MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme ofTeachingandExamination2021-2022 (As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effectivefromtheacademicyear2021–2022)

B.E. in Biomedical and Robotic Engineering [BR]

III SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory/Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT31	Engineering Mathematics-III	Basic Science	Basic Science	2	2	0	03	50	50	100	3
2	PCC	21BR32	Analog Circuit Design	BM & RE	BM & RE	3	2	0	03	50	50	100	4
3	PCC	21BR33	Digital Circuit Design	BM & RE	BM & RE	3	2	0	03	50	50	100	4
4	PCC	21BR34	Basics of Human Anatomy and Physiology	BM & RE	BM & RE	3	0	0	03	50	50	100	3
5	PCC	21BR35	Fundamentals of Robotics	BM & RE	BM & RE	3	2	0	03	50	50	100	4
6	IPCC	21BRL36	Analog and Digital Circuit Design Lab	BM & RE	BM & RE	0	0	3	03	50	50	100	2
7	CEE	21CIV37	Environmental Studies	CEE	CEE	1	0	0	NA	50	-	50	
8	UHV	21UHV38	Universal Human Values and Professional Ethics	Basic Science	Basic Science	1	0	0	NA	50	-	50	
Total						**16**	**08**	**03**	**18**	**400**	**300**	**700**	**22**

Note: BSC: Basic Science Courses, PCC: Professional Core Courses, IPCC: Professional Lab Courses, CEE: Civil Environmental Engineering, UHV: Universal Human Values, HSMC: Humanity, Social Science and Management Courses. NCMC: Non-credit mandatory course, INT: Internship

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

10	NCMC	21MATDIP31	Additional Mathematics-1	Basic Science	Basic Science	2	2	0	03	50	50	100	0
11	NCMC	21KANDIP32	Technical Kannada	Basic Science	Basic Science	0	2	0	-	50	-	50	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 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 has 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

Credit Definition:
- 1-hour lecture**(L)** per week per semester = **1 Credit**
- 2-hour tutorial **(T)** per week per semester = **1 Credit**
- 2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** courses is to be designed for **15** hours of Teaching-Learning process.

AICTE Activity Points to be earned by students admitted to BE/B.Tech., 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 the fifth semester are required to earn 50 Activity Points from the year of entry toUoM. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

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B.E. in Biomedical and Robotic Engineering[BR]

IV SEMESTER

Sl. No	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory/Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT41	Engineering Mathematics-IV	Basic Science	Basic Science	2	2	0	03	50	50	100	3
2	PCC	21BR42	Signal Conditioning and Data Acquisition Circuits	BM & RE	BM & RE	3	2	0	03	50	50	100	4
3	PCC	21BR43	Biomedical Transducers and Instrumentation	BM & RE	BM & RE	3	0	0	03	50	50	100	3
4	IPCC	21BR44	Microcontroller and Embedded Systems	BM & RE	BM & RE	3	0	2	03	50	50	100	4
5	PCC	21BR45	Control Systems	BM & RE	BM & RE	3	2	0	03	50	50	100	4
6	IPCC	21BRL46	Signal Conditioning and Biomedical Transducers Lab	BM & RE	BM & RE	0	0	3	03	50	50	100	2
7	HSMC	21CPH47	Constitution of India, Professional Ethics and Cyber Law	Basic Science	Basic Science	1	0	0	NA	50	-	50	1
8	HSMC	21AEC48	Ability Enhance Course-II	BM & RE	BM & RE	1	0	0	NA	50	-	50	1
9	INT	21INT49	Summer Internship-I	(To be carried out during the intervening vacations of IV and V semesters)					-	-	-	-	-
Total						**16**	**06**	**05**	**18**	**400**	**300**	**700**	**22**

Note: BSC: Basic Science Courses, PCC: Professional Core Courses, IPCC: Professional Lab Courses, CEE: Civil Environmental Engineering, UHV: Universal Human Values, HSMC: Humanity, Social Science and Management Courses. NCMC: Non-credit mandatory course, INT: Internship.

Summer Internship-I (21INT59): shall be carried out at industrial (State and Central Government /Non-government organizations (NGOs)/Micro, Small and Medium Enterprise (MSME)/Innovation centers/ Incubation centers. The internship can also be Rural internship. All the students admitted shall have to undergo a mandatory internship of 04 weeks during the intervening vacation of IV and V semesters. A University Viva-Voce examination (Presentation followed by Question & Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester. The 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. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)
Summer Internship-I: SEE shall be through seminar and viva-voce.

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

11	NCMC	21MATDIP41	Additional Mathematics-II	Basic Science	Basic Science	02	02	-	03	50	50	100	0
12	NCMC	21ENGDIP42	Technical English	Basic Science	Basic Science	-	2	-	-	50	-	50	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 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 has 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

Credit Definition:
- 1-hour lecture**(L)** per week per semester = **1 Credit**
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- 2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** courses is to be designed for **15** hours of Teaching-Learning process.

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

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B.E. in Biomedical and Robotic Engineering [BR]

V-SEMESTER

Sl No	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	HSMC	21BR51	Management and Entrepreneurship	HSMC	HSMC	3	0	0	03	50	50	100	3
2	PCC	21BR52	Sensors and Actuators	BM & RE	BM & RE	3	2	0	03	50	50	100	4
3	PCC	21BR53	Fundamentals of Signal and DSP	BM & RE	BM & RE	3	0	0	03	50	50	100	3
4	PCC	21BR54	Biomedical Equipments & Clinical Instruments	BM & RE	BM & RE	3	0	0	03	50	50	100	3
5	PCC	21BR55	Robot programming	BM & RE	BM & RE	3	0	0	03	50	50	100	3
6	PCC	21BR56X	Professional Elective - 1	BM & RE	BM & RE	3	0	0	03	50	50	100	3
7	IPCC	21BRL57	Robot Programming and simulation Lab	BM & RE	BM & RE	0	0	3	03	50	50	100	2
8	IPCC	21BRL58	Clinical Instrumentation and Signal Processing Lab	BM & RE	BM & RE	0	0	3	03	50	50	100	2
9	INT	21INT59	Summer Internship-I	Completed during the vacation of IV and V semesters					NA	50	-	50	1
Total						**18**	**02**	**06**	**24**	**450**	**400**	**850**	**24**

Note: ESC: Engineering Science Courses, ,EEC: Engineering Elective Course , MAT: Mathematics, CS & E: Computer Science and Engineering, HSMC: Humanity, Social Science and Management Courses, INT: Internship.

Professional Elective-1

Course Code	Course Title
21BR561	Advanced control systems
21BR562	Rehabilitation Engineering
21BR563	Biostatistics

Credit Definition:

- 1-hour lecture**(L)** per week per semester = **1 Credit**
- 2-hour tutorial **(T)** per week per semester = **1 Credit**

2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** courses are to be designed for **15** hours of Teaching-Learning process.

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

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VI-SEMESTER

Sl. No	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	PCC	21BR61	Medical Image Processing	BM & RE	BM & RE	3	-	-	03	50	50	100	3
2	PCC	21BR62	Virtual Instrumentation	BM & RE	BM & RE	3	-	-	03	50	50	100	3
3	PCC	21BR63X	Professional Elective -2	BM & RE	BM & RE	3	-	-	03	50	50	100	3
4	OEC	21BR64X	Open Elective –A	BM & RE	BM & RE	3	-	-	03	50	50	100	3
5	HSMC	21BR65	Research Methodology and Intellectual Property Rights	Any Dept.	Any Dept.	3	-	-	03	50	50	100	3
6	IPCC	21BRL66	Medical Image Processing and Analysis lab	BM & RE	BM & RE	-	-	3	03	50	50	100	2
7	IPCC	21BRL68	Virtual Instrumentation Lab	BM & RE	BM & RE	-	-	3	03	50	50	100	2
8	MP	21BRP69	Mini Project	BM & RE	BM & RE	0	0	2	NA	50	-	50	1
9	INT	21INT	Summer Internship-II	(To be carried out during the intervening vacations of VI and VII semesters)					-	-	-	-	-
Total						**15**	**00**	**08**	**21**	**400**	**350**	**750**	**20**

Note: ESC: Engineering Science Courses, EEC: Engineering Elective Course, OEC: Open Elective Course, CS & E: Computer Science and Engineering, MP: Mini Project, INT: Internship

Professional Elective-2

Course Code	Course Title
21BR631	Advanced Clinical Instrumentation
21BR632	Medical Design Regulation and Safety
21BR633	Laser and optical fibers in Medicine
21BR634	Hospital design, planning and management,

Open Elective-A (21CS65X is not opted by BM, RE & DS Program)

21CS641	Wireless network and communication
21CS642	Micro and smart system technology
21CS643	Drives and controls for robots
21CS644	Artificial neural network

Students can select any one of the open electives offered by any Department (Please refer to the list of open electives under 18AI65X).
Selection of an open elective is not allowed provided,

- 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 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/ Adviser/Mentor.

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

CIE procedure for Mini project:

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

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

Summer Internship-II: 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 takeup/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, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

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VII-SEMESTER

Sl No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	PCC	21BR71	Biomedical DSP	BM & RE	BM & RE	3	0	0	03	50	50	100	3
2	PCC	21BR72	Machine Learning for Health Care	BM & RE	BM & RE	3	0	0	03	50	50	100	3
3	PCC	21BR73X	Professional Elective – 3	BM & RE	BM & RE	3	-	-	03	50	50	100	3
4	OEC	21BR74X	Open Elective –B	BM & RE	BM & RE	3	-	-	03	50	50	100	3
5	IPCC	21BRL75	Biomedical DSP Lab	BM & RE	BM & RE	0	-	3	03	50	50	100	2
6	Project	21BRP76	Project Work Phase – 1	BM & RE	BM & RE	-	-	2	00	100	-	100	2
7	HSMC	21AEC77	Ability Enhance Course-III	Any Dept.	Any Dept.	1	0	0	NA	50	-	50	1
8	INT	-	Summer Internship-II	(If not completed during the vacation of VI and VII semesters, it has to be carried out during the intervening vacations of VII and VIII semesters)									
Total						**13**	**00**	**05**	**15**	**400**	**250**	**650**	**17**

Note: ESC: Engineering Science Courses, EEC: Engineering Elective Course, OEC: Open Elective Course, CS & E: Computer Science and Engineering, AEC: Ability Enhancement Course, INT: Internship.

Professional Elective-3

Course Code	Course Title
21BR731	Biomechanics and Biodynamics
21BR732	Artificial Intelligence and Pattern Recognition in Medicine
21BR733	Internet of Things
21BR734	Medical informatics and expert systems

Open Elective-B (21CS75X is not opted by BM, RE & DS Program)

21CS741	Cloud Computing and Virtualization
21CS742	Python Application Programming
21CS743	Power Electronics
21CS744	Blockchain Technology

Students can select any one of the open electives offered by any Department.
Selection of an open elective is not allowed provided,

- 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 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/ Adviser/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 beassigned to anindividual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students fromdifferent disciplines, the projectstudent 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 theDepartment, 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.Themarks 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 externalguide/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 presentationskill 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 /orVII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall beconsidered 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 tocomplete during subsequent University examination after satisfying the internship requirements

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

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VIII-SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	PCC	21BR81	Medical Imaging system	BM & RE	BM & RE	3	-	-	03	50	50	100	3
2	PCC	21BR82X	Professional Elective – 4	BM & RE	BM & RE	3	-	-	03	50	50	100	3
3	Project	21BRP83	Project Work Phase-2	BM & RE	BM & RE	-	-	4	03	50	50	100	4
4	Seminar	21BRS84	Technical Seminar	BM & RE	BM & RE	-	-	2	03	100	-	100	2
5	INT	21INT85	Summer Internship-II	(Completed during the intervening vacations of VI and VII semesters and /or VII and VIII semesters.)					03	50	50	100	3
Total						**06**	**-**	**06**	**15**	**300**	**200**	**500**	**15**

Note: ESC: Engineering Science Courses, EEC: Engineering Elective Course, CS & E: Computer Science and Engineering, INT: Internship

Professional Elective-4

Course Code	Course Title
21BR821	Bio-MEMS
21BR822	Multilayer Neural Networks and Deep Learning
21BR823	Biomaterials and artificial organs
21BR824	Computer communication network in Health Care

Project Work CIE procedure for Project Work Phase - 2:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.
SEE for Project Work Phase - 2:
(i) Single discipline: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.
(ii) Interdisciplinary: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.
Internship: Those, who have not pursued /completed the internship shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card. Activity points of the students who have earned the prescribed AICTE activity Points shall be sent the University along with the CIE marks of 8th semester. In case of students who have not satisfied the AICTE activity Points at the end of eighth semester, the column under activity Points shall be marked NSAP (Not Satisfied Activity Points).

Engineering Mathematics-III [21MAT31]

Semester III			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Fourier Series:** Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Application of Practical harmonic analysis.	**08 Hours**
Module 2	**Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems.	**08 Hours**
Module 3	**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 and applications to solve difference equations.	**08 Hours**
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. Solution of Lagrange's linear PDE. Derivation of one-dimensional heat equation and wave equation. Solution of one-dimensional heat equation and wave equation by the method of separation of variables.	**08 Hours**
Module 5	**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- $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.	**08 Hours**

Course outcomes:

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

- Explain the basic concepts of Fourier Series, Fourier Transforms, Z-Transforms, Partial Differential Equations, Some concepts of statistical analysis and curve fitting.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text Books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2017.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. B.V.Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.

Reference Books:

1. Srimanta Pal & Subobh C Bhunia: “Engineering Mathematics”, Oxford University Press, 3rd Reprint, 2016.
2. C.Ray Wylie, Louis C.Barrett : “Advanced Engineering Mathematics", 6th Edition, 2. McGrawHill Book Co., New York, 1995.
3. S.S.Sastry: “Introductory Methods of Numerical Analysis”, 11th Edition, Tata McGraw-Hill, 2010
4. N.P.Bali and Manish Goyal, “A Text Book of Engineering Mathematics”, Laxmi Publications. Latest edition, 2014.
5. Chandrika Prasad and Reena Garg “Advanced Engineering Mathematics”, Latest edition, Khanna Publishing, 2018.

Additional Mathematics-I [21MATDIP31]

Semester III			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	1	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	00

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Complex Variables:** 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.	**08 Hours**
Module 2	**Differential Calculus**: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.	**08 Hours**
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-simple problems. Solenoidal and irrotational vectorfields-Problems.	**08 Hours**
Module 4	**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.	**08 Hours**
Module 5	**Ordinary differential equations (ODE's)**. Introduction-solutions of first order and first-degree differential equations: exact, linear differential equations. Equations reducible to exact and Bernoulli's equation.	**08 Hours**

Course outcomes:

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

- Explain the basic concepts of complex trigonometry, differential calculus and vector differentiation, Numerical methods, Ordinary Differential Equations of first order.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text Books:

1. S C Chapra and R P Canale, *Numerical Methods for Engineering,* 15th Edition, Tata McGraw Hill
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
3. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
4. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

Reference Books:

1. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.
2. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
3. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Analog Circuit Design [21BR32]

Semester III			
No. of Teaching Hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture Hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**BJT Biasing:** Introduction, operating point, Fixed-bias configuration, Emitter-bias configuration, Voltage-divider biasing, Collector feedback bias, Emitter follower configuration. Current mirror circuits, Bias stabilization.	**08 Hours**
Module 2	**AC Analysis of BJT:** Introduction, BJT modeling, r_e transistor model: Common Emitter and fixed bias configuration, Voltage-divider bias, CE Emitter-bias Configuration, Emitter follower configuration, Cascaded Systems, mention of Cascode & Darlington connection and its application. The Hybrid equivalent model, Approximate Hybrid equivalent circuit: Fixed bias configuration, Voltage-divider configuration, Hybrid π model.	**08 Hours**
Module 3	**FET Biasing:** Introduction, Fixed-bias configuration, Self-bias configuration, Voltage-divider biasing. **FET Amplifiers:** Introduction, JFET Small signal model, JFET AC equivalent circuit, Fixed- bias configuration, Self-bias configuration with by passed source resistance, Voltage-divider configuration, Source follower configuration.	**08 Hours**
Module 4	**BJT and JFET Frequency Response:** Introduction, General Frequency Considerations, Low Frequency Response of BJT Amplifier, Low Frequency Response of FET Amplifier, Miller Effect Capacitance, High frequency response of BJT Amplifier, High frequency response of FET Amplifier.	**08 Hours**
Module 5	**Power Amplifiers:** Introduction, Series Fed Class A Amplifier, Transformer-Coupled Class A Amplifier, Class B Amplifier operation. **Class B amplifier circuits:** Transformer-Coupled Push-Pull and Complementary–Symmetry circuits, Amplifier Distortion. **Feedback and Oscillator Circuits:** Feedback concepts, Feedback connection types, effects of negative feedback, Practical feedback circuits: BJT current series and FET voltage shunt feedback configurations. Oscillator operation, Barkhaunsen's criteria, RC phase oscillator using BJT.	**08 Hours**

Course outcomes:

After Studying this course, students will be able to

- Design and implement a biasing circuit for BJT and FET
- Model the BJT/FET amplifier for ac analysis
- Analyze Frequency response of BJT and FET amplifier
- Acquire the knowledge of classifications of Power amplifier and its operation
- Understand the feedback concepts and designing of oscillator circuits

Text and Reference Books:

Text Book:

Robert L Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 10th Edition, Pearson Prentice Hall, 2009

Reference Books:

1. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008
2. Anil K Maini, VarshaAgarwal, Electronic Devices and Circuits, Wiley, 2012.
3. Jacob Millman, Christos C. Halkias,Integrated Electronics: Analog and Digital Circuits and Systems, McGraw-Hill, 2015

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108102112
2. https://nptel.ac.in/courses/108105158
3. http://elearning.vtu.ac.in/econtent/ECE.php#
4. http://elearning.vtu.ac.in/econtent/courses/video/ECE/06ES32.html
5. http://elearning.vtu.ac.in/econtent/courses/video/ECE/Analog_Electronics_Lab.html

Digital Circuit Design [21BR33]

Semester III			
No. of Teaching Hour/Week	3	**CIE Marks**	50
No. of Tutorial Hours/Week	2	**SEE Marks**	50
Total No. of Lecture Hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Principles and Design of Combinational Logic:** Theorems and Properties of Boolean algebra, Boolean Functions, Definition of combinational logic, Canonical forms, Generation of switching equations from Truth Tables, Relevant Problems	**08 Hours**
Module 2	**Karnaugh Maps:** Minimum forms of switching functions, two and three variable Karnaugh maps, four variable Karnaugh maps, determination of minimum expressions using essential prime implicants, Quine-McClusky Method: determination of prime implicants. Related Problems.	**08 Hours**
Module 3	**Logic Circuit Design:** Arithmetic Operation, Combinational Circuit, Binary Adder, Binary Subtractor, Binary Parallel Adder, The Look-Ahead-Carry Binary Adders, Comparator. **Data Processing:** Introduction, Decoders: One-to-Two Line Decoder, Two-to-Four Line Decoder, Three-to-Eight Line Decoder, Encoders: Four-to-Two Line Encoder, Four-to-Two Line Priority Encoders, Multiplexers: Two-to-One Multiplexer, Four-to-One Multiplexer, Eight-to-One Multiplexer, Cascading of Multiplexer using Enable	**08 Hours**
Module 4	**Latches and Flip-Flops:** Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop 3, SR Flip Flop, J K Flip Flop, T Flip Flop, Relevant Problems.	**08 Hours**
Module 5	**Design of Sequential Circuits:** Introduction, Notations, Moore and Mealy Sequential Circuits, Analysis of Asynchronous Sequential Circuits. **Registers and Counters:** Introduction, Registers, Shift Registers, Ripple Counters, Synchronous counters, timing sequences, shift registers, design of Binary counters, counters for other sequences, counter design using SR and J K Flip Flops.	**08 Hours**

Course outcome:

After Studying this course, students will be able to

- Ability to apply the knowledge of mathematics and science to understand the operation of logic circuits and performance parameters.
- Ability to apply the simplification techniques/methods to optimize and implement the digital functions/circuits.
- Ability to analyze the given logic circuit based on the knowledge of digital elements
- Ability to design a combinational and sequential logic circuit for the given requirements/specifications
- Ability to understand and design the State machines with state graphs for sequential design

Text and Reference Books:

Text Books:

1. Charles H. Roth. Jr, Larry L. Kenny, "**Fundamentals of Logic Design**", 7th edition, Cengage Learning, ISBN: 978-1133628477.
2. Morris Mano , "**Digital Logic and Computer Design**", Pearson, 2016, ISBN: 9789332542525.
3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009, Dremtech Press

Reference Books:

1. Tomas Lang, Jaime H Moreno, "**Introduction to Digital System**", Milos Ercegovac, John Wiley, 2005, ISBN:978-8126522514.
2. John M Yarbrough, "**Digital Logic Applications & Design**", Cengage Delmar Learning India Pvt, 2015, ISBN: 9788131500583.

Basics of Human Anatomy and Physiology [21BR34]

Semester III			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Homeostasis, Tissue, Cartilage:** Levels of structural complexity, The internal environment and homeostasis, Communication, Movement of substances within the body, Body fluids, Cell structure and functions. Tissues: Epithelial tissue (all types), Connective tissue (all types), Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage.	**08 Hours**
Module 2	**Cardiovascular System:** Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, Capillaries. Control of blood vessel diameter, Blood supply- internal respiration, cell nutrition. Heart- position, structure - pericardium, myocardium, endocardium, interior of the heart. Flow of blood through the heart, blood supply to heart. Conducting system of the heart, factors affecting heart rate, Cardiac cycle, cardiac output, blood pressure, control of blood pressure, pulse and factors affecting the pulse rate. Circulation of the blood- pulmonary circulation, systemic circulation-aorta (different parts of aorta & their blood supply, in brief). Summary of the main blood vessels (arteries & veins, brief explanation with flow diagram only)	**08 Hours**
Module 3	**Nervous System:** Functional Components of nervous system, Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Nerve impulse (action potential). Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: Meninges, ventricles of the brain and CSF. Brain: Cerebrum, functions of cerebrum, functional areas of the cerebrum, Brainstem, Cerebellum, Spinal cord- grey matter, white matter, Spinal nerves (in brief list & functions only), Cranial nerves (in brief list & functions only), Autonomic nervous system (in brief)- functions and effects.	**08 Hours**
Module 4	**Respiratory System:** Organs of respiration, Nose and Nasal cavity- position, structure and functions, Pharynx - position, structure, functions. Larynx - position, structure and functions. Trachea - position, structure, functions, Bronchi, bronchioles and alveoli – structure and functions, Lungs- position, associated structure, pleura and pleural cavity. Respiration - muscles of respiration, cycle of respiration, variables affecting respiration, lung volumes and capacity. **Digestive System:** Introduction, Organs of the digestive system, Basic structure of the alimentary canal, Stomach - Structure, gastric juice and functions of stomach.	**08 Hours**
Module 5	**Urinary System:** Introduction, Kidneys – Gross structure of kidney, microscopic structure of kidney, Functions of kidney. **Skeletal System:** Bone - Types of bone, Bone structure, microscopic structure of bone, Functions of bone. Skull bones	**08 Hours**

	(name and position only), Sinuses, Fontanelles, Vertebral column - characteristics of typical vertebra, Different parts of vertebral column (name and position only), Features of vertebral column, Functions of vertebral column. Bones of Thoracic cage (name and position only), Bones of shoulder girdle and upper limb (name and position only), Bones of pelvic girdle and lower limb (name and position only). **Muscles and Joints:** Muscle tissue: Skeletal muscle, Smooth muscle, Cardiac muscle, functions of muscle tissue. Types of joint- Fibrous, Cartilaginous, Synovial, Characteristics of synovial joints, shoulder joint, Hip joint, Knee joint.	

Course outcomes:

After Studying this course, students will be able to

- Describe internal environment of human body and explain the fundamental concept of homeostasis.
- Explain the structure and functioning of various types of tissues.
- Describe the structure and explain the functioning of various nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system.
- Demonstrate and analyze various physiological parameters in normal and abnormal conditions.

Text and Reference Books:

Text Books:

1. Ross & Wilson's Anatomy and Physiology in Health and Illness – by Anne Waugh and Allison Grant, 9th Edition, Churchill Livingstone Publications

Reference Books:

1. Concise Medical Physiology- by Sujit K. Chaudhuri, 5th Edition, New Central Book Agency Pvt. Ltd.
2. Essentials of Medical Physiology - by K. Sembulingam and Prema Sembulingam, 3rd Edition, Jaypee Publications
3. Human Physiology: From Cells to Systems – by Lauralee Sherwood, 6th Edition, Thomson India Edition, 2007.

Fundamentals of Robotics [21BR35]

Semester III			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Robotics:** Introduction to Robotics and Automation technologies, Brief history of robotics, Robot Anatomy, Four common configurations of Robot, Robot motions-Linear, Rotational, Revolving, twisting, Cylindrical, Spherical. **Degrees of Freedom of Robot,** Introduction to degrees of freedom, three degrees of freedom associated with arm and body polar Robot. Three degrees of freedom associated with robot wrist, Joint notation scheme. Work Volume, links and joints. Introduction to End Effectors-types-basic definitions and operations, Spatial Resolution, Accuracy, Repeatability, and Compliance.	**08 Hours**
Module 2	**Robot Control Systems:** Introduction to Mathematical model of spring mass damper system. The Four types of Robot controls: Limited sequence robots, Playback robots with point to point control, playback robots with continuous path control, intelligent control. Robot controllers-On-off, proportional, integral, proportional-plus-integral, proportional-plus-derivative, proportional-plus integral plus derivative.	**08 Hours**
Module 3	**Robot ARM Kinematics:** Introduction to manipulator kinematics, Robot position representation, Forward transformation of a 2-degree of freedom Arm, Reverse Transformation of the 2-Degree of freedom Arm. **Robot ARM Dynamics:** Introduction to robot arm dynamics, understanding of Dynamics using Euler-Lagrangian-formation method. Only Introduction to Denavit–Hartenberg parameters. Simple problems on transformations.	**08 Hours**
Module 4	**Robot Sensors and Actuators: Feedbackcomponents**: Internal state sensors, external state sensors position,velocitysensors, Resolvers, Encoders.Tactile sensor, Force sensors, Joint sensing, Tactile array sensors, Proximity and range sensors, Introduction to functions of Machine vision systems only.	**08 Hours**
Module 5	**Introduction to Robot Programming:**Methods of Robot Programming-Lead through methods, Textural robot languages, Powered lead through, manual lead through. Introduction to generations of Robot Programming Languages-First Generation Languages-Second generation languages. Robot language structure block diagram. Definitions of Robot Language Elements and its functions, Robot Applications in Engineering and Specific applications in healthcare/Biomedical.-Practical demo	**08 Hours**

Course outcomes:

After studying this course, students will able to:

1. Comprehend basic concepts of robot which includes Degrees of freedom, links, joints, robot performances.
2. Develop the control aspect of robotic systems.
3. Analyze the different transformations associated with robot kinematics and robot arm dynamics, motion equations.
4. Illustrate different attributes of robot sensors and actuators.
5. To comprehend the basics/ fundamentals of Robot programming and its structure, to understand the applications of robotics in engineering and healthcare sectors.

Text and Reference Books:

Text Books:

1. Mikell P Groover, Industrial Robotics-Technology, Programming and Applications 2nd edition, Tata McGraw Hill
2. Robert J Schilling, Fundamentals of Robotics,2003.
3. Richard D.Klafter, Robotics Engg. PHI, 2003.
4. R.K.Mittal and J.Nagarath, Robotics and Control,Tata McGraw Hill, Year 1995.

Reference Books:

1. K.S.Fu, R.C.Gonzales and Lee. Robotics, McGraw Hill International, 2008.
2. Ganesh S Hegde, Industrial Robotics –Second Edition.

Analog and Digital Circuit Design Lab [21BRL36]

Semester III			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	03	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	02

List of Experiments

Sl No.	Course Content
1.	Study and plot the input and output characterises of CE transistor
2.	Study and plot the drain and transfer characteristics of FET
3.	Find the Efficiency and ripple factor of full-wave bridge rectifier
4.	Study the frequency response of CE amplifier with and without bypass capacitor
5.	Study the frequency response of CC amplifier and find the input and output impedances.
6.	Study of BJT based RC-Phase Shift Oscillator
Circuit Analysis using PSpice/Multisim	
7.	Analysis of voltage-divider biasing of BJT and FET.
8.	Analysis of two-stage RC-Coupled CE amplifier
9.	AC analysis of BJT with Voltage divider and Darlington configurations
10.	Analysis of frequency response of voltage divider biased single stage BJT and FET.
11.	Study of FET based Colpits and Hartley and oscillator
12.	Analysis of Series-FED Class A and Complementary Push-Pull Amplifiers

Course Outcome

After Studying this course, students will be able to

- Design and Test rectifiers circuits
- Design and Test BJT/JFET biasing circuits.
- Plot the frequency response of amplifier circuits
- Analyze the limitation in bandwidth of single stage and multi stage amplifier.
- Simulate and analyze amplifier, oscillator and power amplifier circuits using PSpice.

Digital Circuit Design Lab

Sl. No.	Course Content
List of Experiments	
1	Simplification, realization of Boolean expressions using logic gates and Universal gates.
2	Realization of half and full adders, half and full subtractor using logic gates.
3	(a) Realization of parallel adder and parallel subtractor using 7483 chip (b) Demonstration of BCD to Excess–3 code conversion and vice versa.
4	Application of the IC's – MUX–74153 for half and full adders, DEMUX – 74139 for 3 – bit binary to Gray and BCD to Excess–3 code converters.
5	Realization of 2 – bit comparator using gates and basic operational study of Priority encoder using 74147
6	Operational verification of Flip–Flops: (i) T type (ii) D type and iii) J–K Master slave.
7	Realization of 3 bit binary, and modulo N counters and display the count on seven segment display.
8	Realization of Shift left, Shift right, SIPO, SISO, PISO, PIPO register operations using 7495
9	Design and implementation of Multiplexer and De-multiplexer using logic gates
10	Design and implementation of encoder and decoder using logic gates
11	Design and implementation of 3-bit synchronous up/down counter
12	Design the Ring counters and Johnson counter.

Open ended Experiments:

1. Design and implement a circuit to synthesize clock signal of given frequency.
2. Design and implement a circuit to count event and latch it.
3. Design and implement a circuit to control traffic signal (Simple function).

Course Outcome

After Studying this course, students will be able to

- Analyzeand optimize the logic circuit for given Booleanexpressions.
- Design and Implement combinational digital circuits
- Design and Implement Sequential digital circuits
- Design and Develop a logic circuit for given problem.

Environmental Studies (21CIV37)

Semester III (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Environment - Components of Environment **Ecosystem**: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security. **Impacts**: Impacts of Agriculture & Housing Impacts of Industry, Mining & Transportation Environmental Impact Assessment, Sustainable Development.	**03 Hours**
Module 2	**Natural Resources, Water resources –** Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources, Forest Wealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle. **Energy** – Different types of energy, Conventional sources &Non-Conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	**04 Hours**
Module 3	**Environmental Pollution** – Water Pollution, Noise pollution, Land Pollution, Public Health Aspects. **Global Environmental Issues:** Population Growth, Urbanization, Land Management, Water & Waste Water Management	**03 Hours**
Module 4	**Air Pollution & Automobile Pollution:** Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures. **Solid Waste Management**, E –Source, Segregation, Transportation, and Waste Treatment and Management &**Biomedical Waste Management** - Sources, Characteristics & Disposal methods.	**03 Hours**
Module 5	Applications of GIS & Remote Sensing and Smart Technologies in Environmental Engineering Practices. **Environmental Legislations:** Acts, Rules& Regulations, Role of government, Legal aspects, Role of Nongovernmental Organizations (NGOs), Environmental Education & Women Education.	**03 Hours**

Course outcomes:

After Studying this course, students will be able to

- Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
- Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- Demonstrate Solid Waste Management.
- Apply knowledge and technology in environmental practices
- Build inquisitiveness to protect environment through societal interventions

Text Books:

1. Benny Joseph, “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited, 2005.
2. R.J.Ranjit Daniels and JagadishKrishnaswamy, “Environmental Studies”, Wiley India Private Ltd., New Delhi, 2009.
3. R Rajagopalan, “Environmental Studies – From Crisis to Cure”, Oxford University Press, 2005.
4. Aloka Debi, “Environmental Science and Engineering”, Universities Press (India) Pvt. Ltd. 2012.

Universal Human Value and Professional Ethics [21UHV39]

Semester III			
No. of Teaching hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	-
Total No. of Lecture hours	16	**Exam Hours**	-
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Value Education:** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations	**03 Hours**
Module 2	**Harmony in the Human Being:** Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health	**03 Hours**
Module 3	**Harmony in the Family and Society:** Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order	**03 Hours**
Module 4	**Harmony in the Nature/Existence:** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence	**03 Hours**
Module 5	**Implications of the Holistic Understanding – a Look at Professional Ethics:** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	**04 Hours**

Course outcomes:

The course and further follow up is expected to positively impact common graduate attributes like:

- Holistic vision of life
- Socially responsible behaviour and Environmentally responsible work
- Ethical human conduct.

- Having Competence and Capabilities for Maintaining Health and Hygiene
- Appreciation and aspiration for excellence (merit) and gratitude for all

Textbook and Reference Books :

1. R R Gaur, R Asthana, G P Bagaria,The Textbook "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 447-1 b.
2. R R Gaur, R Asthana,The Teacher's Manual for "A Foundation Course in Human Values and Professional Ethics"

Engineering Mathematics-IV [21MAT41]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Calculus of complex functions:** Review of function of a complex variables, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. **Construction of analytic functions:** Milne-Thomson method- Problems.	**08 Hours**
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.	**08 Hours**
Module 3	**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. Runge -Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae)-Problems. Numerical Solution of Second Order ODE's - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).	**08 Hours**
Module 4	**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.	**08 Hours**
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.	**08 Hours**

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

- Explain the concepts of integral calculus, higher order differential equations, Laplace transforms, Probability and Linear Algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text and Reference Books:

Text Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
2. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
3. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

Reference Books:

1. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.
2. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
3. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Additional Mathematics-II [21MATDIP41]

Semester IV			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	1	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	00

Modules	Course Content	Teaching Hours
Module 1	**Integral Calculus**: Review of elementary integral calculus. Reduction formulae for $sin^n x, cos^n x$ (with proof) and $sin^m x cos^n x$(without proof) and evaluation of these with standard limits-Examples. Double integrals-Simple examples. Beta and Gamma functions- Simple problems	**08 Hours**
Module 2	**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$R(x) = e^{ax}$, $\sin ax$ / $\cos ax$for$f(D)y = R(x)$].	**08 Hours**
Module 3	**Laplace Transform:** Definition and Laplace transforms of elementary functions (statements only)-problems. Inverse Laplace Transform: Inverse Laplace transforms by method of partial fractions, Convolution theorem to find the inverse Laplace transforms. Solution of linear differential equations using Laplace transforms.	**08 Hours**
Module 4	**Introduction to Probability:** Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability, Bayes's theorem, problems.	**08 Hours**
Module 5	**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.	**08 Hours**

Course outcomes:

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

- Explain the concepts of integral calculus, Higher order differential equations, Laplace transforms, Probability and Linear Algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text and Reference Books:

Text Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
2. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
3. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

4. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.

Reference Books:

1. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
2. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Signal Conditioning and Data Acquisition Circuits [21BR42]

SemesterIV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Operational Amplifiers:** Introduction, Block schematic of an Op-amp, Power supply connections, Characteristics of an Ideal OP-AMP, Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR. (Relevant problems). **Operational Amplifier Characteristics:** DC characteristics – Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate, PSRR. **Basic op-amp applications:** Scale changer/Inverter. Summing amplifier: Inverting summing amplifier, Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems).	**08 Hours**
Module 2	**Operational Amplifier Applications:** V – I and I – V converter, Op-amp circuit using diodes, sample and hold circuit, Differentiator and Integrator. **Comparator and waveforms generator:** Comparator, Regenerative comparator (Schmitt Trigger), Astablemutivibrator, Monostablemultivibrator and Triangular waveform generator. Phase shift oscillator, Wien bridge oscillator. (Relevant problems).	**08 Hours**
Module 3	**Voltage Regulators:**Introduction, Series Op-amp regulator, IC voltage regulators, 723 general purpose regulators, switching regulator. **Active filters:**First and Second order LPF, First and Second orders HPF, Band Pass Filters, Band Reject filters. (Design examples).	**08 Hours**
Module 4	**555 Timer:** Description of Functional Diagram, Monostable operation, Applications of MonostableMultivibrator: Frequency Divider & Pulse Width Modulation. Astable operation, Applications of AstableMultivibrator: FSK Generator and Pulse Position Modulation. **Phase Locked Loops:** Basic Principles, Analog phase Detector/comparator, Voltage controlled oscillator.PLL applications: Frequency Multiplication/Division, Frequency translation, FM demodulation	**08 Hours**
Module 5	**Data Acquisition Systems:**Types of instrumentation systems, Components of analog data acquisition system, Digital data acquisition system. Single channel and Multi-channel data acquisition. **Data Converters:**Digital to AnalogConverters:Basic DAC techniques, Weighted Resistor DAC, R – 2R Ladder DAC, DAC 0800 (Data sheet: Features and description only).	**08 Hours**

	Analog to Digital Converters:Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC. ADC 0809 (Data sheet: Features, specifications and description only), DAC/ADC specifications	

Course outcomes:

After Studying this course, students will be able to

1. Understand the basic principles and operation of op-amp.
2. Design and develop circuits to meet the practical applications
3. Implement and integrate the op-amp circuits in electronic gadgets.

Text and Reference Books:

Text Books:

1. D. Roy Choudhury and Shail B. Jain, "Linear Integrated Circuits", 4th edition, Reprint 2010, New Age International. (Module -1,2,3,4 & 5)
2. Ramakant A. Gayakwad, "Op - Amps and Linear Integrated Circuits", 4th edition, PHI (Module-3)
3. A K Sawhney, "A course in Electrical & Electronic Measurements & Instrumentation", DhanpatRai Publications, 19th edition, 2011.(Module-5)

Reference Books:

1. Robert. F. Coughlin & Fred. F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", PHI/Pearson, 2006
2. James M. Fiore, "Op - Amps and Linear Integrated Circuits", Thomson Learning, 2001
3. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", TMH, 3e, 2005.

Biomedical Transducers and Instrumentation [21BR43]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Measurement, Functional Elements of Measurement System and Transducers:** Measurement, Significance of measurement, Instruments and measurement systems, Electronic instruments, Analog and digital modes of operation, Functions of instruments and measurement systems, Applications of measurement systems, Basic medical instrumentation system, Performance requirements of medical instrumentation systems, PC based medical instruments, General constraints in design of medical instrumentation systems. Transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers.	**08 Hours**
Module 2	**Bioelectric Signals and Electrodes:**Sources of Biomedical Signals, Origin of Bioelectric Signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes– Electrode-tissue interface, Electrolyte-Skin interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.	**08 Hours**
Module 3	**Measurement of Displacement:** Introduction, Principles of Transduction: Variable resistance devices, Variable Inductance Transducer, Synchros and Resolvers, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer **Measurement of Strain:** Introduction, Electrical Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, Semiconductor strain gauges (principle, types & list of characteristics only), Materials for strain gauges. Wheatstone bride circuit for strain gauges, Applications.	**08 Hours**
Module 4	**Measurement of Temperature**: Introduction, Resistance type temperature sensors, Platinum resistance thermometer, Thermistors (principle, types & characteristics), Thermocouples, Solid state sensors – principle and working of AD590 (characteristics and features), and LM35 (characteristics and features), Quartz thermometer, Temperature measurement by radiation methods, Optical pyrometer. **Measurement of Force**: Introduction, Force measuring sensor – Load cells – Column type devices, Proving rings, Cantilever beam,Hydraulic load cell, Electronic weighing system.	**08 Hours**
Module 5	**Flow Measurement**: Introduction, Classification of Flow Meters, Head type flow meters – Orifice meter and Venturi	**08 Hours**

	tube, Rotameter, Electromagnetic Flow Meter, Ultrasonic flow meter, Laser anemometer, Rotor torque mass flow meter. **Measurement of Pressure**: Introduction, Diaphragms, Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device (principle, schematic & working, no derivation), Piezoelectric pressure transducer, Pressure multiplexer.	

Course outcomes:

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

- Define the measurement, instrument, transducer, and explain the basic medical instrumentation system.
- Explain the principle, construction and working of transducers for the measurement of displacement and strain.
- Discuss the principle, construction and working of transducers for the measurement of temperature and force.
- Illustrate the methods for the measurement of flow and pressure.
- Use the above transducers for the measurement of physiological signals.

Text and Reference Books:

Textbooks:

1. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.(Module-1).
2. Handbook of Biomedical Instrumentation- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003. (Module-1 & 2)
3. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3, 4 & 5).

Reference Books:

1. Electronic Instrumentation and Measurements - David A Bell, 3rd Edition, Oxford University Press, 2013.
2. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
3. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
4. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.

Microcontroller and Embedded Systems [21BR44]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Microprocessors versus Microcontrollers, ARM Embedded Systems:** The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table , Core Extensions	**08 Hours**
Module 2	**Introduction to the ARM Instruction Set :** Data Processing Instructions , Programme Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs	**08 Hours**
Module 3	**Embedded System Components:** Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.	**08 Hours**
Module 4	**Embedded System Design Concepts:** Characteristics and Quality Attributes of Embedded Systems, Operational quality attributes,non-operational quality attributes, Embedded 08 Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling, embedded firmware design and development.	**08 Hours**
Module 5	**RTOS and IDE for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues-Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment-Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan.	**08 Hours**

Course outcomes:

After Studying this course, students will be able to

- Describe the architectural features and instructions of ARM microcontroller

- Apply the knowledge gained for Programming ARM for different applications.
- Interface external devices and I/O with ARM microcontroller.
- Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Develop the hardware /software co-design and firmware design approaches.
- Demonstrate the need of real time operating system for embedded system applications

Text and Reference Books:

Text Books:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.

Reference Books:

1. Raghunandan.G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
2. The Insider‟s Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.
3. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.
4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

Microcontroller and Embedded Systems Lab

Sl. No.	Course Content
	List of Experiments
PART A: Conduct the following experiments by writing program using ARM7TDMI/LPC2148 using an evaluation board/simulator and the required software tool.	
1	Write a program to multiply two 16 bit binary numbers
2	Write a program to find the sum of first 10 integer numbers.
3	Write a program to find factorial of a number
4	Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5	Write a program to find the square of a number (1 to 10) using look-up table.
6	Write a program to find the largest/smallest number in an array of 32 numbers .
7	Write a program to arrange a series of 32 bit numbers in ascending/descending order.
8	Write a program to count the number of ones and zeros in two consecutive memory locations.
PART –B Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.	
9	Display "Hello World" message using Internal UART.
10	Interface and Control a DC Motor.
11	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
12	Determine Digital output for a given Analog input using Internal ADC of ARM controller.
13	Interface a DAC and generate Triangular and Square waveforms.
14	Interface a 4x4 keyboard and display the key code on an LCD.
15	Demonstrate the use of an external interrupt to toggle an LED On/Off
16	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

Control Systems [21BR45]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Modelling of Systems and Block diagram: I**ntroduction 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. Introduction to Simulation package for practical component.	**08 Hours**
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.	**08 Hours**
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. The Root Locus Technique: Introduction. Root locus concepts. Construction of root loci. Stability analysis using Root locus Technique. Numerical problems on all topics.	**08 Hours**
Module 4	**Frequency domain Analysis:** Introduction to frequency domain analysis, Correlation between time & frequency response, Bode plots. Numerical problems on all topics. Polar Plot: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion. Stability analysis using Polar plot. Numerical problems on all topics.	**08 Hours**
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.	**08 Hours**

PRACTICAL COMPONENT: Using suitable simulation software, demonstrate the operation of the following:

1. Determination of time response specification of a first order, second order and third order system taking suitable transfer functions.
2. Determination of time response specification of a second order underdamped system, for different damping factors.
3. Determination of frequency response of a second order System

4. Determination of frequency response of a lead lag compensator
5. Using suitable simulation package, plot Root locus plot for the given transfer function and analyse for stability.
6. Using suitable simulation package, plot Bode plot for the given transfer function and analyse for stability.
7. Using suitable simulation package, plot Nyquist plot for the given transfer function and analyse for stability.
8. Using suitable simulation package, obtain the time response from state model of a system.

Course outcomes:

After studying this course, students will able to:

- Apply modelling knowledge in implementation physical systems.
- Understand the reduction of block diagram &analyze using Signal flow graph.
- Comment on performance of a system by evaluating various parameters.
- Model a system by applying the concept of State Space analysis

Text and Reference Books:

Text Books:

1. I.J. Nagarath and M. Gopal, "Control Systems Engineering",5th edition,New Age International (P) Limited, Publishers,– 2012.
2. K. Ogata, "Modern Control Engineering",4thEdition, Pearson Education Asia/ PHI, 2002

Reference Books:

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

Signal Conditioning and Biomedical Transduers Lab [21BRL46]

Semester IV			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	03	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	02

Sl. No.	Course Content
1	To design and implement • Inverting Amplifier and Inverting Attenuator • Non-Inverting Amplifier and Voltage Follower
2	To realize • Full wave Precision rectifier • Voltage regulator using IC 723
3	To design and implement • Butterworth I order Low-pass filter • Butterworth II order High-pass filter
4	To design and implement • RC Phase shift oscillator • Wein Bridge oscillator
5	To realize • ZCD • Positive and Negative Voltage level detectors
6	To design and implement • AstableMultivibrator using 555 timer • Mono-stable Multivibrator using 555 timer
7	To realizeSample and Hold circuit using discrete components
8	To realizeProgrammable Gain Amplifier using Analog Mux
9	Measurement of displacement using LVDT and finding the sensitivity & resolution.
10	Characteristics of Load cell and Cantilever beam using Strain gauge: Plotting the characteristics and finding their sensitivity for Quarter, Half and Full bridge configurations.
11	Temperature measurement using RTD, Thermistor and Thermocouple: Plotting the characteristics and finding their sensitivity.
12	Temperature measurement using AD590/LM35: Plotting the characteristics and finding their sensitivity.

Course outcomes:

After studying this course, students will able to;

- Sketch circuit schematics, construct circuits on breadboards, analyze and troubleshoot circuits containing Op-amps, resistors, diodes, capacitors and independent sources.
- Memorizeand reproduce the manufacturer's data sheets of IC 555 timer, IC μa741 op-amp and data converters like IC ADC 0800 and IC DAC 0809.
- Design and evaluate analog integrated circuits like Amplifiers, Oscillators, Active filters, Precision Rectifiers and Voltage level detectors, and compare the experimental results with theoretical values.
- Demonstrate and analyze the working of Sample-Hold, Programmable gain amplifier and Analog Multiplexer circuits in data acquisition system.
- Design and evaluate different resolution data converters using discrete components and ICs.

Text and Reference Books:

1. D. Roy Choudhury and Shail B Jain, "Linear Integrated Circuits", 4th edition, Reprint 2010, New Age International.
2. Ramakant A. Gayakwad, "Op - Amps and Linear Integrated Circuits", 4th edition, PHI.
3. A K Sawhney, "A course in Electrical & Electronic Measurements & Instrumentation", 19th edition, DhanpatRai Publications, 2011.
4. Robert. F. Coughlin &Fred. F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", PHI/Pearson, 2006
5. James M. Fiore, "Op - Amps and Linear Integrated Circuits", Thomson Learning, 2001
6. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", TMH, 3rd edition, 2005

Constitution of India, Professional Ethics and Cyber Law [21CPH46]

Semester IV			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	-
Total No. of Lecture hours	16	**Exam Hours**	-
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Indian Constitution:** Definition of Constitution, Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly. Preamble of Indian Constitution & Key concepts of the Preamble. Salient features of India Constitution.	**03 Hours**
Module 2	**Fundamental Rights (FR's), Directive Principles of State Policy (DPSP's) and Fundamental Duties (FD's):** Fundamental Rights and its Restriction and limitations in different Complex Situations. DPSP's and its present relevance in Indian society. Fundamental Duties and its Scope and significance in Nation building.	**03 Hours**
Module 3	**Union Executive:** Parliamentary System, 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.	**03 Hours**
Module 4	**State Executive & Elections, Amendments and Emergency Provisions:** State Executive, Election Commission, Elections & Electoral Process. Amendment to Constitution (Why and How) and Important Constitutional Amendments till today. Emergency Provisions.	**03 Hours**
Module 5	**Professional Ethics:** Definition of Ethics & Values. Professional & Engineering Ethics. Positive and Negative aspects of Engineering Ethics. **Cyber Laws:** Salient features of the IT Act, 2000, various authorities under IT Act and their powers. ; Penalties & Offences, amendments. **Computer & Cyber Security:** (a) Types of Attacks, (b) Network Security (c) Overview of Security threats, (d) Hacking Techniques, (e) Password cracking (f) Insecure Network connections, (g) Malicious code (h) Concept of Fire wall Security	**04 Hours**

Course outcomes:

After studying this course, students will able to:

- Have constitutional knowledge and legal literacy.
- Understand Engineering and Professional ethics and responsibilities of Engineers.
- Understand cyber threats & cyber laws, acts and their powers

Textbook/Reference Books:

1. Shubham Singla, 'Constitution of India, Professional Ethics & Human Rights', CENGAGE Publications 2018
2. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White publications, Mumbai
3. Cyber Law in India by Farooq Ahmad; Pioneer Books

Ability Enhancement Course – II [21AEC47]

Semester IV			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	-
Total No. of Lecture hours	16	**Exam Hours**	-
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Technical Report Writing:** Introduction to Technical writing process, Understanding of writing process, Introduction to various Technical Report writing.	**03 Hours**
Module 2	**Art of condensation and Paragraph Writing:** Introduction and importance, Types and principles of condensation. Importance of paragraph writing, Features and its construction styles.	**03 Hours**
Module 3	**Business Report Writing:** Introduction, Definition and Salient features of Business reports. Significance and types of report writing. (Formal and Informal). Resume building and Types of resumes. (samples of resumes)	**03 Hours**
Module 4	**Technical Articles and Proposals:** Nature and significance, Types of technical Articles Journal articles and conference papers. Elements of technical articles .Introduction to technical proposal writing, Purpose, importance, structure and types of technical proposals.	**04 Hours**
Module 5	**Social media posts and Blog Writing:** Ethics and practices of social media posts, Principles and fundamentals, Guiding principles for composition of articles, some common pitfalls. Maintaining common etiquette. Blogs and Blog writings strategies.	**03 Hours**

Course outcomes

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

- Effectively communicate in technical matters.
- Practice preparation of gist, abstract and notes from a technical article.
- Prepare a business proposals and reports.
- Write and respond in social media and write blogs.

Text Book/ Reference Books:

1. Sanjay Kumar and Pushpalata, 'Communication Skills', Oxford University Press. 2018.
2. M. Ashraf Rizvi, 'Effective Technical Communication', McGraw Hill, 2018.
3. Gajendra Singh Chauhan and et.al. 'Technical Communication', Cengage Publication, 2018.
4. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practice, Oxford University Press, 2018.