Textbook 1: Chapter 6 : 6.1 –6.2, Chapter 7:7.2, Chapter 8 : 8.1-8.3

Textbook 2: Chapter 8 : 8.1 – 8.7, Chapter 9 : 9.1-9.3, 9.7, 9.9 Reference 2: Chapter 16 : 16.1 - 16.7	
Revised Bloom's Taxonomy Level	RBT: L1, L2, L3

Course outcomes:

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

- Use different types of data structures, operations and algorithms
- Apply searching and sorting operations on files
- Use stack, Queue, Lists, Trees and Graphs in problem solving
- Implement all data structures in a high-level language for problem solving.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Fundamentals of Data Structures in C	Ellis Horowitz and Sartaj Sahni	Universities Press,	2nd Edition, 2014
2	Data Structures Schaum's Outlines	Seymour Lipschutz,	McGraw Hill,	Revised 1st Edition 2014
Reference Books				
1	Data Structures: A Pseudo-code approach with C,	Gilberg & Forouzan,	Cengage Learning	2nd Edition, 2014
2	Data Structures using C,	Reema Thareja	Oxford press	3rd Edition, 2012
3	An Introduction to Data Structures with Applications,	Jean-Paul Tremblay & Paul	McGraw Hill,	2nd Edition, 2013
4	Data Structures using C	A M Tenenbaum,	PHI	1989
5	Data Structures and Program Design in C.	Robert Kruse	PHI	2nd Edition,1996

B.E ROBOTICS AND AUTOMATION
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SEMESTER - III

MANUFACTURING TECHNOLOGY

Course Code	18RA34	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

This course will enable students to:

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

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.

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

Module-2

Introduction to metal working: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working 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

Revised Bloom's Taxonomy Level	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 inclinable press (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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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.

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

Course outcomes:

At the end of the course the student 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Manufacturing Technology	Serope kalpakjain Steuen.R.Sechmid	Pearson Education Asia	5th Ed. 2006
2	Manufacturing Technology Vol 1 & 2	P.N.Rao	Tata McGraw Hill	2001
3	N C Machine Programming and software Design	ChnoHwachang, Michael.A.Melkan off	Prentice Hall	1989
Reference Books				
1	Process and materials of Manufacturing	Roy A Lindberg	Pearson	4th Ed 2006.
2	Workshop Technology	Hajra Choudhary. Vol I & II	Media Publishers, Bombay	2004
3	Production Technology	HMT	Tata McGraw Hill	2001
4	Manufacturing Science	Amitabh Ghosh and Mallik	Affiliated East West Press	2003
5	Fundamentals of Metal Machining and Metal Tools	G.Boothroyd	McGraw Hill	2000
6	Automation Production system and computer Integrated Manufacturing	Mikell.O.Grover	PHI New Delhi	2002

B.E ROBOTICS AND AUTOMATION
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SEMESTER - III

ANALOG & DIGITAL ELECTRONIC CIRCUITS

Course Code	18RA35	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- 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

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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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 decoder

Revised Bloom's Taxonomy Level	L1,L4

Module-5

Sequential Logic: Introduction, Flip flops: Basic circuits, RS flip flop, D-flip-flop, clocked D-flip flop, JK flip flop, clocl flip-flop, clocked T flip-flop, Counters: Binary Ripple counter, BCD ripple ounter, synchronous counter:
Binary up-down counter, Binary counter.

Revised Bloom's Taxonomy Level	L1,L4

Course outcomes:

- At the end of the course the student will be able to:
- Have knowledge of Analog & Digital Electronic Circuits.
- Understand the characteristics & operation of Electronic Circuits.
- Formulate the relations for Voltage Gain ,Frequency of Various Electronics Circuits.
- Design the Electronics Systems for Required Specifications

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Opamp and Linear Integrated Circuits	Ramakant A Gayakwad	PHI	3rd Ed
2	Digital Logic and Computer Design	M Morris Mano	PHI	2000 Edition
Reference Books				
1	Digital Electronics: Principles and Integrated Circuits	Anil K Maini	Wiley India	2008
2	Linear Integrated Circuits	D. Roy Choudhury and Shail B Jain	New Age International	2nd Edition, Reprint 2006
3	Digital Principles and Applications	Malvino & amp; leach	Tata Mc.Graw Hill	

B.E ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - III

COMPUTER AIDED MACHINE DRAWING

Course Code	18ME36A	CIE Marks	40
Teaching Hours/Week (L:T:P)	(1:0:4)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To acquire the knowledge of CAD software and its features.
- To familiarize the students with Indian Standards on drawing practices.
- To impart knowledge of thread forms, fasteners, keys, joints and couplings.
- To make the students understand and interpret drawings of machine components leading to preparation of assembly drawings manually and using CAD packages.
- To acquire the knowledge of limits, tolerance and fits and indicate them on machine drawings.

PART A

Introduction:
Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing, Drawing units, grid and snap. Conversion of pictorial views into orthographic projections of simple machine parts (with and without section). Hidden line conventions. Precedence of lines. Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections. Conversion of pictorial views into orthographic projections of simple machine parts. Hidden line conventions. Precedence of lines. Conversion of pictorial views into orthographic projections of simple machine parts (with section planes indicated on the part).
Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.
Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

PART B

Keys:
Parallel key, Taper key, Feather key, Gib-head key and Woodruff key.
Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.
Couplings: Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, and universal coupling (Hooks' Joint)

PART C

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.
Assembly Drawings: (Part drawings shall be given)
1. Plummer block (Pedestal Bearing)
2. Lever Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Tool head of shaper

Course outcomes:

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

CO1: Identify the national and international standards pertaining to machine drawing.

CO2: Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings

CO3: Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.

CO4: Interpret the Machining and surface finish symbols on the component drawings.

CO5: Preparation of the part or assembly drawings as per the conventions.

Question paper pattern:

Scheme of Examination:

Two questions to be set from each Part A, part B and Part C. Student has to answer one question each from Part A and Part B for 25 marks each and one question from Part C for 50 marks.

INSTRUCTION FOR COMPUTER AIDED MACHINE DRAWING (15ME36A/46A) EXAMINATION

1. No restriction of timing for sketching/ computerization of solutions. The total duration is 3 hours
2. It is desirable to do sketching of all the solutions before computerization.
3. Drawing instruments may be used for sketching.
4. For Part A and Part B, 2D drafting environment should be used.
5. For Part C, 3D environment should be used for parts and assembly, and extract 2D views of assembly

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Machine Drawing	K.R. Gopala Krishna	Subhash Publication	2005
2	Machine Drawing	N.D.Bhat&V.M. Panchal	Charoratar publishing house	2005
Reference Books				
1	A Text Book of Computer Aided Machine Drawing	S. Trymbaka Murthy	CBS Publishers, New Delhi	2007
2	Engineering drawing	P.S.Gill	S K Kataria and Sons	2013
3	Machine Drawing	N. Siddeshwar, P. Kanniah, V.V.Sastri	Tata McGraw Hill	2006

B.E ROBOTICS AND AUTOMATION
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SEMESTER - III

MATERIALS TESTING AND MACHINE SHOP LAB

Course Code	18RAL37	CIE Marks	40
Teaching Hours/Week (L:T:P)	(0:2:2)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

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

SL. NO	Parts	RBT Level
	PART A	
1	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 student 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.

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.

Scheme of Examination:

- 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 ROBOTICS AND AUTOMATION
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SEMESTER - III

ANALOG/DIGITAL ELECTRONICS LAB

Course Code	18RAL38	CIE Marks	40
Teaching Hours/Week (L:T:P)	(0:2:2)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

Students will able

- To understand the characteristics and working of analog and digital components.
- To design and develop analog and digital applications

Sl. No	Part A
1	Clipper circuits and Clamper circuits using diodes
2	Single stage RC coupled amplifier using BJT and its frequency response
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
1	Simplification and realization of Boolean expression using logic gates/universal gates**.**
2	Half adder and Full Adder using logic gates.
3	Decoder and Encoders
4	Multiplexers and demultiplexers.
5	Realization of counters.
	Scheme for Examination • 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.

Course outcomes:

- At the end of the course the student will be able to:
- Demonstrate the operation of wave shaping networks, amplifiers& clampers.
- Analyze the performance of 555 timer as monostable & a stable multi vibrator.
- Design the oscillator & multi vibrator for desired frequency.
- 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.

B.Tech. (ROBOTICS AND AUTOMATION)
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SEMESTER - III

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW

Course Code	18CPC39/18CPH49	CIE Marks	40
TeachingHours/Week (L:T:P)	(1:0:0)	SEE Marks	60
Credits	01	Exam Hours	03

Course objectives:

- Know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens
- Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.
- Know about the cybercrimes and cyber laws for cyber safety measures.

Module-1

Introduction to Indian Constitution: The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building.

Module-2

Union Executive and State Executive: Parliamentary System, Federal System, Centre- State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370.371,371J) for some States.

Module-3

Elections, Amendments and Emergency Provisions: Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73,74, ,75, 86, and 91,94,95,100,101,118 and some important Case Studies. Emergency Provisions, types of Emergencies and its consequences.

Constitutional special provisions: Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

Module-4

Professional / Engineering Ethics: Scope & Aims of Engineering & Professional Ethics -Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering

Module-5

Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies.

Course outcomes:

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

CO1: Have constitutional knowledge and legal literacy.

CO2: Understand Engineering and Professional ethics and responsibilities of Engineers.

CO3: Understand the the cybercrimes and cyber laws for cyber safety measures.

Question paper pattern:

- The SEE question paper will be set for 100 marks and the marks scored by the students will Proportionately be reduced to 60. The pattern of the question paper will be objective type (MCQ).
- For the award of 40 CIE marks, refer the University regulations 2018.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Constitution of India, Professional Ethics and Human Rights	Shubham Singles, Charles E. Haries, and et al	Cengage Learning India	2018
2	Cyber Security and Cyber Laws	Alfred Basta and et al	Cengage Learning India	2018
Reference Books				
3	Introduction to the Constitution of India	Durga Das Basu	Prentice –Hall,	2008.
4	Engineering Ethics	M. Govindarajan, S. Natarajan, V. S. Senthilkumar	Prentice –Hall,	2004

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SEMESTER - III

ADDITIONAL MATHEMATICS – I
(Mandatory Learning Course: Common to All Branches)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech programmes)

Course Code	18MATDIP31	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:1:0)	SEE Marks	60
Credits	--	Exam Hours	03

Course objectives:

- To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
- To provide an insight into vector differentiation and first order ODE's.

Module-1

Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).
Vector Algebra: Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-2

Differential Calculus: Review of elementary differential calculus. Polar curves –angle between the radius vector and the tangent pedal equation- Problems. Maclaurin's seriesexpansions, problems.
Partial Differentiation: Euler's theorem for homogeneous functions of two variables. Total derivatives-differentiation of composite function. Application to Jacobians of order two.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-3

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). Solenoidal and irrotational vector fields-Problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-4

Integral Calculus: Review of elementary integral calculus. Statement of reduction formulae for $\sin^n x, \cos^n x, and \sin^m x \times \cos^n x$ and evaluation of these with standard limits-Examples. Double and triple integrals, problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-5

Ordinary differential equations (ODE's): Introduction-solutions of first order and first degree differential equations: Variable Separable method, exact and linear differential equations of order one. Application to Newton's law of cooling.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Course outcomes:

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

- CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
- CO2: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
- CO3: Analyze position, velocity and acceleration in two and three dimensions of vector valued functions.
- CO4: Learn techniques of integration including the evaluation of double and triple integrals.
- CO5: Identify and solve first order ordinary differential equations.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43rd Edition, 2015
Reference Books				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics Vol. I	Rohit Khurana	Cengage Learning	2015

****** END ******

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SEMESTER - IV

COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS
(Common to all branches)
[As per Choice Based Credit System (CBCS) scheme]

Course Code	18MAT41	CIE Marks	40
TeachingHours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.

Module-1

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences.
Construction of analytic functions: Milne-Thomson method-Problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-2

Conformal transformations: Introduction. Discussion of transformations: $w = Z^2, w = e^z, w = z + \frac{1}{z}, (z \neq 0)$. Bilinear transformations- Problems.
Complex integration: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-3

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying.

Module-4

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation -problems. Regression analysis- lines of regression –problems.
Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form- $y = ax + b, y = ax^b \text{ and } y = ax^2 + bx + c.$

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying.

Module-5

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.
Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

Revised Bloom's Taxonomy Level	L_2 – Understanding, L_3 – Applying, L_4 – Analysing

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

- CO1: Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- CO2: Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow

visualization and image processing.

- CO3: Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- CO4: Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- CO5 : Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition,2016
2	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Edition, 2017
3	Engineering Mathematics	Srimanta Pal et al	Oxford University Press	3rd Edition,2016
Reference Books				
1	Advanced Engineering Mathematics	C.Ray Wylie, Louis C.Barrett	McGraw-Hill	6th Edition 1995
2	Introductory Methods of Numerical Analysis	S.S.Sastry	Prentice Hall of India	4th Edition 2010
3	Higher Engineering Mathematics	B.V.Ramana	McGraw-Hill	11th Edition,2010
4	A Text Book of Engineering Mathematics	N.P.Bali and Manish Goyal	Laxmi Publications	2014

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME – 20

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SEMESTER - IV

THEORY OF MACHINES

Course Code	18RA42	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course objectives:

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

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.

Revised Bloom's Taxonomy Level **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

Revised Bloom's Taxonomy Level **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

Revised Bloom's Taxonomy Level **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 transmitted and simple numerical.

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

Module-5

Introduction to Robotics: 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.

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

Course outcomes:

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

CO1: Knowledge of mechanisms and their motion.
CO2: Understand the inversions of four bar mechanisms.
CO3: Analyse the velocity, acceleration of links and joints of mechanisms.
CO4: Analysis of cam follower motion for the motion specifications.
CO5: Understand the working of the spur gears.
CO6: Analyse the gear trains speed ratio and torque

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Theory of Machines	Sadhu Singh	Pearson	Third Edition 2019
2	Theory of Machines	Ratan S S	Tata Mc Graw Hill Publishing company	2014
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	Mechanisms and Machines-Kinematics, Dynamics and Synthesis	Michael M Stanisic	Cengage Learning	2016
3	Mechanism & Machine theory	G.Ambekar	PHI	2009
4	Theory of Machines and Mechanisms	Amitabha Ghosh and Mallick	East West Press	3rd Edition 2006

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SEMESTER – IV

CONTROL SYSTEMS

Course Code	18RA43	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To develop comprehensive knowledge and understanding of modern control theory, industrial automation, and systems analysis.
- To model mechanical, hydraulic, pneumatic and electrical systems.
- To represent system elements by blocks and its reduction techniques.
- To understand transient and steady state response analysis of a system.
- To carry out frequency response analysis using polar plot, Bode plot.
- To analyse a system using root locus plots.
- To study different system compensators and characteristics of linear systems.

Module-1

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.

Revised Bloom's Taxonomy Level **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.

Revised Bloom's Taxonomy Level **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

Revised Bloom's Taxonomy Level **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

Revised Bloom's Taxonomy Level **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 and Laplace transform method. Numerical problems

Revised Bloom's Taxonomy Level **L3**

Course outcomes:

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

- Demonstrate the concepts of Control systems and its Specifications for mathematical modelling, feedback control and stability analysis in Time and Frequency domains
- 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
- Apply root-locus and Routh–Hurwitz stability criterion technique to analyse and design control systems
- 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)

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Automatic Control Systems	Farid G., Kuo B. C	McGraw Hill Education	10^{th}, Edition 2018
2	Control systems	Manik D. N	Cengage	2017
3	Control Systems Engineering	Nagraj, M Gopal	New Age International (P) Ltd	2012
4	Modern control Engineering	K. Ogeta	Pearson	5th Edition, 2010
Reference Books				
1	Automatic Control systems	Benjamin C. Kuo,	John Wiley India Pvt. Ltd	Eight Edition, 2008
2	Modern control Systems	Richard C Dorf	Pearson	2017
3	Control Systems Engineering	S Palani	Tata McGraw Hill Publishing Co Ltd	SBN-13 97800706719

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SEMESTER – IV

FLUID MECHANICS AND FLUID MACHINES

Course Code	18RA44	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- 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.

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.

Revised Bloom's Taxonomy Level **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.

Revised Bloom's Taxonomy Level **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.

Revised Bloom's Taxonomy Level **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.

Revised Bloom's Taxonomy Level **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 compounding, methods of compounding. Reaction turbine - Parson's reac tion turbine, condition for maximum blade efficiency, reaction staging, simple problems.

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

Course outcomes:
At the end of the course the student 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	A Text Book of Fluid Mechanics And Hydraulic Machines	Dr R.K Bansal	Laxmi Publishers	2004
2	Fluid Mechanics	F M White	McGraw Hill Publications	Eighth edition 2016
3	Text book of Turbomachines	M S Govinde Gowda	M M Publishers	2011
Reference Books				
1	Fundamentals of Fluid Mechanics	Munson, Young, Okiishi & Huebsch,	John Wiley publications	7th edition
2	Fluid Mechanics	Pijush.K.Kundu,I RAM COCHEN	ELSEVIER	3rd Ed. 2005
3	Fluid Mechanics and Hydraulics	Dr.Jagadishlal	Metropolitan Book Co-Ltd.,	1997
4	Fluid Mechanics	John F.Douglas, Janul and M.Gasiosek and john A.Swaffield	Pearson Education Asia,	5th Edition 2006
5	Fluid Mechanics and Fluid Power Engineering	Kumar.D.S,	Kataria and Sons.,	2004

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SEMESTER – IV

INSTRUMENTATION & MEASUREMENTS

Course Code	18RA45	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- 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 Transducers and display devices

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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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

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

Course outcomes:

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

- 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Electrical and Electronic Measurements and Instrumentation	A. K. Sawhney,	DhanpatRai& Co. Pvt. Ltd.	17th Edition (Reprint 2004)
2	Instrumentation: Devices and Systems	C. S. Rangan, G. R. Sarma, V. S. V. Mani	McGraw Hill Education	2nd Edition 2014
3	Process Measurement Instrument Engineers Handbook	Bela G. Liptak	Chilton Book Company	1982
4	Electronics Instrumentation	H.S. Kalsi	TMH	2004
Reference Books				
1	Transducers and Instrumentation	D.V.S.Murty	PHI,	2nd Edition 2009
2	Introduction to Measurements and Instrumentation	A. K. Ghosh	PHI,	2nd Edition 2007
3	Instrumentation Measurement and Analysis	B.C.Nakra and K.K.Choudhry,	McGraw Hill Education (India) Pvt.Ltd	3rd Edition 2009
4	Measurement Systems Application and Design	Ernest O.Doeblin and Dhanesh N Manik,	McGraw Hill	5th Edition 2007

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SEMESTER – IV

MICROCONTROLLER

Course Code	18RA46	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- 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

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.

Revised Bloom's Taxonomy Level	L1, L2

Module-2

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.

Revised Bloom's Taxonomy Level	L1, L2

Module-3

8051 Stack, I/O Port Interfacing and Programming: 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops. Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.

Revised Bloom's Taxonomy Level	L1, L2,L3

Module-4

8051 Timers and Serial Port: 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS-232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.

Revised Bloom's Taxonomy Level	L1, L2,L3

Module-5

8051 Interrupts and Interfacing Applications:8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a portpin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly language interfacing programming.

Revised Bloom's Taxonomy Level	L1, L2,L3

Course outcomes:

At the end of the course the student 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 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	The 8051 Microcontroller and Embedded Systems – using assembly and C	Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay	PHI/ Pearson	2006
2	The 8051 Microcontroller"	Kenneth J. Ayala	Thomson/Cengage Learning	3rd Edition
Reference Books				
1	The 8051 Microcontroller Based Embedded Systems	Manish K Patel	McGraw Hill,	ISBN: 978-93-329-0125-4
2	Microcontrollers: Architecture, Programming, Interfacing and System Design	Raj Kamal,	Pearson Education	2005
3	Microcontrollers- Theory and Applications",	AjayV.Deshmukh	TMH	2005
4	Microcontroller and its applications",	Dr.Ramani Kalpathi and Ganesh Raja	SanguineTechnical publishers, Bangalore	2005

B.TECH.. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

MICROCONTROLLER LABORATORY

Course Code	18RAL47	CIE Marks	40
Teaching Hours/Week (L:T:P)	(0:2:2)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

- 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.

Sl. NO	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:

At the end of the course the student 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:

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.TECH.. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - IV

INSTRUMENTATION AND MEASUREMENTS LAB

Course Code	18RAL48	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

The course should enable the students to:

I. Understand basic principles of instrumentation and control systems
II. Apply calibration of measuring instruments for linear and angular displacement.
III. Understand calibration of measuring instruments for temperature
IV. Apply calibration of measuring instruments of flow and speed measurement
V. Understand the functioning of strain gauges for measuring pressure and vibration

Sl. No	PART A
1	Calibration of capacitive transducer for angular measurement.
2	Study and calibration of LVDT transducer for displacement measurement.
3	Study of resistance temperature detector for temperature measurement.
4	Calibration of thermister for temperature measurement.
5	Calibration of thermocouple for temperature measurement.
	PART B
1	Calibration of Pressure gauges.
2	Calibration of strain gauge for temperature measurement.
3	Study and calibration of photo speed pickups for the measurement of speed.
4	Study and calibration of rotameter for flow measurement.
5	Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various Loads.
6	Calibration of Mcleod gauge for low pressure.

Course outcomes:

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

1. To produce engineering professional capable of synthesizing and analyzing mechanical system including allied engineering streams.
2. An ability to adapt and integrate current technologies in the design and manufacturing domain to enhance the employability.
3. To build the nation by imparting technological inputs and managerial skills to become a Technocrats.

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.
5. 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.
6. 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books				
1	Measurement Systems: Applications & Design	D.S.Kumar	Anuradha Agencies	1st Edition,2013
2	Instrumentation, Measurement &Analysis	C.Nakra,K.K. Choudhary	Tata Mc Graw Hill	1st Edition,2013

B.TECH. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - IV

ADDITIONAL MATHEMATICS – II
(Mandatory Learning Course: Common to All Branches)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech programmes)

Course Code	18MATDIP41	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:1:0)	SEE Marks	60
Credits	--	Exam Hours	03

Course objectives:

- To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them.
- To provide an insight into elementary probability theory and numerical methods.

Module-1

Linear Algebra: Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of a square matrix. Problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-2

Numerical Methods: Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)-Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-3

Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators.[Particular Integral restricted to $R(x) = e^{ax}, \frac{sin ax}{cosax}, x^n \; for \; f(D)y = R(x)$.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-4

Partial Differential Equations (PDE's): Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Module-5

Probability: Introduction. Samplespace and events. Axioms of probability. Addition&multiplication theorems. Conditional probability, Bayes's theorem, problems.

Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.

Course outcomes:
At the end of the course the student will be able to:
CO1: Solve systems of linear equations using matrix algebra.
CO2: Apply the knowledge of numerical methods in modelling and solving of engineering problems.
CO3: Apply the knowledge of numerical methods in modelling and solving of engineering problems.
CO4: Classify partial differential equations and solve them by exact methods.
CO5: Apply elementary probability theory and solve related problems.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43rd Edition, 2015
Reference Books				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics Vol.I	Rohit Khurana	Cengage Learning	2015.

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B.TECH. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – V

Technological Innovation Management And Entrepreneurship

Course Code	18RA51	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- 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

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.

Revised Bloom's Taxonomy Level	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).

Revised Bloom's Taxonomy Level	L1,L2

Module-3

Social Responsibilities of Business: Meaning of Social Responsibility, 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 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).

Revised Bloom's Taxonomy Level	L1,L2

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
.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.

Revised Bloom's Taxonomy Level	L1,L2

Module-5

Industry 4.0: Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, Smart Manufacturing, Smart Devices and Products, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Cloud Computing and Industry 4.0, Industry 4.0 laboratories, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world

Revised Bloom's Taxonomy Level	L1,L2

Course outcomes:

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

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

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

CO3: Understand the components in developing a business plan.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Principles of Management	P.C. Tripathi, P.N Reddy,	McGraw Hill Education	6th Edition, 2017.ISBN13:978-93-5260-535-4
2	Entrepreneurship Development Small Business Enterprises	Poornima M Charantimath	Pearson Education	2008, ISBN978-81-7758-260-4
3	Dynamics of Entrepreneurial Development and Management	Vasant Desai.	HPH 2007	ISBN:978-81-8488-801-2.
4	Entrepreneurship	Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd	Tata Mc-graw Hill Publishing Co.ltd.	New Delhi,2012
5	Management Fundamentals-Concepts, Application, Skill Development	Robers Lusier – Thomson	Sage Publications	6th Edition2014
Reference Books				
1	Essentials of Management: An International, Innovation and Leadership perspective	Harold Koontz, Heinz Weihrich	McGraw Hill Education	10th Edition 2016. ISBN- 978-93-392-2286-4

B.TECH. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - V

Design and Analysis of Machine Elements

Course Code	18RA52	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

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

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

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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).

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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)

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

Course outcomes:

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

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

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Mechanical Engineering Design	Joseph E Shigley and Charles R. Mischke.	McGraw Hill International edition	6thEdition 2009
2	Design of Machine Element	V.B. Bhandari	Tata McGrawHill Publishing Company Ltd., New Delhi	3rdEdition 2010
3	Machine Design	Dr. P C Sharma and Dr. D K Aggarwal	S. K. Kataria& Sons	11th Edition 2009
4	Finite Elements in engineering	Chandrupatla T. R.,	PHI	2nd Edition,2013
5	Finite element method in engineering	Rao, S. S.	Pergaman Int. Library of Science,	5th Edition 2010

Design Data Hand Book

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

Reference Books				
1	Machine Design	Robert L. Norton	Pearson Education Asia	2001
2	Design of Machine Element	M. F. Spotts, T. E. Sh oup, 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 Lt d., New Delhi,	Special Indian Edition, 2008
4	Finite Element Method	J.N. Reddy	McGraw -Hill International Edition	2005

B.TECH. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - V

Virtual Instrumentation

Course Code	18RA53	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 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.

Revised Bloom's Taxonomy Level	L5

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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	L4

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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	L3

Course outcomes:

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

- Understand the structured LabVIEW programming concepts in developing Virtual Instrumentation.
- Build applications employed in various debugging techniques, simulating and analyzing the data and use general purpose interface bus and Serial communication Interface
- Create applications that uses plug in DAQ boards and built in analysis functions to process the data.
- Design and analyse various applications on Real time monitoring using DAQ boards

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

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Virtual Instrumentation using LabVIEW	Jovitha Jerome	PHI publication	2010
2	Virtual Instrumentation, LABVIEW	Sanjay Gupta	TMH	NewDelhi,2003
Reference Books				
1	PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control.	Kevin James	Newnes	2000

B.TECH.ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – V

Hydraulics and Pneumatics

Course Code	18RA54	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

- 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

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.

Revised Bloom's Taxonomy Level	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

Revised Bloom's Taxonomy Level	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

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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.

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) using cascading 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.

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

Course outcomes:

At the end of the course the student 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 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

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbook/s				
1	Fluid Power with Applications	Anthony Esposit	Pearson Education, Inc,	Sixth edition 2000
2	Pneumatics and Hydraulics	Andrew Parr	Jaico Publishing Co	1993
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	Industrial Press US	1997
4	Pneumatic Systems	S. R. Majumdar	Tata McGraw Hill Publish	1995
5	Hydraulic & Pneumatics' CMTI Data Book.			

B.TECH. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - V

Robot Programming

Course Code	18RA55	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives: To Familiarize

- Fundamental concept of AI and expert system
- Concept of AI programming languages
- Applications of AI in the field of Robotics

Module-1

Introduction to Robot Programming

Robot software functions - coordinate systems, position control, other control functions, subroutines, Program planning for Robot flow charting for robot programs with few examples.

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

Module-2

Methods of Robot Programming

Online programming, off-line programming, advantages of off-line programming, lead through methods - powered lead through, manual lead through, Teach pendant, Robot program as a path in space, defining position in space, motion interpolation, WAIT, SIGNAL and DELAY commands, Branching capabilities and Limitations of head through methods.

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

Module-3

Robot Languages

Textual ROBOT Languages, first generation and second generation languages, structure of a robot language - operating systems, Elements and Functions, constants, variables and other data objects, Motion commands, points in workspace, End effector and sensor commands, computations and operations, program control and subroutines, communications and Data processing.

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

Module-4

VAL II

General description, Monitor commands, motion command, Hand Control, Configuration control, interlock commands, INPUT/OUTPUT Controls, Program Control, examples.

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

Module-5

AML

General description, AML statements, Constant and variables, program control statements, motion commands, Sensor commands, Grip sensing capabilities, Data processing, examples.

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

Course outcomes:

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

CO1: Have knowledge of Robot software functions and Robot flow charting

CO2: Understand the Robot programming and its languages

CO3: Apply working principles of programming for various applications.

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

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	'Industrial Robotics Technology, Programming and Applications'	Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey	Mc Graw Hill Book company	1986
Reference Books				
1	'Industrial Robotics'	Bernard Hodges	Jaico Publishing House	1993

B.TECH. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - V

MECHATRONICS

Course Code	18RA56	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

Mechatronics system design deals with the design of controlled electromechanical systems by the integration of functional elements from a multitude of disciplines. It starts with thinking how the required function can be realized by the combination of different subsystems according to a systematic step-by-step engineering design approach applied to a realistic mechatronics design problem.

Module-1

Module 1 Introduction: Introduction to Mechatronics, Design process, Systems, Measurement systems, Control systems, Examples of mechatronic systems: Digital camera with autofocus, Engine management system. Sensors and Transducers (only selected topics): Smart sensors, Pneumatic sensors, Proximity switches, Pyroelectric sensors, Piezoelectric sensors, Tactile sensor. [Textbook-1]

Module-2

Module -2 Pneumatic And Hydraulic Actuation Systems: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure control valves, Servo and proportional control valves, Process control valves, Rotary actuators. Mechanical Actuation Systems: Mechanical systems, Types of motion, Kinematic chains, Cams, Gears, Belt and chain drives, Bearings.[Textbook-1]

Module-3

Module -3 Electrical Actuation Systems: Electrical systems, Mechanical switches, Solenoids, D.C. motors, A.C. motors, Stepper motors. Fault Finding: Fault-detection techniques, Watchdog timer, Parity and error coding checks, Common hardware faults, Microprocessor systems, Emulation and simulation. [Textbook-1]

Module-4

Module -4 Interfacing Microcontrollers with Actuators: Introduction, Interfacing with general purpose three state transistors, Interfacing relays, Interfacing solenoids, Interfacing stepper motors, interfacing permanent magnet motors, Interfacing sensors, Interfacing with DAC, interfacing power supplies, Compatibility at an interface. Reliability: Meaning of reliability, The life curve, Repairable and non-repairable systems, Failure or hazard rate models, Reliability systems, Response surface modeling. [Textbook-2]

Module-5

Module -5 Components Based Modular Design and System Validation: Introduction, Components based modular design view, System validation, Validation methodology, Validation scheme, Fusion techniqueAn example with vision system. Integration: Introduction, Background, Advanced actuators, Industrial robot, Autonomous guided vehicle (AGV), Drilling machine for PCB board. [Textbook-3]

Course outcomes:

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

1. Describe and analyze the mechatronic systems and their associated systems
2. Discuss and illustrate different types of actuation systems that can be employed in a mechatronic system.
3. Demonstrate the integration of mechatronic systems.
4. Identify and solve the faults in mechatronic systems and assess the reliability.
5. Design and develop microcontroller and actuator based mechatronic system.
6. Design modular system and perform validation.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering	W. Bolton	Pearson Education Asia, 4th Edition	2013
2	Mechatronics: Principles and Applications	Godfrey C. Onwubolu	Elsevier (BH) Publications, India Reprint	2013
3	Mechatronics: Principles, Concepts and applications	NitaigourPremch andMahailik	TMH	2003
Reference Books				
1	Introduction to mechatronics and measurement systems	–David G. Alciatore& Michel BiHistand	Tata McGraw Hill	2000
2	Mechatronics	H.D. Ramachandra	Sudha Publication	2003
3	Mechatronics System design	DevadasShetty and Richard A. Kark	Thomas Learning	1997
4	Mechatronics an Introduction	Robert H Bishop	CR	2005
5	Mechatronics Systems Fundamentals	Rolf Isermann	Springer	2005

B.TECH. ROBOTICS AND AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - V

Virtual Instrumentation and Automation

Course Code	18RAL57	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

Revised Bloom's Taxonomy Level	Design , Create , Apply

Course outcomes:

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

- Develop LabVIEW programming which employs simulating and analyzing the data for real time automation
- Engage in designing, implementing, analyzing and demonstrating an application using tools in available in LabVIEW through an open ended experiment.
- 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.Tech. ROBOTICS AND AUTOMATION

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

SEMESTER - V

Robotic programming and simulation

Course Code	18RAL58	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	02	Exam Hours	03

Course objectives:

- To introduce different types of robotics and demonstrate them to identify different parts and components.
- To write programming for simple operations

Sl. No	Experiments
1	Determination of maximum and minimum position of links
2	Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
3	Estimation of accuracy, repeatability and resolution
4	Robot programming and simulation for pick and place
5	Robot programming and simulation for Color identification
6	Robot programming and simulation for Shape identification
7	Robot programming and simulation for machining (cutting, welding, Drilling)
8	Robot programming and simulation for Continuous Path Operation on Cylinder
9	Robot programming and simulation for any industrial process (Packaging, Assembly)
10	Robot programming and simulation for multi process

Course outcomes:

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

- Use of any robotic simulation software to model the different types of robots and calculate work volume for different robots.

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 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.TECH. ROBOTICS AND AUTOMATION

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

SEMESTER - V

ENVIRONMENTAL STUDIES

Course Code	18CIV59	CIE Marks	40
Teaching Hours/Week (L:T:P)	(1:0:0)	SEE Marks	60
Credits	01	Exam Hours	02

Module-1

Ecosystems (Structure and Function): Forest, Desert, Wetlands, Riverine, Oceanic and Lake.
Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

Module-2

Advances in Energy Systems(Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind.
Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Module-3

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.
Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module-4

Global Environmental Concerns(Concept, policies and case-studies): Ground waterdepletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module-5

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications):
G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs.
Field work: Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

Course outcomes:

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

CO1: Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale

CO2: Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.

CO3: Demonstrate ecology knowledge of a complex relationship between biotic and a biotic components.
CO4: Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Question paper pattern:

- The Question paper will have 100 objective questions.
- Each question will be for 01 marks
- Student will have to answer all the questions in an OMR Sheet.
- The Duration of Exam will be 2 hours.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Environmental Studies	Benny Joseph	Tata Mc Graw – Hill.	2ndEdition, 2012
2	Environmental Studies	S M Prakash	Oxford Publisher	2005
3	Environmental Studies – From Crisis to Cure	R Rajagopalan	Oxford Publisher	2005
Reference Books				
1	Principals of Environmental Science and Engineering	Raman Sivakumar	Cengage learning, Singapur.	2ndEdition, 2005
2	Environmental Science – working with the Earth	G.Tyler Miller Jr	Thomson Brooks /Cole,	11thEdition, 2006
3	Text Book of Environmental and Ecology	Pratiba Sing, AnoopSingh& PiyushMalaviya	Acme Learning Pvt. Ltd. New Delhi.	1stEdition

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B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

PLC and SCADA

Course Code	18RA61	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

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.

Revised Bloom's Taxonomy Level	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

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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**.**

Revised Bloom's Taxonomy Level	L1, L2, L3

Course outcomes:

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

- Demonstrate the concepts of basic programming skills of PLC using logical instructions
- Apply the architecture process involved in programmable logic controller and basic programming skills of PLC using logical instructions
- Examine the various operation involved in the PLC input/output module and SCADA system
- 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.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	PLC and Industrial application	Madhuchhandan Gupts and SamarjitSen	pernram international pub. (Indian) Pvt. Ltd.,	2011
2	Securing SCADA System	Ronald L Krutz	Wiley Publication	2005
Reference Books				
1	Introduction to Programmable Logic Controllers	GaryDunning	Thomson	2 nd Edition
2	Programmable Logic Controllers: Principles and Application	John W Webb, Ronald A Reis	PHI Learning, Newdelhi	5th Edition
3	SCADA Supervisory Control and Data Acqusition	Stuart A Boyer	ISA	4 th Revised edition

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

FINITE ELEMENT METHODS

Course Code	18RA62	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course objectives:

- To learn the basic principles of finite element analysis procedure
- To understand the design and heat transfer problems with application of FEM.
- Solve 1 D, 2 D and dynamic problems using Finite Element Analysis approach.
- To learn the theory and characteristics of finite elements that represent engineering structures.
- To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses

Module-1

Introduction to Finite Element Method: General steps of the finite element method. Engineering applications of finite element method. Advantages of the Finite Element Method.
Boundary conditions: Homogeneous and non-homogeneous for structural, heat transfer and fluid flow problems. Potential energy method, Rayleigh Ritz method, Galerkin"s method, Displacement method of finite element formulation. Convergence criteria, Discretisation process, Types of elements:1D, 2D and 3D, Node numbering, Location of nodes.
Strain-displacement relations, Stress-strain relations, Plain stress and Plain strain conditions, temperature effects.
Interpolation models: Simplex, complex and multiplex elements, linear interpolation polynomials in terms of global coordinates 1D, 2D, 3D Simplex Elements.

Revised Bloom's Taxonomy Level	L1,L2,L3

Module-2

Introduction to the stiffness (Displacement) method: Introduction, Derivation of stiffness matrix, Derivation of stiffness matrix for a spring element, Assembly the total stiffness matrix by superposition. One-Dimensional Elements-Analysis of Bars and Trusses, Linear interpolation polynomials in terms of local coordinate"s for1D, 2D elements. Higher order interpolation functions for 1D quadratic and cubic elements in natural coordinates, Constant strain triangle, Four-Nodded Tetrahedral Element (TET 4), Eight-Nodded Hexahedral Element (HEXA 3 8), 2D iso-parametric element, Lagrange interpolation functions.
Numerical integration: Gaussian quadrature one point, two point formulae, 2D integrals. Force terms: Body force, traction force and point loads, Numerical Problems: Solution for displacement, stress and strain in 1D straight bars, stepped bars and tapered bars using elimination approach and penalty approach

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

Module-3

Beams and Shafts:
Boundary conditions, Load vector, Hermite shape functions, Beam stiffness matrix based on Euler-Bernoulli beam theory, Examples on cantilever beams, propped cantilever beams, Numerical problems on simply supported, fixed straight and stepped beams using direct stiffness method with concentrated and uniformly distributed load.
Torsion of Shafts:
Finite element formulation of shafts, determination of stress and twists in circular shafts.

Revised Bloom's Taxonomy Level	L1,L2,L3

Module-4

Heat Transfer:
Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, 1D finite element formulation using vibration method, Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins.
Fluid Flow:
Flow through a porous medium, Flow through pipes of uniform and stepped sections, Flow through hydraulic net works

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

Module-5	
Axi-symmetric Solid Elements: Derivation of stiffness matrix of axisymmetric bodies with triangular elements, Numerical solution of axisymmetric triangular element(s) subjected to surface forces, point loads, angular velocity, pressure vessels. **Dynamic Considerations:** Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix of bar element, truss element, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.	
Revised Bloom's Taxonomy Level	L1,L2,L3

Course outcomes:

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

- Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
- Develop element characteristic equation and generation of global equation.
- Formulate and solve Axi-symmetric and heat transfer problems.
- Apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat
- transfer, fluid flow, axi-symmetric and dynamic problems

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	A first course in the Finite Element Method	Logan, D. L	Cengage Learning	6th Edition 2016
2	Finite Element Method in Engineering	Rao, S. S	Pergaman Int. Library of Science	5th Edition 2010
3	Finite Elements in Engineering	Chandrupatla T.	PHI	2nd Edition 2013
Reference Books				
1	Finite Element Method	J.N.Reddy	McGraw -Hill	International Edition-
2	Finite Elements Procedures	Bathe K. J	PHI	1996
3	Concepts and Application of Finite Elements Analysis	Cook R. D., et al.	Wiley & Sons	4th Edition 2003

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VI

MOTORS, DRIVES and POWER ELECTRONICS

Course Code	18RA63	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course objectives:

- To understand and acquire knowledge about various power semiconductor devices.
- To prepare the students to analyze and design different power converter circuits

Module-1

Elements and Dynamics of Electric Drive Systems

Basic components of an Electric drive system: Mechanical loads, electric motors, power sources, converters and controllers. Moment of inertia, basic concept of Traveling time, gears and belts, traveling time of dc motors and traveling time of induction motors.

Braking of electric motors

DC shunt and series motors: Regenerative , dynamic, and concurrent braking. Induction motors: Regenerative , dynamic and concurrent braking

Revised Bloom's Taxonomy Level	L1,L2,L3

Module-2

Power electronic devices

Ratings of power electronic devices, Characteristics of : power diodes, power transistors, power mosfets, triac and IGBT. Thyristors (SCR): static VI characteristics, turn on methods, switching characteristics, gate characteristics, two transistor model, di/dt and dv/dt protection. Firing circuits for SCRs

Revised Bloom's Taxonomy Level	L1,L2,L3

Module-3

Solid state switching circuits

Single- phase , half-wave, ac/dc conversion for resistive loads, Single- phase , full-wave, ac/dc conversion for resistive loads, Single- phase , half-wave, ac/dc conversion for inductive loads without/with freewheeling diode, single phase dc/ac converter, voltage, frequency and sequence control and PWM,. Current source Inverter.

Revised Bloom's Taxonomy Level	L_1,L_2,L_3

Module-4

Speed –torque characteristics of electric motors

Joint Speed-Torque Characteristics of Electric Motors and Mechanical Loads DC motors: separately excited motors, shunt motors, series motors and compound motors, Induction motors: equivalent circuit, power flow, torque characteristics, starting procedure ,Damage to electric machines.

Revised Bloom's Taxonomy Level	L1,L2,L3

Module-5

Speed Control of Electric motors

Speed control of shunt or separately excited DC motors: by adding resistance, adjusting armature voltage, adjusting field voltage and solid-state control, Speed control of DC series motor: by adding resistance to armature circuit , adjusting armature voltage, and by adjusting field current, speed control of induction motors: by rotor resistance, by slip energy recovery method, by adjusting the stator voltage, adjusting the supply frequency, voltage/frequency(V/F) control.

Revised Bloom's Taxonomy Level	L1,L2,L3

Course outcomes:

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

- Acquire knowledge about fundamental concepts and techniques used in power electronics.
- Ability to analyze various single phase and three phase power converter circuits and understand their applications.
- Foster ability to identify basic requirements for power electronics based design application.
- To develop skills to build, and troubleshoot power electronics circuits.
- Foster ability to understand the use of power converters in commercial and industrial applications

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Fundamental of electric drives,	Gopal K Dubey,	Second, Narosa publication,	2005
2	Power Electronics,	P.S Bhimbhra,	Khanna	2007
3	Fundamental of electric drives	Mohammed A Sharkawi,	Fourth, Brooks/Cole	2007
Reference Books				
1	Power Electronics Circuits,devices and applications,	Rashid M H,	Second, PHI,	2007

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

Professional Elective-1

WIRELESS NETWORKS AND COMMUNICATION

Course Code	18RA55	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	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

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.

Revised Bloom's Taxonomy Level	**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

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**L1,L2**

Module-5

Wireless adhoc networks: Mobile adhoc networks, Sensor Networks, Mesh networks, VANETs.

Revised Bloom's Taxonomy Level	**L1,L2**

Course outcomes:

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

- Keep himself updated on latest wireless technologies and trends in the communication field.
- Understand the transmission of voice and data through various networks.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Wireless and Mobile Network concepts and protocols	S.S. Manvi, M.S. Kakkasageri	Willy	firstedition.2010.
2	Wireless Telecom systems and networks	Mullet	Thomson Learning	2006
Reference Books				
1	Principals of wireless networks	P Kavesh, Krishnamurthy	A unified approach	PHI, 2006
2	Wireless communication and networks 3G and beyond	Iti Saha Mishra	MGH	2009
3	Introduction to wireless telecommunication systems and networks	Mullet	Cengage	2008
4	Introduction to wireless and mobile systems	DP Agarwal, Qing An Zeng	Cengage	2008
5	Handbook of wireless networks and mobile computing'	Ivan Stojmenovic	Willy	2009

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VI

Professional Elective-1
MICRO & SMART SYTEMS TECHNOLOGY

Course Code	18RA56	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

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

Module-1

Introduction to Micro and Smart systems_: Miniaturization, Microsystems versus MEMS, Micro-fabrication, Smart Materials, Structures & Systems, Integrated Microsystems ,Application of Smart Materials & Microsystems**.**

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**L1,L3**

Module-3

Micromachining Technologies: Silicon as a Material for Micromachining, Silicon wafer preparation, thin-film deposition techniques, Lithography, Etching, Silicon micromachining: surface micromachining, bulk micromachining. Specialized Materials for Microsystems.

Revised Bloom's Taxonomy Level	**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 .

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**L1,L3**

Course outcomes:

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

- Have knowledge of Smart Materials, Sensors &Actuators ,Microsystems.
- Understand the Working Methodology of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
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 Methodologies, Smart Material Systems and MEMS	V. Varadan, K. J. Vinoy, S. Goplakrishnan	Wiley	2015
2	MEMS	Nitaigour Premchand Mahalik	TMH	2007
3	MEMS & Microsystems: Design and Manufacture	Tai-Ran Hsu	Tata Mc-Graw-Hill	2017

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

Professional Elective-1
DRIVES AND CONTROL SYSTEMS FOR ROBOTS

Course Code	18RA643	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- The commands to the joint actuators to follow the planned trajectory
- Types of drive systems
- Selection of drives system for particular applications
- To accurately position the robotic and effecter with error compensation - Servo control

Module-1

ROBOT DRIVE MECHANISM

Objectives, motivation, open loop control, closed loop control with velocity and position feed back, Types of drive systems. Functions of drive system.
Lead Screws, Ball Screws, Chain & linkage drives, Belt drives, Gear drives, Precision gear boxes, Harmonic drives, Cyclo speed reducers

Revised Bloom's Taxonomy Level	**L1,L2**

Module-2

HYDRAULIC DRIVES
Introduction, Requirements, Hydraulic piston and transfer valve, hydraulic circuit incorporating control amplifier, hydraulic fluid considerations, hydraulic actuators Rotary and linear actuators. Hydraulic components in robots.

Revised Bloom's Taxonomy Level	**L1,L2**

Module-3

PNEUMATIC DRIVES
Introduction, Advantages, pistons-Linear Pistons, Rotary pistons, Motors-Flapper motor, Geared motor, Components used in pneumatic control. Pneumatic proportional controller, pneumatically controlled prismatic joint.

Revised Bloom's Taxonomy Level	**L1,L2**

Module-4

ELECTRIC DRIVES
Introduction, Types, DC electric motor, AC electric motor, stepper motors, half step mode operation, micro step mode. Types of stepper motors, Direct drive actuator

Revised Bloom's Taxonomy Level	**L1,L2**

Module-5

General aspects of robot control. Basic control techniques, mathematical modeling of robot servos, error responses and steady state errors in robot servos, feed back and feed forward compensations, hydraulic position servo, computer controlled servo system for robot applications, selection of robot drive systems.

Revised Bloom's Taxonomy Level	**L1,L2**

Course outcomes:

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

- Have knowledge of different types of Drives.
- Understand the Robot Driven mechanisms using different types of Drive systems.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Robotics and Image Processing an Introduction	P.A. Janaki Raman	Tata Mc Graw Hill Publishing company Ltd.	1995
Reference Books				
1	Engineering foundation of Robotics	Francis N-Nagy Andras Siegler	Prentice Hall Inc	1987
2	Robotics Engineering an Integrated Approach	Richard D. Klafter, Thomas. A, Chmielewski, Michael Negin,	Prentice Hall of India Pvt. Ltd.,	1989
3	Robotics and Image Processing an Introduction	P.A. Janaki	Tata Mc Graw Hill Publishing company Ltd.	1995
4	Industrial Robotics, Technology programming and Applications	Mikell P. Groorer, Mitchell welss, Roger N. Nagel, Nicholas G.Odrey	Mc Graw Hill International Edition	1896
5	Industrial Robotics	Bernard Hodges	Second Edition Jaico Publishing house	1993
6	Fundamentals of Robotics Analysis and Control	Robert J. Schilling	Hall of India Pvt. Ltd	2000
7	Introduction to Robotics Mechanics and Control	John J. Craig	Second Edition, Addison Wesly Longman Inc. International Student edition	1999

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

Professional Elective-1

ARTIFICIAL NEURAL NETWORKS

Course Code	18RA644	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	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.

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.

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**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.

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

Course outcomes:

At the end of the course the student 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:

- 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Neural Networks A Classroom Approach	Satish Kumar	McGraw Hill Education (India) Pvt. Ltd	Second Edition.
Reference Books				
1	Introduction to Artificial Neural Systems	J.M. Zurada	Jaico Publications	1994
2	Artificial Neural Networks	B. Yegnanarayana	PHI, New Delhi	1998

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

Professional Elective-1
AUTOMATION IN MANUFACTURING

Course Code	18RA645	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To understand the concepts of automation in manufacturing systems
- To impart the knowledge of a line balancing and assembly systems
- To explore the idea of robotics and understand the computerized manufacturing planning
- To gain the knowledge of automated inspection and shop floor control
- To understand the concepts of additive manufacturing and latest trends in manufacturing

Module-1

Introduction: Production system facilities, Manufacturing support systems, Automation in production systems, Automation principles &strategies

Manufacturing Operations: Manufacturing operations, Product/production relationship, Production concepts and Mathematical models & costs of manufacturing operations. Problems on mathematical models

Module-2

Line Balancing: Methods of line balancing, Numerical problems on largest candidate rule, Kilbridge's and Wester's method, and ranked positional weights method, computerized line balancing methods.

Automated Assembly System: Design for automated assembly, types of automated assembly system, Parts feeding devices, Analysis of single and multi station assembly machines.

Module-3

Computerized Manufacture Planning and AGVS: Computer aided process planning (CAPP), Retrieval and Generative systems, and benefits of CAPP. Material requirement planning, Inputs to MRP system, working of MRP, Outputs and benefits. Automated Guided Vehicles System: Applications, Guidance and routing,

Industrial Robotics: Definition, Robot anatomy, Joints and links, Robot configurations, Robot control systems, Accuracy and repeatability, End effectors, Sensors in robotics. Industrial robot applications: Material handling, Processing, assembly and inspection.

Module-4

Inspection Technologies: Automated inspection, coordinate measuring machines construction, Operation &programming, Software, application &benefits, Flexible inspection system, Inspection probes on machine tools, Machine vision, Optical inspection techniques & Non-contact Non-optical inspection technologies.

Shop Floor Control and Automatic Identification Techniques: Shop floor control, Factory data collection system, Automatic identification methods, Bar code technology, Automatic data collection systems. An Introduction to QR Code Technology

Module-5

Additive Manufacturing Systems: Basic principles of additive manufacturing, Slicing CAD models for AM, Advantages and limitations of AM technologies, Recent trends in manufacturing, Hybrid manufacturing.

Future of Automated Factory: Trends in manufacturing, the future automated factory, Human workers in future automated factory, Social impact.

Course outcomes:

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

- Explain the basics of productions, automation system and manufacturing operations. Solve the simple problems on mathematical model.
- Analyze and solve problems on line balancing
- Explain CAPP and MRP system and analyze the AGVS
- Understand the inspection technologies and shop floor control
- Explain the modern trends in additive manufacturing and automated factory

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Automation, Production Systems and Computer-Integrated Manufacturing	Mikell PGroover	PHI Learning	3rd Edition, 2009
2	CAD / CAM Principles and Applications	P N Rao	Tata McGraw-Hill	3rd Edition, 2015
3	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing,	Ian Gibson, David W. Rosen, BrentStucker	Springer	2nd Ed. (2015),
Reference Books				
1	Systems Approach to Computer-Integrated Design & Manufacturing	Dr.Nanua Singh,	Wiley	1996
2	CAD/CAM/CIM	P. Radhakrishnan, S. Subramanyan, U.Raju	New Age International	Revised Third Edition 2007

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

OPEN ELECTIVE – A

ROBOTICS & AUTOMATION

Course Code	18RA651	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- Gain fundamental knowledge of Robotics and Automation
- 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:

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

- Have the knowledge of Joints, Links, Sensors, Control units, Actuators. and elements of Automation.
- Describe motions and control system of Robots.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Industrial Robotics	Mikell P. Weiss G.M.,Nagel R.N., Odraj N.G	McGraw-Hill Singapore	1996
2	Control in Robotics and Automation: Sensor Based Integration	Ghosh	Allied Publishers	1998
Reference Books				
1	Robotics technology and flexible Automation	Deb.S.R	John Wiley, USA	1992
2	Robots and manufacturing Automation	Asfahl C.R	John Wiley, USA	1992
3	Robotic Engineering An integrated approach	Klafter R.D., Chimielewski T.A., Negin M	Prentice Hall of India.	1994
4	Introduction to Robotics	Mc Kerrow P.J	Addison Wesley, USA	1991

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

OPEN ELECTIVE – A

PROCESS INSTRUMENTATION

Course Code	18RA652	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- Gain the Knowledge of basic principles of transducers systems.
- Understand the significant material on important specific areas such as pressure, temperature, measurement, Heat flux sensors, flow meters etc.
- 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:

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

- Have the knowledge of design instruments with good precision and Calibrate the designed instruments.
- Understand measurement as applied to research & development operations & also to monitoring & control of industrial & military systems & processors.
- Illustrate the various applications in the field of DCS & SCADA.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Measurement systems application and design	ERNEST O DOEBELIN	Tata McGraw Hill	5th Edition
Reference Books				
1	Instrumentation Devices & Systems	Rangan, Mani and Sharma	Tata McGraw Hill	2nd Edition
2	Transducers & Instrumentation	DVS Murthy	Prentice Hall of India	2008
3	Instrumentation & Process Measurements	W.Bolton	Universities Press	2004

B.TECH. ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

OPEN ELECTIVE – A

CNC MACHINE TOOLS

Course Code	18RA653	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To understand fundamentals of the CNC technology.
- To get exposed to constructional features of CNC machine tools.
- To know the concepts of CNC machine tool drives and feedback systems.
- To understand the programming methods in CNC machines.
- To understand the cutting tools used, and work holding devices on CNC machine tools

Module-1

INTRODUCTION TO CNC MACHINE TOOLS: Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection.

Module-2

STRUCTURE OF CNC MACHINE TOOL: CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.

Module-3

DRIVES AND CONTROLS: Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives – stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer.

Module-4

CNC PROGRAMMING: Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, manual part programming for machining centre and turning centre.

Computer Aided CNC Part Programming: Need for computer aided part programming, Tools for computer aided part programming, APT, CAD/CAM based part programming for well-known controllers such as Fanuc, Heidenhain, Sinumerik etc., and generation of CNC codes from CAM packages.

Module-5

TOOLING AND WORK HOLDING DEVICES: Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification, qualified, semi qualified and pre-set tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, modular fixtures, economics of CNC, maintenance of CNC machines.

Course outcomes:

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

CO1: Understand evolution, classification and principles of CNC machine tools.

CO2: Learn constructional details of CNC machine tools, selection of standard components used for CNC machine tools for accuracy and productivity enhancement.

CO3: Select drives and positional transducers for CNC machine tools.

CO4: Apply CNC programing concepts of for two axis turning centers and three axis vertical milling centers to generate programs different components.

CO5: Generate CNC programs for popular CNC controllers.

CO6: Analyse and select tooling and work holding devices for different components to be machined on CNC machine tools.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Mechatronics	HMT	Tata McGraw-Hill Publishing Company Limited, New Delhi	2005
2	Computer Control of Manufacturing systems	Koren Y	McGraw Hill	1986
3	Computer Numerical Control Machines	Radhakrishnan P	New Central Book Agency	2002
Reference Books				
1	CNC Machining Hand Book	James Madison	Industrial Press Inc 1996	1996
2	Programming of CNC Machines Ken Evans	John Polywka& Stanley Gabrel	Industrial Press Inc New York	Second Edition 2002
3	CNC Programming Hand book	Peter Smid	Industrial Press Inc	2000
4	CAD/CAM	Rao P.N.	Tata McGraw Hill Publishing Company Limited	2002
5	Computer Numerical Control	Warren S. Seames	Thomson Delmar	Fourth Edition 2002

B.TECH. ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

OPEN ELECTIVE – A

MICRO ELECTRO MECHANICAL SYSTEMS

Course Code	18RA653	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives: This course will enable students to:

- Understand overview of microsystems, their fabrication and application areas.
- Working principles of several MEMS devices.
- Develop mathematical and analytical models of MEMS devices.
- Know methods to fabricate MEMS devices.
- Various application areas where MEMS devices can be used.

Module-1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.

Module-2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics. Engineering Science for Microsystems Design and Fabrication: Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry.

Module-3

Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.

Module-4

Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

Module-5

Overview of Micromanufacturing: Introduction, Bulk Micromanufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing.

Course outcomes:

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

- Appreciate the technologies related to Micro Electro Mechanical Systems.
- Understand design and fabrication processes involved with MEMS devices.
- Analyse the MEMS devices and develop suitable mathematical models
- Know various application areas for MEMS device

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering	Tai-Ran Hsu	Wiley	2nd Ed.2008
Reference Books				
1	Micro and Nano Fabrication: Tools and Processes	Hans H. Gatzen, Volker Saile, JurgLeuthold	Springer	2015
2	Microelectromechanical Systems (MEMS)	Dilip Kumar Bhattacharya, Brajesh Kumar	Cengage	1st Edition 2015

B.TECH.ROBOTICS & AUTOMATION
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VI

PLC AND SCADA LABORATORY

Course Code	18RAL66	CIE Marks	40
Teaching Hours/Week (L:T:P)	(0:2:2)	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	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

Course outcomes:

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

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

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

COMPUTER AIDED MODELLING AND ANALYSIS LAB

Course Code	18RAL67	CIE Marks	40
TeachingHours/Week (L:T:P)	(0:2:2)	SEEMarks	60
Credits	02	Exam Hours	03

Course objectives:

- To acquire basic understanding of Modeling and Analysis software
- To understand the concepts of different kinds of loading on bars, trusses and beams, and analyze the results pertaining to various parameters like stresses and deformations.
- To lean to apply the basic principles to carry out dynamic analysis to know the natural frequencies of different kind of beams

Sl. NO	Experiments
	PART A
1	Study of a FEA package and modeling and stress analysis of: a. Bars of constant cross section area, tapered cross section area and stepped bar b. Trusses –(Minimum 2 exercises of different types) c. Beams –Simply supported, cantilever, beams with point load , UDL, beams with varying load etc. (Minimum 6 exercises) d. Stress analysis of a rectangular plate with a circular hole
	PART B
2	Thermal Analysis –1D & 2D problem with conduction and convection boundary conditions (Minimum 4 exercises of different types)
3	Dynamic Analysis to find: a) Natural frequency of beam with fixed –fixed end condition b) Response of beam with fixed –fixed end conditions subjected to forcing function c) Response of Bar subjected to forcing functions
	PART C (only for demo)
4	a.Demonstrate the use of graphics standards (IGES, STEP etc) to import the model from modeler to solver. b.Demonstrate one example of contact analysis to learn the procedure to carry out contact analysis. c. Demonstrate at least two different types of example to model and analyze bars or plates made from composite material

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

Course outcomes:

At the end of the course the student will be able to:
CO1: Use the modern tools to formulate the problem, create geometry, descritize, apply boundary conditions to solve problems of bars, truss, beams, and plate to find stresses with different-loading conditions.
CO2: Demonstrate the ability to obtain deflection of beams subjected to point, uniformly distributed and varying loads and use the available results to draw shear force and bending moment diagrams.
CO3: Analyze and solve 1D and 2D heat transfer conduction and convection problems with different boundary conditions.
CO4: Carry out dynamic analysis and finding natural frequencies of beams, plates, and bars for various boundary conditions and also carry out dynamic analysis with forcing functions

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.

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SEMESTER -VI

MINI PROJECT

Course Code	18RAMP68	CIE Marks	40
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	60
Credits	02	Exam Hours/Batch	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

Course outcomes:

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

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

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SEMESTER - VI

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 VIand 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 as fail and shall have to complete during subsequent University examinations after satisfying the internship requirements.

Course Code	Refer to VIII semester scheme	CIE Marks	40
Duration of internship	04 weeks	SEE Marks	60
Credit	02	Exam Hours/ Batch	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

- To put theory into practice.
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking,

Internship: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

Course outcomes:

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

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learnt to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

INTERNSHIP (continued)

Continuous Internal Evaluation

CIE marks for the Internship shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairman.

The CIE marks awarded shall be based on the evaluation of Internship Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

Semester End Examination

SEE marks for the Internship shall be awarded based on the evaluation of Internship Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

**** END ****

B.TECH. **Robotics and Automation**

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SEMESTER - VII

INDUSTRIAL ROBOTICS

Course Code	18RA71	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

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

Module-1

Fundamentals of Automation: Automation and robotics, Robotics in Science Fiction , Brief history of robotics, robotics market and the future prospects**.**

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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

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

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

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:

- 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	"Industrial Robotics: Technology, Programming and Applications"	Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta,	Tata McGraw Hill	2nd Edition 2012
2	"Introduction to Autonomous Mobile Robots"	Roland Siegwart, Illah R. Nourbakhsh, an d Davide Scaramuzza	PHI	2nd Edition 2011

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SEMESTER - VII

THERMAL ENGINEERING

Course Code	18RA72	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

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.

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 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.

Revised Bloom's Taxonomy Level	L1,L2,L3

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.

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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, Simple problems.

Revised Bloom's Taxonomy Level	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.

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

Course outcomes:

At the end of the course the student 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:

- 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.

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbook/s				
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	1986
2	Basic Engineering Thermodynamics data hand book	B. T. Nijaguna	Sudha Publications	2018
3	Thermodynamics, An Engineering approach	Yunus a. Cenegal and Michael a.Boles	Tata McGraw Hill	2011
4	Heat transfer-A basic approach	Ozisik	Tata McGraw Hill	2002
5	Heat transfer	P. K. Nag	Tata McGraw Hill	2002.

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SEMESTER - VII

Professional Elective-2

IOT Technology

Course Code	18RA731	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

This course will enable students to:

- Assess the genesis and impact of IoT applications, architectures in real world.
- Illustrate diverse methods of deploying smart objects and connect them to network.
- Compare different Application protocols for IoT.
- Infer the role of Data Analytics and Security in IoT.
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry

Module-1

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and 10 Hours IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Module-2

Smart Objects: The "Things" in IoT, Sensors, Actuat ors, and Smart Objects, Sensor 10 Hours Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

Module-3

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, 10 Hours Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods..

Module-4

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine 10 Hours Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.

Module-5

IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

Course outcomes:

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

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network.
- Appraise the role of IoT protocols for efficient network communication.
- Elaborate the need for Data Analytics and Security in IoT.
- illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things"	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry	Pearson Education	1st Edition
2	Internet of Things	Srinivasa K G	CENGAGE Leaning India	2017
Reference Books				
1	"Internet of Things (A Hands –on Approach)"	Vijay Madisetti and Arshdeep Bahga	VPT	1st Edition, 2014
2	Internet of Things: Architecture and Design Principles	Raj Kamal	McGraw Hill Education	1st Edition, 2017

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SEMESTER - VII

Automation in Process Control

Course Code	18RA732	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- 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

INTRODUCTION TO PROCESS CONTROL: process control block diagram, control system evolution. Final control: introduction to final control operation, signal conversions, actuators, control elements. Alarm and annunciators, control drawing: P & ID symbols and diagrams, flow sheet symbols, inter logic symbols, graphic symbols.

Module-2

Introduction, process characteristics, control system parameters, discontinuous control modes, continuous control modes, and composite control modes

Module-3

DISCRETE-STATE PROCESS CONTROL: Introduction, definition and characteristics of discrete state process control. Control-loop characteristics: Introduction, control system configuration, multivariable control systems, control system quality, stability, and process loop tuning.

Module-4

ANALOG CONTROLLERS: Introduction, general features, electronic controllers, pneumatic controllers, designs considerations

Module-5

DIGITAL–TO-ANALOG CONVERTERS: V-F, and F-V converters, performance specifications, D-A conversion techniques (R-2R & binary weighted) multiplying DAC applications. A-D conversion techniques (flash, successive approximation, single slope, dual slope), over sampling converters.

Course outcomes:

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

CO1: Have a knowledge of Process Control System on various Process Parameter (P,PI,PID) and Converter.
CO: Understanding the concepts of Automation in Process Control Involved in Measurement System and Controller used in Industry.
CO3: Application of Digital and Analog Controller used in various Automated Application based on Controller Parameters

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Process Control Instrumentation Technology	C D Johnson	Pearson	2005
Reference Books				
1	Design with operational amplifiers and analog integrated circuits	SERGIO FRANCO	Tata McGraw Hill.	3rd Edition 2005

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SEMESTER - VII

OBJECT ORIENTED PROGRAMMING USING C++

Course Code	18RA733	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- Gain Knowledge of fundamentals of C++, classes, objects, constructors & destructors, function prototypes, private and public acces sand class implementations with inheritance and polymorphism.
- Understand the C++ Programming using classes, objects, constructors & destructors, function prototypes, private and public access and class implementations with inheritance and polymorphism.

Module-1

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

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**

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

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

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)

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

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

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Object Oriented Programming with C++	E.Balaguru swamy	TMH	6th Edition, 2013
Reference Books				
2	Object Oriented Programming using C++	Robert Lafore,	Galgotia publication	2010.

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SEMESTER - VII

NON DESTRUCTIVE TESTING & EVALUATION

Course Code	18RA735	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To introduce the basic principles, techniques, equipment, applications and limitations of Non Destructive Testing (NDT) methods such as Visual, Penetrant Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography, Eddy Current.
- To enable selection of appropriate NDT methods.
- To identify advantages and limitations of NDT methods
- To make aware the developments and future trends in NDT.

Module-1

OVERVIEW OF NDT: NDT Versus Mechanical testing, Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT. Visual inspection – Unaided and aided..

Module-2

SURFACE NDT METHODS: Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials, magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

Module-3

THERMOGRAPHY AND EDDY CURRENT TESTING (ET): Thermography- Principles, Contact and non -contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing- Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

Module-4

ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE): Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications.

Module-5

RADIOGRAPHY (RT): Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography.

Course outcomes:

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

CO1: Classify various 144on-destructive testing methods.

CO2: Check different metals and alloys by visual inspection method.

CO3: Explain and perform non-destructive tests like: Liquid penetrant test, Magnetic particle test, Ultrasonic test, X- ray and Gamma ray radiography, Leak Test, Eddy current test.

CO4: Identify defects using relevant NDT methods.

CO5: Differentiate various defect types and select the appropriate NDT methods for better evaluation.

CO6: Document the testing and evaluation of the results.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Practical Non-Destructive Testing	Baldev Raj, T.Jayakumar, M.Thavasimuthu	Narosa Publishing House	2009
2	Non-Destructive Testing Techniques	Ravi Prakash	New Age International Publishers	1st revised edition2010
Reference Books				
1	ASM Metals Handbook,"NonDestructive Evaluation and Quality Control", Volume-17	American Society of Metals,	Metals Park, Ohio, USA,	2000
2	Introduction to Nondestructive testing: a training guide	Paul E Mix,	Wiley	2nd Edition New Jersey, 2005
3	Handbook of Nondestructive evaluation	Charles, J. Hellier	McGraw Hill, New York	2001

ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.

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SEMESTER - VII

MACHINE LEARNING

Course Code	18RA741	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	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

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.

Module-2

Plasticity effects: Irwin plastic zone correction. Dugdale's approach. The shape of the plastic zone for plane stress and plane strain cases. The 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,size requirements,etc.

Module-3

Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Backpropagation algorithm.

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.

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.

Course outcomes:

At the end of the course the student 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:

- 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Machine Learning	Tom M. Mitchell	McGraw Hill Education	India Edition 2013
Reference Books				
1	The Elements of Statistical Learning	Trevor Hastie, Robert Tibshirani,	springer series in statistics	2nd edition,
2	Introduction to machine learning	Ethem Alpaydın	MIT press.	second edition

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SEMESTER - VII

DIGITAL IMAGE PROCESSING

Course Code	18RA742	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	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.

Module-1

Digital image fundamentals: What is Digital image processing? Fundamental steps in digital image processing, components of an image processing system, elements of Visual Perception.

Module-2

Images sensing and Acquisition: images sampling and Quantization's, Some Basic Relationships between Pixels, Linear and Nonlinear Operations

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.

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.

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.

Course outcomes:

At the end of the course the student 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:

- 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
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,	2010
2	Digital Image Processing and Analysis	B. Chanda and D. Dutta Majumdar	PHI	2003

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VII

Mechanical Vibrations

Course Code	18RA743	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	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, influence coefficients, Rayleigh's method, Dunkerley's method, Stodola method, method of matrix iteration (up to two iterations) and Problems.

Course outcomes:

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

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.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
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	Padmanabhan, Pearson Education Inc	5th edition, 2008
2	Mechanical Vibrations	S. Graham Kelly	Tata McGraw Hill	2007

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SEMESTER - VII

Artificial Intelligence

Course Code	18RA744	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

Students will be able to

- Familiar with basic principles of AI
- Capable of using heuristic searches
- Aware of knowledge based systems
- Able to use fuzzy logic and neural networks
- Learn various applications domains AI

Module-1

Fundamentals of Artificial Intelligence: Introduction, A.I. Representation, Non-AI &AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation

Module-2

Uninformed Search Strategies: Formulation of real world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensor-less problems, Contingency problems.

Informed Search Strategies: Generate& test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence

Module-3

Knowledge Representation: Knowledge based agents, Wumpus world. Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forwardand Backward Chaining. Basics of PROLOG: Representation, Structure, Backtracking. Expert System: Case study of Expert System in PROLOG

Module-4

Introduction to Planning and ANN: Blocks world, STRIPS, Implementation using goal stack, Introduction to Neural networks:- basic, comparison of human brain and machine, biological neuron, general neuron model, activation functions, Perceptron learning rule, applications and advantages of neural networks. Brief introduction to single layer and multiplayer networks.

Module-5

Uncertainty: Non Monotonic Reasoning, Logics for Non Monotonic Reasoning, Justification based Truth Maintenance Systems, Semantic Nets, Statistical Reasoning, Fuzzy logic: fuzzy set definition and types, membership function, designing a fuzzy set for a given application. Probability and Bayes' theorem, Bayesian Networks.

Course outcomes:

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

- Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents capable of problem formulation.
- Evaluation of different uninformed search algorithms on well formulate problems along with stating valid conclusions that the evaluation supports.
- Design and Analysis of informed search algorithms on well formulated problems.
- Formulate and solve given problem using Propositional and First order logic.
- Apply planning and neural network learning for solving AI problems
- Apply reasoning for non-monotonic AI problems.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Artificial Intelligence	Elaine Rich and Kevin Knight	Tata McGraw Hill	2010
2	Artificial Intelligence	Stuart Russell & Peter Norvig	Pearson Education	3rd Edition 2010
Reference Books				
1	Prolog Programming For Artificial Intelligence	Ivan Bratko	Addison Wesley	2nd Edition
2	Introduction to AI and Expert Systems	Patterson	Prentice-Hall	1990
3	Principles of Artificial Intelligence	Nilsson	Morgan Kaufmann	1993
4	Introduction to artificial neural systems	Jacek M. Zurada	Jaico Publication	1994

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SEMESTER - VII

Composite Materials Technology

Course Code	18RA745	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

Students will be able to

- To know the behaviour of constituents in the composite materials
- To Enlighten the students in different types of reinforcement
- To Enlighten the students in different types of matrices
- To develop the student's skills in understanding the different manufacturing methods available for composite material.
- To understand the various characterization techniques
- To illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.

Module-1

Introduction to Composite Materials: Definition, classification & brief history of composite materials. Constituent of composite materials: Reinforcements, Matrix, Coupling agents, coatings & fillers. Reinforcements: Introduction, Glass Fibers, Boron Fibers, Carbon Fibers, Organic Fibers, Ceramic Fibers, Whiskers, Other Non-oxide Reinforcements, Comparison of Fibers Matrix Materials: Polymers, Metals and Ceramic Matrix Materials. Interfaces: Wettability, Crystallographic nature of interface, types of bonding at the interface and optimum interfacial bond strength.

Module-2

Polymer Matrix Composites (PMC): Processing of PMC's; Processing of Thermoset Matrix Composites, Thermoplastic Matrix Composites, Sheet Moulding Compound and carbon reinforced polymer composites. Interfaces in PMC's, Structure & Properties of PMC's, applications Metal Matrix Composites: Types of metal matrix composites, Important Metallic Matrices, Processing, Interfaces in Metal Matrix Composites, Properties & Applications.

Module-3

Ceramic Matrix Composites (CMC): Processing of CMC's; Cold Pressing & Sintering, Hot Pressing, Reaction Bonding Processes, Infiltration, Directed Oxidation, In Situ Chemical Reaction Technique, Sol-Gel, Polymer Infiltration & Pyrolysis, Electrophoretic Deposition, Self-Propagating High Temperature Synthesis. Interfaces, properties and applications of CMC's.

Carbon Fiber/Carbon Matrix Composites: Processing of Carbon/Carbon Composites, Oxidation protection of Carbon/Carbon Composites, Properties of Carbon/Carbon Composites, and application of Carbon/Carbon Composites.

Multi-filamentary Superconducting Composites: The Problem of Flux Pinning, Types of Super Conductor, Processing & structure of Multi filamentary superconducting composites. Applications of multi-filamentary superconducting composites.

Module-4

Nonconventional Composites: Introduction, Nanocomposites; Polymer clay nanocomposites, self healing composites, self-reinforced composites. Biocomposites, Laminates; Ceramic Laminates, Hybrid Composites.

Performance/Characterization of Composites: Static Mechanical Properties; Tensile Properties, Compressive Properties, Flexural Properties, In-Plane Shear Properties, Interlaminar Shear Strength.

Fatigue Properties; Tension–Tension Fatigue, Flexural Fatigue. Impact Properties; Charpy, Izod, and Drop Weight Impact Test.

Module-5

Micromechanics of Composites: Density, Mechanical Properties; Prediction of Elastic Constants, Micromechanical Approaches, Halpin-Tsai Equations, Transverse Stresses, Thermal properties. Numerical Problems.

Macromechanics of Composites: Introduction, Elastic constants of an isotropic material, elastic constants of a lamina, relationship between engineering constants and reduced stiffnesses and compliances.

Course outcomes:

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

CO1: Use different types of manufacturing processes in the preparation of composite materials

CO2: Analyze the problems on macro mechanical 88ehavior of composites

CO3: Analyze the problems on micromechanical 88ehavior of Composites

CO4: Determine stresses and strains relation in composites materials.

CO5: Understand and effective use of properties in design of composite structures

CO6: Perform literature search on a selected advanced material topic.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Composite Material Science and Engineering	Krishan K. Chawla	Springer	Third Edition First Indian Reprint 2015
2	Fibre-Reinforced Composites, Materials, Manufacturing, and Design	P.K. Mallick	CRC Press, Taylor & Francis Group	Third Edition
3	Mechanics of Composite Materials & Structures	Madhijit Mukhopadhay	Universities Press	2004
Reference Books				
1	Mechanics of Composite materials	Autar K. Kaw	CRC Taylor & Francis	2nd Ed, 2005
2	Stress analysis of fiber Reinforced Composites Materials	Michael W, Hyer	Mc-Graw Hill International	2009
3	Mechanics of Composite Materials	Robert M. Jones	Taylor & Francis	1999

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

SEMESTER - VII

OPEN ELECTIVE - B

Energy & Environment

Course Code	18RA751	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To understand the fundamentals of energy sources, energy use, energy efficiency, and resulting environmental implications of various energy supplies.
- To introduce various aspects of environmental pollution and its control.
- To understand the causes and remedies related to social issues like global warming, ozone layer depletion, climate change etc.
- To introduce various acts related to prevention and control of pollution of water and air, forest protection act, wild life protection act etc.

Module-1

Basic Introduction to Energy: Energy and power, forms of energy, primary energy sources, energy flows, world energy production and consumption, Key energy trends in India: Demand, Electricity, Access to modern energy, Energy production and trade, Factors affecting India's energy development: Economy and demographics Policy and institutional framework, Energy prices and affordability, Social and environmental aspects, Investment.

Module-2

Energy storage systems: Thermal energy storage methods, Energy saving, Thermal energy storage systems Energy Management: Principles of Energy Management, Energy demand estimation, Energy pricing Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries.

Module-3

Environment: Introduction, Multidisciplinary nature of environmental studies- Definition, scope and importance, Need for public awareness. Ecosystem: Concept, Energy flow, Structure and function of an ecosystem. Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems, Ecological succession.

Module-4

Environmental Pollution: Definition, Cause, effects and control measures of - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards, Solid waste Management, Disaster management Role of an individual in prevention of pollution, Pollution case studies.

Module-5

Social Issues and the Environment: Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation.

Course outcomes:

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

CO1: Understand energy scenario, energy sources and their utilization.

CO2: Understand various methods of energy storage, energy management and economic analysis. CO3: Analyse the awareness about environment and eco system.

CO4: Understand the environment pollution along with social issues and acts.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education		University grant commission and Bharathi Vidyapeeth Institute of environment education and	
2	Energy Management Audit & Conservation- for Module 2	Barun Kumar De	Vrinda Publication	2nd Edition 2010
Reference Books				
1	Energy Management Hand book	Turner, W. C., Doty, S. and Truner, W. C	Fairmont Press	7 th Edition 2009
2	Energy Management	Murphy, W. R	Elsevier	2007
3	Energy Management Principles	Smith, C. B	Pergamum	2007
4	Environment pollution control Engineering	C S Rao	New Age International	reprint 2015, 2nd edition
5	Environmental studies	Benny Joseph	Tata McGraw Hill	2nd edition 2008

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SEMESTER - VII

OPEN ELECTIVE - B

AUTOMOTIVE ENGINEERING

Course Code	18RA752	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To know layout and arrangement of principal parts of an automobile.
- To understand the working of transmission and brake systems.
- To comprehend operation and working of steering and suspension systems.
- To know the Injection system and its advancements.
- To know the automobile emissions and its effects on environment.

Module-1

ENGINE COMPONENTS AND IT'S PRINCIPLE PARTS: Spark Ignition (SI) & Compression Ignition (CI) engines, cylinder – arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Types of combustion chambers for S.I.Engine and C.I.Engines, methods of a Swirl generation, engine positioning. Concept of HCCI engines, Hybrid engines, Twin spark engine, Electric car.

COOLING AND LUBRICATION: Cooling requirements, Types of cooling- Thermo siphon system, Forced circulation water cooling system, Water pump, Radiator, Significance of lubrication, Splash and Forced feed system.

Module-2

TRANSMISSION SYSTEMS: Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints. Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

BRAKES: Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Antilock – Braking systems, purpose and operation of antilock-braking system, ABS Hydraulic Unit, Rear-wheel antilock, & Numerical.

Module-3

STEERING AND SUSPENSION SYSTEMS: Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Suspension, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel, Air suspension system.

IGNITION SYSTEM: Battery Ignition system, Magneto Ignition system, electronic Ignition system.

Module-4

SUPERCHARGERS AND TURBOCHARGERS: Naturally aspirated engines, Forced Induction, Types of superchargers, Turbocharger construction and operation, Intercooler, Turbocharger lag. FUELS, FUEL **SUPPLY SYSTEMS FOR SI AND CI ENGINES:** Conventional fuels, Alternative fuels, Normal and Abnormal combustion, Cetane and Octane numbers, Fuel mixture requirements for SI engines, Types of carburetors, C.D.& C.C. carburettors, Multi point and Single point fuel injection systems, fuel transfer pumps, Fuel filters, fuel injection pumps and injectors. Electronic Injection system, Common Rail Direct Injection System.

Module-5

AUTOMOTIVE EMISSION CONTROL SYSTEMS: Different air pollutants, formation of photochemical smog and causes. Automotive emission controls, Controlling crankcase emissions, Controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Treating the exhaust gas, Air-injection system, Air-aspirator system, Catalytic converter.

EMISSION STANDARDS: Euro I, II, III and IV norms, Bharat Stage II, III, IV norms. Motor Vehicle Act.

Course outcomes:

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

- Identify the different parts of an automobile and it's working.
- Understand the working of transmission and braking systems.
- Understand the working of steering and suspension systems and their applications.
- Selection and applications of various types of fuels and injection systems.
- Analyse the cause of automobile emissions, its effects on environment and methods to reduce the emissions.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Automobile engineering Vol I and II	Kirpal Singh	Standard Publishers	12th Edition 2011
2	Automotive Mechanics	S. Srinivasan	Tata McGraw Hill	2003 2 nd Edition
Reference Books				
1	Automotive Mechanics	William H Crouse &	Tata McGraw Hill Publishing Company	10th Edition 2007
2	Automotive Mechanics: Principles and Practices	Joseph Heitner	D Van Nostrand Company, Inc	2nd edition 1967
3	Automobile Engineering	R. B. Gupta	Satya Prakashan	4th edition 1984.
4	Fundamentals of Automobile Engineering	K.K.Ramalingam	Scitech Publications (India) Pvt. Ltd	2014

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SEMESTER - VII

OPEN ELECTIVE - B

INDUSTRIAL SAFETY

Course Code	18RA753	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- The present course highlights the importance of general safety and its prevention.
- It enables students to understand about mechanical, electrical sand chemical safety.
- The Industrial safety course helps in motivating the students to understand the reason for fire
- Its Controlling of fire by various means are highlighted.
- Importance of chemical safety, labelling of chemicals, hand signals during forklift operations in industrial and aerodromes will help in to understand and apply the techniques in practical field.
- A visit to campus, various labs, workshops, local industries and fire stations helps in analyzing the importance of safety and corrective measures through case studies.

Module-1

Terms used: accident, safety, hazard, safe, safety devices, safety guard, security, precaution, caution, appliance, slip, trip, fall. Ladders and scaffolding. Unsafe acts, reason for accidents, MSDS (material safety data sheet), computer Aided Hazard Analysis, International acts and standards OSHA, WHO. Environment act, control and abatement of environmental pollution-Biomedical waste. Lockout and tag out procedures. Safe material handling and storage. Risk analysis quantification. Case studies: Student should identify the unsafe acts near their surroundings like housekeeping, lab as well as industrial layouts, road safety, campus layout, safety signs.

Module-2

Introduction, toxicity of products of combustion – vapour clouds – flash fire – jet fires – pool fires – autoignition, sources of ignition . Class A, B, C, D and E fire. Fire triangle, Fire extinguishers, Fire hazard and analysis, prevention of fire. Fire protection and loss prevention, steps after occurrence of fire. notice-first aid for burns, Portable fire extinguishers. Fire detection, fire alarm and firefighting systems. Safety sign boards, instruction on portable fire extinguishers. Case studies: demonstration of fire extinguishers, visit to local fire fighting stations. Visit to fire accident sites to analyze the cause of fire and its prevention for future.

Module-3

PPE, safety guards, Mechanical hazards, workplace hazards, Forklift hazard control Safety while working with machine tools like lathe, drill press, power and band saws, grinding machines. Safety during welding, forging and pressing. Safety while handling Material, compressed gas cylinders, corrosive substance, waste drum and containers. Case studies: Visit to machine shop, workshops, foundry lab and local industries to record the practical observation and report the same with relevant figures and comments.

Module-4

Introduction to electrical safety, Indian standards on electrical safety, Electric hazards, effect of electric current on human body, causes of electrical accidents, prevention of electric accidents, PPE used. Protection systems: Fuse, circuit breakers and overload relays – protection against over voltage and under voltage. Electric shock. Primary and secondary electric shocks, AC and DC current shocks. Safety precautions against shocks. Safety precautions in small and residential building installations. Safety procedures in electric plant. Case studies: To visit electrical sub stations, local distribution systems, observe and share the experience and report.

Module-5

Introduction to Chemical safety, Labelling of chemicals, acid hoods. Handling of acids, eye washers and showers. Safety thinking, accident investigation, safety policy of the company, safety, loss prevention and control, check list for LPG installations, safety precautions using CNG, fire prevention and safety audit, confined space entry, risk assessment. Case studies: To visit chemical laboratory of the college and other chemical industries like LPG , CNG facilities and report.

Course outcomes:

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

CO1: Understand the basic safety terms and international standards.

CO2: Identify the hazards and risk analysis around the work environment and industries.

CO3: Use the safe measures while performing work in and around the work area of the available laboratories. Able to recognize the sign boards and its application.

CO4: Recognise the types of fires extinguishers and to demonstrate the portable extinguishers used for different classes of fires.

CO5: Report the case studies by sharing experience of the employees working in housekeeping, laboratories like workshops, electrical labs, machine shops, electronics and computer laboratories. CO6: Recognise the chemical and electrical hazards for its prevention and control.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Industrial Safety and Management	L M Deshmukh	McGraw Hill Education (India) private Limited	ISBN-13: 978-0-07- 061768-1
2	Fire Prevention Hand Book	Derek, James	Butter Worth's and Company, London	1986
3	Electrical Safety, fire safety and safety management	S.Rao, R K Jain and Saluja	Khanna Publishers	ISBN: 978- 81-7409- 306-6
4	Industrial health and safety management	A.M.Sarma	Himalya publishing house	2010
5	Chemical process Industrial safety	K S N Raju	McGraw Hill Education (India) private Limited.	ISBN-13: 978-93-329- 0278-7
	Environmental engineering	Gerard Kiely	McGraw Hill Education (India) private Limited	ISBN-13: 978-0-07- 063429-9
Reference Books				
1	The Environment Act (Protection) 1986	Commercial Law Publishers (India) Pvt. Ltd. New Delhi.		
2	Water (Prevention and control of pollution) act 1974	Commercial Law publishers (India) Updated on		

- To visit respective Institution: stores, office, housekeeping area, laboratories.
- To visit local industries, workshops, district firefighting system facility and local electrical power stations.

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SEMESTER - VII

OPEN ELECTIVE - B

WORLD CLASS MANUFACTURING

Course Code	18RA754	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To understand the concept of world class manufacturing, dynamics of material flow, and Lean manufacturing.
- To familiarize the students with the concepts of Business excellence and competitiveness.
- To apprise the students with the need to meet the current and future business challenges.
- To prepare the students to understand the current global manufacturing scenario.

Module-1

Historical Perspective World class Excellent organizations – Models for manufacturing excellence: Schonberger, Halls, Gunn and Maskell models, Business Excellence.

Module-2

Benchmark, Bottlenecks and Best Practices, Concepts of benchmarking, Bottleneck and best practices, Best performers – Gaining competitive edge through world class manufacturing – Value added manufacturing – Value Stream mapping – Eliminating waste –Toyota Production System –Example.

Module-3

System and Tools for World Class Manufacturing. Improving Product & Process Design – Lean Production – SQC, FMS, Rapid Prototyping, Poka Yoke, 5-S,3 M, JIT, Product Mix , Optimizing , Procurement & stores practices , Total Productive maintenance, Visual Control.

Module-4

Human Resource Management in WCM: Adding value to the organization– Organizational learning – techniques of removing Root cause of problems–People as problem solvers–New organizational structures. Associates–Facilitators– Teams man ship–Motivation and reward in the age of continuous improvement.

Module-5

Typical Characteristics of WCM Companies Performance indicators like POP, TOPP and AMBITE systems– what is world class Performance –Six Sigma philosophy. Indian Scenario on world class manufacturing –Task Ahead. Green Manufacturing, Clean manufacturing, Agile manufacturing.

Course outcomes:

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

CO1: Understand recent trends in manufacturing.

CO2: Demonstrate the relevance and basics of World Class Manufacturing.

CO3: Understand customization of product for manufacturing.

CO4: Understand the implementation of new technologies. CO5: Compare the existing industries with WCM industries

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	World Class Manufacturing Strategic Perspective	Sahay B.S., Saxena KBC.	Mac Milan Publications	New Delhi
2	Just In Time Manufacturing	Korgaonkar M.G	MacMilan Publications	1986
Reference Books				
1	Production and Operational Management	Adam and Ebert	Prentice Hall learning Pvt. Ltd.	5th Edition
2	The Toyota Way – 14 Management Principles	Jeffrey K.Liker 16.04.2020/280 92020 Pvt. Ltd., New Delhi.	Mc-Graw Hill	2003
3	Operations Management for Competitive Advantage	Chase Richard B., Jacob Robert	McGraw Hill Publications	11th Edition 2005
4	Making Common Sense Common Practice	Moore Ron	Butterworth-Heinemann	2002
5	World Class Manufacturing- The Lesson of Simplicity	Schonberger R. J	Free Press	1986

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SEMESTER - VII

ROBOTICS LABORATORY

Course Code	18RAL76	CIE Marks	40
Teaching Hours/Week (L:T:P)	(0:2:2)	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	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
7	Design a Robot System for Pick and Place Operation.
8	Design a Robot System for Point to Point operation.[Cube]
9	Design a Robot System for Continuous Path Operation.
10	Design a Robot System for Circle Path Operation.
11	Design a Robot System for Drilling Operation of Cube.
12	Design a Robot System for Continuous Path Operation for any 3 Objects [Cube, Box, Circle]

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

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.■

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SEMESTER - VII

CNC Lab

Course Code	18RAL77	CIE Marks	40
Teaching Hours/Week (L:T:P)	(0:2:2)	SEEMarks	60
Credits	02	Exam Hours	03

Course objectives:

- Understand Basic CNC Codes
- Gain Knowledge in Drilling, Milling and Thread Cutting programs
- Learn Programming skills for Lathe

Sl. NO	Experiments
	PART A
1	Study of functions assigned to Alphabets and Symbols. G and M codes, grouping of codes, Assigned and Unassigned, Model and Non Model codes.
2	Writing the program for Contour Milling - 4 exercises
3	Writing the program using Canned Cycles, Subroutine Programs for Drilling, Reaming and Thread Cutting - 4 exercises
	PART B
1	Introductive concept of loop in loop program - 2 exercises.
2	Writing CNC program for Lathe - 2 exercises.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

Course outcomes:

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

- Develop G Codes and M codes for different models
- Analyse the programmes for different lathe operations

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.

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SEMESTER -VII

PROJECT WORK PHASE - 1

Course Code	18RAP78	CIE Marks	100
TeachingHours/Week (L:T:P)	(0:0:2)	SEE Marks	--
Credits	01	Exam Hours/Batch	--

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas. ■

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

Course outcomes:

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

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it. ■

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 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.

(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.■

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SEMESTER –VIII

AUTOMOTIVE ELECTRONICS AND HYBRID VEHICLES

Course Code	18RA81	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	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 cconcepts and various Operations using Sensor and Actuators used Automobile.
- Diagnosis the problem related types of, Data Acquisition System and Communication Networks (Bus Systems) Control system using Standard Technology

Module-1

Automotive Fundamentals Overview: Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drie Train, Transmission, Brakes, Steering System, Battery, Starting System. Air/Fuel Systems Fuel Handling, Air Intake System, Air/ Fuel Management

Revised Bloom's Taxonomy Level	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, 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.

Revised Bloom's Taxonomy Level	LI,L2,L3, L4

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

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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

Revised Bloom's Taxonomy Level	LI,L2,L3, L4

Course outcomes:

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

- Understanding of Engine Parameters and a critical awareness of current problems within the automotive electronics domain using Various Measurement Technology.
- Apply the fundamental Concepts of automotive electronics on various Engine parts, Sensor, Actuator, Communication and Measurement System.
- Determine the extent and nature of electronic circuitry in automotive systems including monitoring and control circuits for engines, transmissions, brakes, steering, suspension
- 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Understanding Automotive Electronics	Willliam B. Ribbens	SAMS/Elsevier	6th Edition
2	Electric and Hybrid Vehicles: Design fundamentals	Iqbal Husain	CRC Press	2011
Reference Books				
1	Automotive Electronics Systems and Components	**Robert Bosch GmbH**	John Wiley & Sons Ltd	5th Edition, 2007
2	Electric Vehicle Technology	James Laminie and John Lowry	CRC Press	2011

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SEMESTER –VIII

Professional Electives-4

Management Information Systems

Course Code	18RA821	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

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

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.

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**L1, L2**

Module-3

DATABASE MANAGEMENT SYSTEMS: DBMS HDBMS,NDBMS, RDBMS, OODBMS, Query Processing, SQL, Concurrency Management, Data warehousing and Data Mart.

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**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.

Revised Bloom's Taxonomy Level	**L1 , L2**

Course outcomes:

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

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

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
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	Management Information System: Conceptual Foundations, Structure and Development	Gordon Davis	Tata McGraw Hill	21st Reprint 2008
2	Management Information Systems for the Information Age	Haag, Cummings and Mc Cubbrey	McGraw Hill, 2005	9th edition, 2013
3	Management Information Systems	Raymond McLeod and Jr. George P. Schell	Pearson Education	2007
4	Management Information Systems – Managing Information Technology in the E- business enterprise	James O Brien	Tata McGraw Hill	2004
5	Information Systems	Raplh Stair and George Reynolds	Cengage Learning	10th Edition, 2012
6	Information Technology Control and Audit	Frederick Gallegor, Sandra Senft, Daniel P. Manson and Carol Gonzales	Auerbach Publications	4th Edition, 2013

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SEMESTER -VIII

Professional Electives-4

BIOMEDICAL SIGNAL PROCESSING

Course Code	18RA822	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	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

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)

Revised Bloom's Taxonomy Level	**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)

Revised Bloom's Taxonomy Level	**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)

Revised Bloom's Taxonomy Level	**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).

Revised Bloom's Taxonomy Level	**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).

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

Course outcomes:

At the end of the course the student 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:

- 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
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 & Sons	2002

B.TECH. ROBOTICS AND AUTOMATION
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SEMESTER -VIII

Professional Electives-4

BIG DATA & ANALYTICS

Course Code	18RA823	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- Understand fundamentals of Big Data analytics.
- Explore the Hadoop framework and Hadoop Distributed File system.
- Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
- Employ MapReduce programming model to process the big data.
- Understand various machine learning algorithms for Big Data Analytics, Web Mining and Social Network Analysis.

Module-1

Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies. Text book 1: Chapter 1: 1.2 -1.7

Module-2

Introduction to Hadoop (T1): Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools.
Hadoop Distributed File System Basics (T2): HDFS Design Features, Components, HDFS User Commands.
Essential Hadoop Tools (T2): Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase.
Text book 1: Chapter 2 :2.1-2.6
Text Book 2: Chapter 3
Text Book 2: Chapter 7 (except walk throughs)

Module-3

NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases. **Text book 1: Chapter 3: 3.1-3.7**

Module-4

MapReduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.
Text book 1: Chapter 4: 4.1-4.6

Module-5

Machine Learning Algorithms for Big Data Analytics: Introduction, Estimating the relationships, Outliers, Variances, Probability Distributions, and Correlations, Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Itemsets and Association Rule Mining. Text, Web Content, Link, and Social Network Analytics: Introduction, Text mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics:
Text book 1: Chapter 6: 6.1 to 6.5
Text book 1: Chapter 9: 9.1 to 9.5

Course outcomes:

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

- Understand fundamentals of Big Data analytics.
- Investigate Hadoop framework and Hadoop Distributed File system.
- Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
- Demonstrate the MapReduce programming model to process the big data along with Hadoop tools. Use Machine Learning algorithms for real world big data.
- Analyze web contents and Social Networks to provide analytics with relevant visualization tools.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	"Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning"	Raj Kamal and Preeti Saxena	McGraw Hill Education	2018 ISBN: 9789353164966, 9353164966
2	"Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop	Douglas Eadline	Pearson Education	1st Edition, 2016
Reference Books				
1	"Hadoop: The Definitive Guide"	Tom White	O'Reilly Media	2015
2	"Professional Hadoop Solutions"	Boris Lublinsky, Kevin T Smith,	Wrox Press	1st Edition, 2014
3	Hadoop Operations: A Guide for Developers and Administrators	Eric Sammer	O'Reilly Media	1st Edition, 2012
4	"Big Data Analytics: A Hands-On Approach	Arshdeep Bahga, Vijay Madisetti	VPT Publications	1st Edition, 2018

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER -VIII

Professional Electives-4

COMMUNICATION SYSTEMS

Course Code	18RA824	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- 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

Introduction To Communication Systems: Information, Transmitter, channel-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.

Revised Bloom's Taxonomy Level	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...

Revised Bloom's Taxonomy Level	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

Revised Bloom's Taxonomy Level	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.

Revised Bloom's Taxonomy Level	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

Revised Bloom's Taxonomy Level	L1, L2

Course outcomes:

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

- 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:

- 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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Communication Systems	Simon Haykins	John Willey	3rd Edition,1996
2	An Introduction to Analog and Digital Communication	Simon Haykins	John Willey	2003
3	Digital communications	Simon Haykins	John Willey	2003
Reference Books				
1	Modern digital and analog Communication systems	B. P. Lathi	Oxford University press	3rd Edition 2005
2	Communication Systems	P.E, Stern Samy and A Mahmond	Pearson	Edition 2004

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SEMESTER -VIII

ADDITIVE MANUFACTURING

Course Code	18RA825	CIE Marks	40
TeachingHours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course objectives:

- To know the principle methods, areas of usage, possibilities and limitations of the Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.
- To know the principles of polymerization and powder metallurgy process, extrusion-based system printing processes, sheet lamination processes, beam deposition processes, direct write technologies and Direct Digital Manufacturing.
- To get exposed to process selection, software issues and post processing.

Module-1

Introduction and basic principles: Need for Additive Manufacturing, Generic AM process, stereoli tho graphy or 3dprinting, rapid proto typing ,the benefits of AM, distinction between AM and CNC machining, other related technologies- reverse engineering technology.

Development of Additive Manufacturing Technology: Introduction, computers, computer-aidedde sign technology ,other associated technologies, the use of layers, classification of AM processes, metals ystems, hybrid systems, milestones in AM development.

Additive Manufacturing Process chain: Introduction, the eight steps in additive manufacture, variations from one AM machine to another ,metal systems, maintenance of equipment, materials handling issues, design for AM, and application areas.

Module-2

Photo polymerization processes: Stereolitho graphy (SL), Materials, SL resin curing process, Micro-stereoli thography, Process Benefits and Drawbacks, Applications of Photo polymerization Processes.

Powder bedfusion processes: Introduction, Selective laser Sintering (SLS), Materials, Powder fusion mechanism, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Extrusion-based systems: Fused Deposition Modelling (FDM), Principles, Materials, Plotting and path control, Bio-Extrusion, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes.

Module-3

Printing Processes: evolution of printing as an additive manufacturing process, research achievements in printing deposition, technical challenges of printing, printing process modeling, material modification methods, three-dimensional printing, advantages of binder printing

Sheet Lamination Processes: Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. Beam Deposition Processes: introduction, general beam deposition process, description material delivery, BD systems , process parameters, typical materials and microstructure, processing–structure–properties relationships, BD benefits and drawbacks.

Direct Write Technologies: Background ,ink -basedDW,laser transfer, DW thermals pray,DW beam deposition, DW liquid-phase directde position.

Module-4

Guidelines for Process Selection: Introduction, selection methods for apart, challenges of selection, example system for preliminary selection, production planning and control. Software issues for Additive Manufacturing: Introduction, preparation of cad models – the STL file, problems with STL files, STL file manipulation. Post- Processing: Support material removal, surface texture improvements, preparation for use as a pattern, property enhancements using non-thermal techniques and thermal techniques.

Module-5

The use of multiple materials in additive manufacturing: Introduction, multiple material approaches, discrete multiple material processes, porous multiple material processes, blended multiple material processes, commercial applications using multiple materials, future directions.

AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Remanufacturing. Application: Examples for Aerospace, defense, automobile, Bio-medical and general engineering industries.

Direct digital manufacturing: Align Technology, siemens and phonak, DDM drivers, manufacturing vs. prototyping, life- cycle costing, future of direct digital manufacturing.

Course outcomes:

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

CO1: Demonstrate the knowledge of the broad range of AM processes, devices, capabilities and materials that are available.

CO2: Demonstrate the knowledge of the broad range of AM processes, devices, capabilities and materials that are available.

CO3: Understand the various software tools, processes and techniques that enable advanced/additive manufacturing.

CO4: Apply the concepts of additive manufacturing to design and create components that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes.

CO5: Understand characterization techniques in additive manufacturing.

CO6: Understand the latest trends and business opportunities in additive manufacturing.

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.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing	I. Gibson l D. W. Rosen l B. Stucker	Springer New York Heidelberg Dordrecht, London	2010
Reference Books				
1	"Rapid Prototyping: Principles & Applications	Chua Chee Kai, Leong Kah Fai	World Scientific	2003
2	Rapid Prototyping: Theory & Practice	Ali K. Kamrani, EmandAbouel	Springer	2006
3	Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling"	D.T. Pham, S.S. Dimov	Springer	2001

4	Rapid Prototyping: Principles and Applications in Manufacturing	RafiqNooran	John Wiley & Sons	2006
5	Additive Manufacturing Technology	Hari Prasad, A.V.Suresh	Cengage	2019
6	Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing	Andreas Gebhardt	Hanser Publishers	2011

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SEMESTER -VIII

PROJECT WORK PHASE -II

Course Code	18RAP83	CIE Marks	40
Contact Hours/Week	02	SEE Marks	60
Credits	08	Exam Hours/Batch	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

Course outcomes:

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

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

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.

Semester End Examination

SEE marks for the project (60 marks)shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) as per the University norms by the examiners appointed VTU.

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SEMESTER -VIII

TECHNICAL SEMINAR

Course Code	18RAS84	CIE Marks	100
Contact Hours/Week	02	SEE Marks	--
Credits	01	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the Course of Specialization.

- Carryout literature survey, organize the seminar content in a systematic manner.
- Prepare the report with own sentences, avoiding cut and paste act.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

Course outcomes:

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

- Attain, use and develop knowledge in the field of engineering and other disciplines through independent learning and collaborative study.
- Identify, understand and discuss current, real-time issues.
- Improve oral and written communication skills.
- Explore an appreciation of the self in relation to its larger diverse social and academic contexts.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks

Presentation skill:25 marks

Question and Answer:25 marks.