DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

Evaluation Scheme & Syllabus for

B. Tech. (Bio Technology)

AS PER

AICTE MODEL CURRICULUM

(Effective from the Session: 2018-19)

B. Tech 1st Year (Bio Technology) Structure in accordance with AICTE Model Curriculum Effective w.e.f. Academic Session 2018-19

SEMESTER - I

Sl. No.	Code	SUBJECT	PERIODS			EVALUATION SCHEME				END SEMESTER		TOTAL	CREDIT
			L	T	P	CT	TA	Total	PS	TE	PE		
3 WEEKS COMPULSORY INDUCTION PROGRAM													
1	**KAS101/ KAS102**	Physics/Chemistry	3	1	3	30	20	50	25	100	25	200	5.5
2	**KBT101/ KBT102**	Elementary Mathematics-I /Remedial Biology-I	3	1	0	30	20	50	-	100	-	150	4
3	**KEE101/ KCS101**	Basic Electrical Engineering/Programming for Problem Solving	3	1	2	30	20	50	25	100	25	200	5
4	**KCE101/ KWS101**	Engineering Graphics & Design/Workshop Practices	1	0	4	-	-	-	25	-	25	50	3
	MOOCs (For B.Tech. Hons. Degree**)***												0
		TOTAL										600	17.5

SEMESTER II

Sl. No.	Code	SUBJECT	PERIODS			EVALUATION SCHEME				END SEMESTER		TOTAL	CREDIT
			L	T	P	CT	TA	Total	PS	TE	PE		
1	**KAS201/ KAS201**	Physics/Chemistry	3	1	3	30	20	50	25	100	25	200	5.5
2	**KBT201/ KBT202**	Elementary Mathematics-II /Remedial Biology-II	3	1	0	30	20	50	-	100	-	150	4
3	**KEE201/ KCS201**	Basic Electrical Engineering/Programming for Problem Solving	3	1	2	30	20	50	25	100	25	200	5
4	**KCE201/ KWS201**	Engineering Graphics & Design/Workshop Practices	1	0	4	-	-	-	25	-	25	50	3
5	**KAS204**	Professional English	2	0	2	30	20	50	-	100	-	150	3
	MOOCs (For B.Tech. Hons. Degree**)***												0
		TOTAL										750	20.5
Mini Project or Internship (3-4 weeks) shall be conducted during summer break after II semester and will be assessed during III semester													

*** List of MOOCs (NPTL) Based Recommended Courses for first year B. Tech Students**

1. Developing Soft Skills and personality-Odd Semester-8 Weeks-3 Credits
2. Enhancing Soft Skills and personality-Even Semester-8 Weeks-3 Credits

*** AICTE Guidelines in Model Curriculum:**

After successful completion of 160 credits, a student shall be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours only, if he/she completes additional university recommended courses only (Equivalent to 20 credits; NPTEL Courses of 4 Weeks, 8 Weeks and 12 Weeks shall be of 2, 3 and 4 Credits respectively) through MOOCs. For registration to MOOCs Courses, the students shall follow NPTEL Site http://nptel.ac.in/ as per the NPTEL policy and norms. The students can register for these courses through NPTEL directly as per the course offering in Odd/Even Semesters at NPTEL. These NPTEL courses (recommended by the University) may be cleared during the B. Tech degree program (not necessary one course in each semester). After successful completion of these MooCs courses the students, shall, provide their successful completion NPTEL status/certificates to the University (COE) through their college of study only. The student shall be awarded Hons.

Degree (on successful completion of MOOCS based 20 credit) only if he/she secures 7.50 or above CGPA and passed each subject of that Degree Programme in single attempt without any grace marks.

SEMESTER – I

A Guide to Induction Program

1 Introduction

(Induction Program was discussed and approved for all colleges by AICTE in March 2017. It was discussed and accepted by the Council of IITs for all IITs in August 2016. It was originally proposed by a Committee of IIT Directors and accepted at the meeting of all IIT Directors in March 2016.1 This guide has been prepared based on the Report of the Committee of IIT Directors and the experience gained through its pilot implementation in July 2016 as accepted by the Council of IITs. Purpose of this document is to help institutions in understanding the spirit of the accepted Induction Program and implementing it.)

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

There is a mad rush for engineering today, without the student determining for himself his interests and his goals. This is a major factor in the current state of demotivation towards studies that exists among UG students. The success of gaining admission into a desired institution but failure in getting the desired branch, with peer pressure generating its own problems, leads to a peer environment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further worsens it with also a poor daily routine.

To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them

A Committee of IIT Directors was setup in the 152nd Meeting of IIT Directors on 6th September 2015 at IIT Patna, on how to motivate undergraduate students at IITs towards studies, and to develop verbal ability. The Committee submitted its

report on 19th January 2016. It was considered at the 153rd Meeting of all IIT Directors at IIT Mandi on 26 March 2016, and the accepted report came out on 31 March 2016. The Induction Program was an important recommendation, and its pilot was implemented by three IITs, namely, IIT(BHU), IIT Mandi and IIT Patna in July 2016. At the 50th meeting of the Council of IITs on 23 August 2016, recommendation on the Induction Program and the report of its pilot implementation were discussed and the program was accepted for all IITs, work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

2. Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.[2]

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

[2]Induction Program as described here borrows from three programs running earlier at different institutions: (1) Foundation Program running at IIT Gandhinagar since July 2011, (2) Human Values course running at IIIT Hyderabad since July 2005, and (3) Counselling Service or mentorship running at several IITs for many decades. Contribution of each one is described next.

1. IIT Gandhinagar was the first IIT to recognize and implement a special 5-week Foundation Program for the incoming 1st year UG students. It took a bold step that the normal classes would start only after the five week period. It involved activities such as games, art, etc., and also science and other creative workshops and lectures by resource persons from outside.

2. IIIT Hyderabad was the first one to implement a compulsory course on Human Values. Under it, classes were held by faculty through discussions in small groups of students, rather than in lecture mode. Moreover, faculty from all

departments got involved in conducting the group discussions under the course. The content is non-sectarian, and the mode is dialogical rather than sermonising or lecturing. Faculty were trained beforehand, to conduct these discussions and to guide students on issues of life.

3. Counselling at some of the IITs involves setting up mentor-mentee network under which 1st year students would be divided into small groups, each assigned a senior student as a student guide, and a faculty member as a mentor. Thus, a new student gets connected to a faculty member as well as a senior student, to whom he/she could go to in case of any difficulty whether psychological, financial, academic, or otherwise.

The Induction Program defined here amalgamates all the three into an integrated whole, which leads to its high effectiveness in terms of building physical activity, creativity, bonding, and character. It develops sensitivity towards self and one's relationships, builds awareness about others and society beyond the individual, and also in bonding with their own batch-mates and a senior student besides a faculty member.

Scaling up the above amalgamation to an intake batch of 1000 plus students was done at IIT(BHU), Varanasi starting from July 2016.

2.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

2.2 Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program.

These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

2.3 Universal Human Values

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them.[3]

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

The Universal Human Values Course is a result of a long series of experiments at educational institutes starting from IIT-Delhi and IIT Kanpur in the 1980s and 1990s as an elective course, NIT Raipur in late 1990s as a compulsory one-week off campus program. The courses at IIT(BHU) which started from July 2014, are taken and developed from two compulsory courses at IIIT Hyderabad first introduced in July 2005.

2.4 Literary

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

2.5 Proficiency Modules

This period can be used to overcome some critical lacunas that students might have,
for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in

several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

2.6 Lectures by Eminent People

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

2.7 Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

2.8 Familiarization to Dept./Branch & Innovations

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

3 Schedule

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

3.1 Initial Phase

Time	Activity
Day 0	
Whole day	Students arrive - Hostel allotment. (Preferably do pre allotment)
Day 1	
09:00 am - 03:00 pm	Academic registration
04:30 pm - 06:00 pm	Orientation
Day 2	
09:00 am - 10:00 am	Diagnostic test (for English etc.)
10:15 am - 12:25 pm	Visit to respective depts.
12:30 pm - 01:55 pm	Lunch
02:00 pm - 02:55 pm	Director's address
03:00 pm - 05:00 pm	Interaction with parents
03:30 pm - 05:00 pm	Mentor-mentee groups - Introduction within group. (Same as Universal Human Values groups)

3.2 Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

3.2.1 Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods
within the Induction Program. We first show a typical daily timetable.

Session.	Time	Activity	Remarks
Day 3 onwards			
	06:00 am	Wake up call	
I	06:30 am - 07:10 am	Physical activity (mild exercise/ yoga)	
	07:15 am - 08:55 am	Bath, Breakfast, etc.	
II	09:00 am - 10:55 am	Creative Arts / Universal Human Values	Half the groups do Creative Arts
III	11:00 am - 12:55 pm	Universal Human Values/ Creative Arts	Complementary alternate
	01:00 pm - 02:25 pm	Lunch	
IV	02:30 pm - 03:55 pm	Afternoon Session See below.	
V	04:00 pm - 05:00 pm	Afternoon Session See below.	
	05:00 pm - 05:25 pm	Break / light tea	
VI	05:30 pm - 06:45 pm	Games / Special Lectures	
	06:50 pm - 08:25 pm	Rest and Dinner	
VII	08:30 pm - 09:25 pm	Informal interactions (in hostels)	

Sundays are off. Saturdays have the same schedule as above or have outings.

3.2.2 Afternoon Activities (Non-Daily)

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

Activity	Session	Remarks
Familiarization with Dept/Branch & Innovations	IV	For 3 days (Day 3 to 5)
Visits to Local Area	IV, V and VI	For 3 days - interspersed (e.g., 3 Saturdays)

Lectures by Eminent People	IV	As scheduled - 3-5 lectures
Literary (Play / Book Reading / Lecture)	IV	For 3-5 days
Proficiency Modules	V	Daily, but only for those who need it

3.3 Closing Phase

Time	Activity
Last But One Day	
08:30 am - 12 noon	Discussions and finalization of presentation within each group
02:00 am - 05:00 pm	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations (if any). May be expanded to last 2 days, in case needed.

3.4 Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc. (For every 10 undergraduate first year students, there would be a senior student as a student guide, and for every 20 students, there would be a faculty mentor.) Such a group should remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline. Here we list some important suggestions which have come up and which have been experimented with.

3.4.1 Follow Up after Closure – Same Semester

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)

3.4.2 Follow Up – Subsequent Semesters

It is extremely important that continuity be maintained in subsequent semesters.
It is suggested that at the start of the subsequent semesters (upto fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work,

and group discussions be conducted. Subsequently, the groups should meet at least once a month.

4 Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution.

The graduating student must have values as a human being, and knowledge and meta skills related to his/her profession as an engineer and as a citizen. Most students who get demotivated to study engineering or their branch, also lose interest in learning.
The Induction Programis designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The Universal Human Valuescomponent, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and we are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept. nature, and character to follow through. It also makes them reflect on their relationshipwith their families and extended family in the college (with hostel staff and others). It alsoconnects students with each other and with teachers so that they can share any difficultythey might be facing and seek help.

References:

Motivating UG Students Towards Studies, Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors), 31 March 2016, IIT Directors' Secretariat, IIT Delhi.

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PHYSICS

Module - 1 Relativistic Mechanics: [8]

Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle.

Module- 2 Electromagnetic Field Theory: [8]

Continuity equation for current density, Displacement current, Modifying equation for the curl of magnetic field to satisfy continuity equation, Maxwell's equations in vacuum and in non conducting medium, Energy in an electromagnetic field, Poynting vector and Poynting theorem, Plane electromagnetic waves in vacuum and their transverse nature. Relation between electric and magnetic fields of an electromagnetic wave, Energy and momentum carried by electromagnetic waves, Resultant pressure, Skin depth.

Module- 3 Quantum Mechanics: [8]

Black body radiation, Stefan's law, Wien's law, Rayleigh-Jeans law and Planck's law, Wave particle duality, Matter waves, Time-dependent and time-independent Schrodinger wave equation, Born interpretation of wave function, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton effect.

Module- 4 Wave Optics: [10]

Coherent sources, Interference in uniform and wedge shaped thin films, Necessity of extended sources, Newton's Rings and its applications. Fraunhoffer diffraction at single slit and at double slit, Absent spectra, Diffraction grating, Spectra with grating, Dispersive power, Resolving power of grating, Rayleigh's criterion of resolution, Resolving power of grating.

Module- 5Fibre Optics & Laser: [10]

Fibre Optics**:** Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres.
Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, Various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

Course Outcomes:

1. To solve the classical and wave mechanics problems
2. To develop the understanding of laws of thermodynamics and their application in various processes
3. To formulate and solve the engineering problems on Electromagnetism & Electromagnetic Field Theory
4. To aware of limits of classical physics & to apply the ideas in solving the problems in their parent streams

Reference Books:

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Optics - Brijlal& Subramanian (S. Chand)
4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

5. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
6. Engineering Physics-Malik HK and Singh AK (McGrawHill)

Physics Lab

List of Experiments

Any ten experiments (at least four from each group).

Group A

1. To determine the wavelength of sodium light by Newton's ring experiment.
2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
3. To determine the specific rotation of cane sugar solution using polarimeter.
4. To determine the focal length of the combination of two lenses separated by a distance and verify the formula for the focal length of combination of lenses.
5. To measure attenuation in an optical fiber.
6. To determine the wavelength of He-Ne laser light using single slit diffraction.
7. To study the polarization of light using He-Ne laser light.
8. To determine the wavelength of sodium light with the help of Fresnel's bi-prism.
9. To determine the coefficient of viscosity of a given liquid.
10. To determine the value of acceleration due to gravity (g) using compound pendulum.

Group B

1. To determine the energy band gap of a given semiconductor material.
2. To study Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall effect setup.
3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
4. To verify Stefan's law by electric method.
5. To determine resistance per unit length and specific resistance of a given resistance using Carey Foster's Bridge.
6. To study the resonance condition of a series LCR circuit.
7. To determine the electrochemical equivalent (ECE) of copper.
8. To calibrate the given ammeter and voltmeter by potentiometer.
9. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.
10. To measure high resistance by leakage method.

Reference Books

1. Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)
2. Engineering Physics-Theory and Practical- Katiyar& Pandey (Wiley India)
3. Engineering Physics Practical- S K Gupta (KrishnaPrakashan Meerut)

Course Outcomes:

1. To determine the wavelength of sodium light by Newton's ring experiment
2. To determine the wavelength of sodium light with the help of Fresnel's bi-prism
3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
4. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.

CHEMISTRY

Module-1 **[08]**

Atomic and Molecular Structure:

Molecular orbital's of diatomic molecules. Band theory of solids. Liquid crystal and its applications. Point defects in solids. Structure and applications of Graphite and Fullerenes. Concepts of Nanomaterials and its application.

Module-2 **[08]**

Spectroscopic techniques and Applications:

Elementary idea and simple applications of Rotational, Vibrational, Ultravoilet& Visible and Raman spectroscopy.

Module-3 **[08]**

Electrochemistry

Nernst Equation and application, relation of e.m.f. with thermodynamic functions (ΔH, ΔF and ΔS). Lead storage battery.

Corrosion; causes, effects and its prevention.

Phase Rule and its application to water system.

Module-4 **[08]**

Water Analysis; Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method).

Fuels: classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeterand Dulong'smethos).

Module-5 **[08]**

Polymer; Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications.

Course Outcomes:

1. Use of different analytical instruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measure hardness of water.
4. Estimate the rate constant of reaction.

Reference Books:

1. University Chemistry By B.H. Mahan
2. University Chemistry By C.N.R. Rao
3. Organic Chemistry By I.L. Finar
4. Physical Chemistry By S. Glasstone
5. Engineering Chemistry By S.S. Dara
6. Polymer Chemistry ByFre W., Billmeyer
7. Engineering ChemistryBy Satya Prakash

CHEMISTRY-PRACTICAL

LIST OF EXPERIMENTS

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA.
3. Determination of iron content in the given solution by Mohr's method.
4. Determination of viscosity of given liquid.
5. Determination of surface tension of given liquid.
6. Determination of chloride content in water sample.
7. Determination of available chlorine in bleaching powder.
8. Determination of pH by pH-metric titration.
9. Preparation of Phenol-formaldehyde and Urea-formaldehyde resin.
10. Determination of Cell constant and conductance of a solution.
11. Determination of rate constant of hydrolysis of esters.
12. Verification of Beer's law.

NOTE: Choice of any 10 experiments from the above. Institute can change any 02 experiments from the aforesaid experiments.

Course Outcomes:

1. Use of different analytical instruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measure hardness of water.
4. Estimate the rate constant of reaction.

Elementary Mathematics-I

(B. Tech. Biotechnology Engineering)

Module 1: Algebra **[9]**

Fundamental Theorem of Algebra (without proof), solution of quadratic equations. Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables. Solution of system of linear inequalities in two variables-graphically.

Module 2: Arithmetic and Geometrical Progressions **[9]**

Arithmetic progression (A.P.), general term of A.P., sum of a series in A.P., arithmetic mean (A.M.) Geometric progression (G.P.), general term of a G.P., sum of n terms of a G.P., sum of infinite terms in G.P., geometric mean (G.M.), relation between A.M. and G.M. Sum to n terms of the special series n, n^2 and n^3 in A.P..

Module 3: Coordinate Geometry **[9]**

Straight Lines: Introduction, Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two point form, intercepts form and normal form. General equation of a line. Distance of a point from a line, with numerical examples.

Conic Sections: Sections of a cone: circle, ellipse, parabola, hyperbola and pair of intersecting lines. Standard equations and simple properties of parabola, ellipse and hyperbola. Standard equation of a circle, with numerical examples.

Module 4: Calculus I **[9]**

Introduction, Definition of limit, continuity and differentiability, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric function, derivative ofcomposite functions, chain rule, derivatives of inverse trigonometric functions, exponential, logarithmic and parametric forms. Logarithmic differentiation. Derivative introduced as rate of change both as that of distance function and geometrically.

Module 5: Calculus II **[9]**

Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretations with illustrate examples.

Applications of Derivatives: Applications of derivatives: rate of change, increasing/decreasing functions, tangents &normals, approximation and errors, maxima and minima of one variable. Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).

COURSE OUTCOMES

1. Illustrate the concept of equation and apply for solving quadratic equations and system of linear inequality in two variables.
2. Apply the concept of arithmetic, and geometric progressions for finding the sum to n terms and infinite number of terms
3. Remember the concept of coordinate system and apply for finding distance of a point from a line and conics.
4. Understand the concept of differentiation and apply for finding rate of change, slope.

5. Remember the concept of differentiation and apply for finding the derivative of different types functions and maxima and minima.

Recommended Textbooks.

1) Mathematics - Textbook for Class XI, NCERT Publication
2) Mathematics Part I - Textbook for Class XII, NCERT Publication
3) Mathematics Part II - Textbook for Class XII, NCERT Publication

Reference books:

1) B.V.Rammana:Higher Engineering Mathematics (Tata Macgraw Hill)
2) Glynjames :Advanced modern Engineering Mathematics (Pearson education)

Remedial Biology-I

(B. Tech. Biotechnology Engineering)

Module-1 **[8]**

The cell concept, structure of prokaryotic, eukaryotic cells, plant cells and animal cells, Structure and function of cell membrane, cell organelles and their function. Structure and use of compound microscope, Macro and micro molecules, Basic chemical constituents of living body.

Module-2 **[8]**

Tissues in animal and plants, Morphology, anatomy and functions of different parts of plants: Root, stem, leaf, inflorescence, flower, fruit and seed, Concepts of botanical garden, herbaria, zoological park and museums.

Module-3 **[8]**

Classification of living organisms (Five kingdom classification, major groups and principles of classification in each kingdom), Systematic and binomial system of nomenclature, Concept of animal and plant classification.

Module-4 **[8]**

Concepts of alleles and genes, Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis, techniques to study mitosis and meiosis.

Module-5 **[8]**

Plant Physiology: Concepts of diffusion, osmosis, imbibitions, Movement of water, food, nutrients and gases, Photosynthesis, plant growth and development.

COURSE OUTCOMES

1. To understand the basics of living systems
2. To understand key common features of living organisms & its function
4. To know the anatomy and functions of cells
5. To know the concepts of alleles and genes
6. To understand the plant physiology

Recommended Text Book:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication

Reference Book:

Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (McGraw Hill Publication)

BASIC ELECTRICAL ENGINEERING

Module - 1: DC Circuits **[08]**

Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Superposition theorem, Thevenin theorem, Norton theorem.

Module - 2: Steady- State Analysis of Single Phase AC Circuits **[10]**

Representation of Sinusoidal waveforms – Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current.

Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor.

Three phase balanced circuits, voltage and current relations in star and delta connections.

Module - 3 : Transformers **[08]**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module –4 : Electrical machines **[08]**

DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Module –5 : Electrical Installations **[06]**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries.Elementary calculations for energy consumption and savings, battery backup.

COURSE OUTCOMES

1. Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2. Analyze the steady state behavior of single phase and three phase AC electrical circuits.
3. Identify the application areas of a single phase two winding transformer as well as an auto transformer and calculate their efficiency. Also identify the connections of a three phase transformer.
4. Illustrate the working principles of induction motor, synchronous machine as well as DC machine and employ them in different area of applications.
5. Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Spoken Tutorial (MOOCs):

1. AC DC Circuit Analysis using NgSpice, Open Source Software (http://spoken-tutorial.org)

Text Books:

1. Ritu Sahdev, "Basic Electrical Engineering", Khanna Publishing House.

2. S. Singh, P.V. Prasad, "Electrical Engineering: Concepts and Applications" Cengage.

3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill.

4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill.

Reference Books:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

2. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press.

3. V. D. Toro, "Electrical Engineering Fundamentals", Pearson India.

BASIC ELECTRICAL ENGINEERING LABORATORY

LIST OF EXPERIMENTS

Note: A minimum of ten experiments from the following should be performed.

1. Verification of Kirchhoff's laws
2. Verification of Superposition and Thevenin Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Connection and measurement of power consumption of a fluorescent lamp (tube light).
6. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
7. Determination of parameters of ac single phase series RLC circuit
8. To observe the B-H loop of a ferromagnetic material in CRO.
9. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
10. Determination of efficiency of a dc shunt motor by load test
11. To study running and speed reversal of a three phase induction motor and record speed in both directions.
12. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

COURSE OUTCOMES

1. Conduct experiments illustrating the application of KVL/KCL and network theorems to DC electrical circuits.
2. Demonstrate the behavior of AC circuits connected to single phase AC supply and measure power in single phase as well as three phase electrical circuits.
3. Perform experiment illustrating BH curve of magnetic materials.
4. Calculate efficiency of a single phase transformer and DC machine.
5. Perform experiments on speed measurement and reversal of direction of three phase induction motor and Identify the type of DC and AC machines based on their construction.

Programming for Problem Solving

Module – 1 : **(Introduction to Programming)** **[08]**

Introduction to components of a computer system: Memory, processor, I/O Devices, storage, operating system, Concept of assembler, compiler, interpreter, loader and linker.

Idea of Algorithm: Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code.

Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C, Fundamental data types, Variables and memory locations, Storage classes.

Module – 2 : **(Arithmetic expressions & Conditional Branching)** **[08]**

Arithmetic expressions and precedence: Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity.

Conditional Branching: Applying if and switch statements, nesting if and else, use of break and default with switch.

Module – 3 : **(Loops & Functions)** **[08]**

Iteration and loops: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

Functions: Introduction, types of functions, functions with array, passing parameters to functions, call by value, call by reference, recursive functions.

Module – 4 : **(Arrays & Basic Algorithms)** **[08]**

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, Passing arrays to functions.

Basic Algorithms: Searching &Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, Notion of order of complexity.

Module – 5 :**(Pointer& File Handling)** **[08]**

Pointers: Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (no implementation)

File handling: File I/O functions, Standard C preprocessors, defining and calling macros, command-line arguments.

COURSE OUTCOMES

1. To develop simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To implement conditional branching, iteration and recursion.
4. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
5. To use arrays, pointers and structures to develop algorithms and programs.

Text books:

1. Schum's Outline of Programming with C by Byron Gottfried, McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education.
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
5. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
6. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
7. Let Us C By Yashwant P. Kanetkar.
8. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson
   Addison-Wesley, 2006.
9. Programming in C by Kochan Stephen G. Pearson Education – 2015.
10. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New AgeInternational Publication.
11. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication.
12. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
13. Computer Fundamentals and Programming in C. ReemaThareja, Oxford Publication
14. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House

Programming for Problem Solving Lab

Other Reference:-

1. Use C Open Source Software referring Spoken Tutorial MOOC

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula C/5=(F-32)/9.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:

Between 90-100%----------Print 'A'

80-90%----------Print 'B'

60-80%----------Print 'C'

Below 60%----------Print 'D'

11. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
12. WAP to print the sum of all numbers up to a given number.
13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the entered number.
18. WAP to find the reverse of a number.

19. WAP to print Armstrong numbers from 1 to 100.

20. WAP to convert binary number into decimal number and vice versa.

21. WAP that simply takes elements of the array from the user and finds the sum of these elements.

22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.

23. WAP to find the minimum and maximum element of the array.

24. WAP to search an element in a array using Linear Search.

25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.

26. WAP to add and multiply two matrices of order nxn.

27. WAP that finds the sum of diagonal elements of a mxn matrix.

28. WAP to implement strlen (), strcat (),strcpy () using the concept of Functions.

29. Define a structure data type TRAIN_INFO. The type contain Train No.: integer type Train name: string Departure Time: aggregate type TIME Arrival Time: aggregate type TIME Start station: string End station: string The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:

(i) List all the trains (sorted according to train number) that depart from a particular section.

(ii) List all the trains that depart from a particular station at a particular time.

(iii) List all he trains that depart from a particular station within the next one hour of a given time.

(iv) List all the trains between a pair of start station and end station.

30. WAP to swap two elements using the concept of pointers.

31. WAP to compare the contents of two files and determine whether they are same or not.

32. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

COURSE OUTCOMES

1. To write programs for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To write programs for conditional branching, iteration and recursion.
4. To write programs using functions and synthesize a complete program using divide and conquer approach.
5. write programs using arrays, pointers and structures.

Engineering Graphics and Design

Module 1: Introduction to Engineering Drawing, Orthographic Projections [08]

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales
Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.

Module 2: Projections and Sections of Regular Solids [08]

Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans the include: windows, doors and fixtures such as WC, Both, sink, shower, etc.
Prism, Cylinder, Pyramid, Cone – Auxiliary Vies: Development of surfaces of Right Regular Solids – Prism, Pyramid, Cylinder and Cone.

Module 3: Isometric Projections [08]

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.

Module 4: Computer Graphics [08]

Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Baekground, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];
Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles:
Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to pater using the print command: orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective,

isometric, Multiview, auxiliary, and section views. Spatial visualization exercises Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling:

Module 5: Demonstration of a simple team design project

[08]

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Course Outcomes

1: Understanding of the visual aspects of engineering design
2: Understanding of engineering graphics standards and solid modelling
3: Effective communication through graphics
4: Applying modern engineering tools necessary for engineering practice
5: Appling computer-aided geometric design
6: Analysis of Isometric views
7: Creating working drawings

Suggested Text/ Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.
(ii) Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(iii) Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication
(iv) Engineering Graphics & Design, A.P. Gautam & Pradeep Jain, Khanna Publishing House
(v) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
(vi) (Corresponding set of) CAD Software Theory and User Manuals.

WORKSHOP PRACTICE

LIST OF EXPERIMENTS

Machine shop:

- Study of machine tools in particular Lathe machine
- Demonstration of different operations on Lathe machine
- Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting.
- Study of Quick return mechanism of Shaper.

Fitting shop:

- Preparation of T-Shape Work piece as per the given specifications.
- Preparation of U-Shape Work piece which contains: Filing, Sawing, Drilling, Grinding.
- Practice marking operations.

Carpentry:

- Study of Carpentry Tools, Equipment and different joints.
- Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

Electrical & Electronics

- Introduction to House wiring, different types of cables. Types of power supply, types of motors, Starters, distribution of power supply, types of bulbs, parts of tube light, Electrical wiring symbols.
- Soldering and desoldering of Resistor in PCB.
- Soldering and desoldering of IC in PCB.
- Soldering and desoldering of Capacitor in PCB

Welding:

- Instruction of BI standards and reading of welding drawings.
- Butt Joint
- Lap Joint
- TIG Welding
- MIG Welding

Casting:

- introduction to casting processes

Smithy

- Sharpening any arc and edge.
- Preparing small arc and edge,
- Repair of agricultural implements and power plough, use of power hammer etc.

Plastic Moulding& Glass Cutting

- Introduction to Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes
- Demo of mould preparation
- Practice – Preparation of mould
- Glass cutting

COURSE OUTCOMES

1. Study and practice on machine tools and their operations
2. Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
3. Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping
4. Welding and soldering operations
5. Apply basic electrical engineering knowledge for house wiring practice

Text Books:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. JeyapoovanT.and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008.

SEMESTER - II

PHYSICS

Module - 1 Relativistic Mechanics: [8]

Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle.

Module- 2 Electromagnetic Field Theory: [8]

Continuity equation for current density, Displacement current, Modifying equation for the curl of magnetic field to satisfy continuity equation, Maxwell's equations in vacuum and in non conducting medium, Energy in an electromagnetic field, Poynting vector and Poynting theorem, Plane electromagnetic waves in vacuum and their transverse nature. Relation between electric and magnetic fields of an electromagnetic wave, Energy and momentum carried by electromagnetic waves, Resultant pressure, Skin depth.

Module- 3 Quantum Mechanics: [8]

Black body radiation, Stefan's law, Wien's law, Rayleigh-Jeans law and Planck's law, Wave particle duality, Matter waves, Time-dependent and time-independent Schrodinger wave equation, Born interpretation of wave function, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton effect.

Module- 4 Wave Optics: [10]

Coherent sources, Interference in uniform and wedge shaped thin films, Necessity of extended sources, Newton's Rings and its applications. Fraunhoffer diffraction at single slit and at double slit, absent spectra, Diffraction grating, Spectra with grating, Dispersive power, Resolving power of grating, Rayleigh's criterion of resolution, Resolving power of grating.

Module- 5Fibre Optics & Laser: [10]

Fibre Optics**:** Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres.

Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

Course Outcomes:

1. To solve the classical and wave mechanics problems
2. To develop the understanding of laws of thermodynamics and their application in various processes
3. To formulate and solve the engineering problems on Electromagnetism & Electromagnetic Field Theory
4. To aware of limits of classical physics & to apply the ideas in solving the problems in their parent streams

Reference Books:

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Optics - Brijlal& Subramanian (S. Chand)
4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)
5. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
6. Engineering Physics-Malik HK and Singh AK (McGrawHill)

PHYSICS LAB

List of Experiments (Any ten experiments (at least four from each group).

Group A

11. To determine the wavelength of sodium light by Newton's ring experiment.
12. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
13. To determine the specific rotation of cane sugar solution using polarimeter.
14. To determine the focal length of the combination of two lenses separated by a distance and verify the formula for the focal length of combination of lenses.
15. To measure attenuation in an optical fiber.
16. To determine the wavelength of He-Ne laser light using single slit diffraction.
17. To study the polarization of light using He-Ne laser light.
18. To determine the wavelength of sodium light with the help of Fresnel's bi-prism.
19. To determine the coefficient of viscosity of a given liquid.
20. To determine the value of acceleration due to gravity (g) using compound pendulum.

Group B

11. To determine the energy band gap of a given semiconductor material.
12. To study Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall effect setup.
13. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
14. To verify Stefan's law by electric method.
15. To determine resistance per unit length and specific resistance of a given resistance using Carey Foster's Bridge.
16. To study the resonance condition of a series LCR circuit.
17. To determine the electrochemical equivalent (ECE) of copper.
18. To calibrate the given ammeter and voltmeter by potentiometer.
19. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.
20. To measure high resistance by leakage method.

Course Outcomes:

1. To determine the wavelength of sodium light by Newton's ring experiment
2. To determine the wavelength of sodium light with the help of Fresnel's bi-prism
3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
4. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.

Reference Books

1. Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)
2. Engineering Physics-Theory and Practical- Katiyar& Pandey (Wiley India)
3. Engineering Physics Practical- S K Gupta (KrishnaPrakashan Meerut)

CHEMISTRY

Module-1 **[08]**

Atomic and Molecular Structure:

Molecular orbital's of diatomic molecules. Band theory of solids. Liquid crystal and its applications. Point defects in solids. Structure and applications of Graphite and Fullerenes. Concepts of Nanomaterials and its application.

Module-2 **[08]**

Spectroscopic techniques and Applications:

Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet& Visible and Raman spectroscopy.

Module-3 **[08]**

Electrochemistry

Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and ΔS). Lead storage battery.

Corrosion; causes, effects and its prevention.

Phase Rule and its application to water system.

Module-4 **[08]**

Water Analysis; Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method).

Fuels: classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeterand Dulong'smethos).

Module-5 **[08]**

Polymer; Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications.

Course Outcomes:

1. Get an understanding of the theoretical principles understanding molecular structure, bonding and properties.
2. Know the fundamental concepts of determination of structure with various techniques.
3. Know the fundamental concepts of chemistry applicable in industrial processes.

Reference Books:

1. University Chemistry By B.H. Mahan
2. University Chemistry By C.N.R. Rao
3. Organic Chemistry By I.L. Finar
4. Physical Chemistry By S. Glasstone
5. Engineering Chemistry By S.S. Dara
6. Polymer Chemistry ByFre W., Billmeyer
7. Engineering Chemistry By Satya Prakash

CHEMISTRY- PRACTICAL

LIST OF EXPERIMENTS

13. Determination of alkalinity in the given water sample.
14. Determination of temporary and permanent hardness in water sample using EDTA.
15. Determination of iron content in the given solution by Mohr's method.
16. Determination of viscosity of given liquid.
17. Determination of surface tension of given liquid.
18. Determination of chloride content in water sample.
19. Determination of available chlorine in bleaching powder.
20. Determination of pH by pH-metric titration.
21. Preparation of Phenol-formaldehyde and Urea-formaldehyde resin.
22. Determination of Cell constant and conductance of a solution.
23. Determination of rate constant of hydrolysis of esters.
24. Verification of Beer's law.

NOTE: Choice of any 10 experiments from the above. Institute can change any 02 experiments from the aforesaid experiments.

Course Outcomes:

1. Use of different analytical instruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measure hardness of water.
7. Estimate the rate constant of reaction.

Elementary Mathematics-II

(B. Tech. Biotechnology Engineering)

Module 1: Integrals [8]

Integration of functions by substitution, partial fractions and by parts, only simple integrals of the type to be evaluated. Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals. Applications of the Integrals: Applications in finding the area between simple curves, especially lines, areas of circles/parabolas/ellipses (in standard form only).

Module 2: Differential Equations [8]

Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables, homogeneous differential equations of first order, and first degree. Solutions of linear differential equation of the type: $\frac{dy}{dx} + py = q$, where p and q are functions of x.

Module 3: Vector Algebra [8]

Vectors and scalars, magnitude and direction of a vector. Directioncosines/ratios of vectors. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar (dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors.

Module 4: Three-Dimensional Geometry [8]

Three – dimensional Geometry: Direction cosines / ratios of a line joining two points**.** Cartesian equation of a line, coplanar lines, shortest distance between two lines. Cartesian equation of a plane, Angle between (a) two lines (b) two planes and (c) a line and a plane. Distance of a point from a plane.

Module 5: Probability [8]

Exhaustive events, Randomexperiments, trial and events, equally likely events, independent events, mutually exclusive events, compound events, favorable events, definition of probability, Axioms of probability, Addition theorem of probability with examples, Multiplication theorem of probability with illustrate examples. Conditional probability, Bay's theorem with examples.

COURSE OUTCOMES

1. Apply the concept of integration to evaluate integrals and apply for finding definite integrals.
2. Understand the concept of differentiation and apply for finding the solution of differential equations.
3. Understand the concept of vector and apply for finding direction cosines, projection of vector on a line.

4. Apply the concept of three-dimensional geometry to find the shortest distance between two lines. Also apply for finding coplanar lines and Cartesian equation of a line.
5. Apply the probability to evaluate addition, multiplication and conditional law of probability

Recommended Textbooks.

1) Mathematics - Textbook for Class XI, NCERT Publication
2) Mathematics Part I - Textbook for Class XII, NCERT Publication
3) Mathematics Part II - Textbook for Class XII, NCERT Publication

Reference books:

1) B.V. Ramana: Higher engineering mathematics (Tata Macgraw Hill)
2) Glynjames :Advanced modern engineering mathematics (Pearson education)

Remedial Biology-II

(B. Tech. Biotechnology Engineering)

Module-1: **[8]**

Brief history of microbiology, Types of microorganisms, Basic idea of domain bacteria, proteobacteria, non proteobacteria Gram –ve and Gram +ve bacteria, lichens, algae, protozoa, helminthes, viral structures, viral multiplication, Role of microorganisms in the production of industrial chemicals and pharmaceuticals.

Module-2: **[8]**

Functional Anatomy of Prokaryotic and Eukaryotic Cells: Size, shape, and arrangement of bacterial cells. Structure and function of cells.

Module-3: **[8]**

Catabolic & anabolic reactions: enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, Energy production mechanism, metabolic diversity & pathways of energy use. Integration of metabolism.

Module-4: **[8]**

Energy Utilization: Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, formation of acetyl co-A, Kreb cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration.

Module-5: **[8]**

Reproductive health and human welfare: Population and birth control, sexually transmitted diseases, infertility, Cancer and AIDS, Basic concepts of immunology, vaccines.

COURSE OUTCOMES

1. To know the basic idea of Microbiology
2. To Understand the functional Anatomy of Cells
3. To know the energy production mechanism
4. To understand the energy utilization.
5. Reproductive health and human welfare

Recommended Text Book:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication
3. Microbiology- Pelzar, Tata Mcgraw- Hill Publishing Com. Ltd., 2002
4. An introduction to immunology by C.V. Rao, Narosa publishing house

Reference Book:

Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)
General Microbiology: Stainier, Adelberq and Ingraham.

BASIC ELECTRICAL ENGINEERING

Module - 1: DC Circuits **[08]**

Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Superposition theorem, Thevenin theorem, Norton theorem.

Module - 2: Steady- State Analysis of Single Phase AC Circuits **[10]**

Representation of Sinusoidal waveforms – Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current.

Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor.

Three phase balanced circuits, voltage and current relations in star and delta connections.

Module - 3 : Transformers **[08]**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module –4 : Electrical machines **[08]**

DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Module –5 : Electrical Installations **[06]**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries.Elementary calculations for energy consumption and savings, battery backup.

COURSE OUTCOMES

1. Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2. Analyze the steady state behavior of single phase and three phase AC electrical circuits.
3. Identify the application areas of a single phase two winding transformer as well as an auto transformer and calculate their efficiency. Also identify the connections of a three phase transformer.
4. Illustrate the working principles of induction motor, synchronous machine as well as DC machine and employ them in different area of applications.
5. Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Spoken Tutorial (MOOCs):

1. AC DC Circuit Analysis using NgSpice, Open Source Software (http://spoken-tutorial.org)

Text Books:

1. Ritu Sahdev, "Basic Electrical Engineering", Khanna Publishing House.

2. S. Singh, P.V. Prasad, "Electrical Engineering: Concepts and Applications" Cengage.

3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill.

4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill.

Reference Books:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

2. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press.

3. V. D. Toro, "Electrical Engineering Fundamentals", Pearson India.

BASIC ELECTRICAL ENGINEERING LABORATORY

LIST OF EXPERIMENTS

Note: A minimum of ten experiments from the following should be performed.

1. Verification of Kirchhoff's laws
2. Verification of Superposition and Thevenin Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Connection and measurement of power consumption of a fluorescent lamp (tube light).
6. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
7. Determination of parameters of ac single phase series RLC circuit
8. To observe the B-H loop of a ferromagnetic material in CRO.
9. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
10. Determination of efficiency of a dc shunt motor by load test
11. To study running and speed reversal of a three phase induction motor and record speed in both directions.
12. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

COURSE OUTCOMES

1. Conduct experiments illustrating the application of KVL/KCL and network theorems to DC electrical circuits.
2. Demonstrate the behavior of AC circuits connected to single phase AC supply and measure power in single phase as well as three phase electrical circuits.
3. Perform experiment illustrating BH curve of magnetic materials.
4. Calculate efficiency of a single phase transformer and DC machine.
5. Perform experiments on speed measurement and reversal of direction of three phase induction motor and Identify the type of DC and AC machines based on their construction.

Programming for Problem Solving

Module – 1 : **(Introduction to Programming)** **[08]**

Introduction to components of a computer system: Memory, processor, I/O Devices, storage, operating system, Concept of assembler, compiler, interpreter, loader and linker.

Idea of Algorithm: Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code.

Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C, Fundamental data types, Variables and memory locations, Storage classes.

Module – 2 : **(Arithmetic expressions & Conditional Branching)** **[08]**

Arithmetic expressions and precedence: Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity.

Conditional Branching: Applying if and switch statements, nesting if and else, use of break and default with switch.

Module – 3 : **(Loops & Functions)** **[08]**

Iteration and loops: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

Functions: Introduction, types of functions, functions with array, passing parameters to functions, call by value, call by reference, recursive functions.

Module – 4 : **(Arrays & Basic Algorithms)** **[08]**

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, Passing arrays to functions.

Basic Algorithms: Searching &Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, Notion of order of complexity.

Module – 5 :**(Pointer & File Handling)** **[08]**

Pointers: Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (no implementation)

File handling: File I/O functions, Standard C preprocessors, defining and calling macros, command-line arguments.

COURSE OUTCOMES

1. To develop simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To implement conditional branching, iteration and recursion.
4. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
5. To use arrays, pointers and structures to develop algorithms and programs.

Text books:

1. Schum's Outline of Programming with C by Byron Gottfried, McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education.
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
5. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
6. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
7. Let Us C By Yashwant P. Kanetkar.
8. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson
   Addison-Wesley, 2006.
9. Programming in C by Kochan Stephen G. Pearson Education – 2015.
10. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New AgeInternational Publication.
11. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication.
12. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
13. Computer Fundamentals and Programming in C. ReemaThareja, Oxford Publication
14. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House

Programming for Problem Solving Lab

Other Reference:-

1. Use C Open Source Software referring Spoken Tutorial MOOC

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula C/5=(F-32)/9.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:

Between 90-100%----------Print 'A'

80-90%----------Print 'B'

60-80%----------Print 'C'

Below 60%----------Print 'D'

11. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
12. WAP to print the sum of all numbers up to a given number.
13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the entered number.
18. WAP to find the reverse of a number.
19. WAP to print Armstrong numbers from 1 to 100.

20. WAP to convert binary number into decimal number and vice versa.

21. WAP that simply takes elements of the array from the user and finds the sum of these elements.

22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.

23. WAP to find the minimum and maximum element of the array.

24. WAP to search an element in a array using Linear Search.

25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.

26. WAP to add and multiply two matrices of order nxn.

27. WAP that finds the sum of diagonal elements of a mxn matrix.

28. WAP to implement strlen (), strcat (),strcpy () using the concept of Functions.

29. Define a structure data type TRAIN_INFO. The type contain Train No.: integer type Train name: string Departure Time: aggregate type TIME Arrival Time: aggregate type TIME Start station: string End station: string The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:

(i) List all the trains (sorted according to train number) that depart from a particular section.

(ii) List all the trains that depart from a particular station at a particular time.

(iii) List all he trains that depart from a particular station within the next one hour of a given time.

(iv) List all the trains between a pair of start station and end station.

30. WAP to swap two elements using the concept of pointers.

31. WAP to compare the contents of two files and determine whether they are same or not.

32. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

COURSE OUTCOMES

1. To write programs for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To write programs for conditional branching, iteration and recursion.
4. To write programs using functions and synthesize a complete program using divide and conquer approach.
5. write programs using arrays, pointers and structures.

Engineering Graphics and Design

Module 1: Introduction to Engineering Drawing, Orthographic Projections:
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales
Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.

Module 2: Projections and Sections of Regular Solids
Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans the include: windows, doors and fixtures such as WC, Both, sink, shower, etc.
Prism, Cylinder, Pyramid, Cone – Auxiliary Vies: Development of surfaces of Right Regular Solids – Prism, Pyramid, Cylinder and Cone.

Module 3: Isometric Projections:
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.

Module 4: Computer Graphics:
Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Baekground, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];
Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles:
Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to pater using the print command: orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling:

Module 5: Demonstration of a simple team design project:
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour

coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Suggested Text/ Reference Books:

(vii) Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.
(viii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(ix) Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication
(x) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
(xi) (Corresponding set of) CAD Software Theory and User Manuals.

Course Outcomes

1: Understanding of the visual aspects of engineering design
2: Understanding of engineering graphics standards and solid modelling
3: Effective communication through graphics
4: Applying modern engineering tools necessary for engineering practice
5: Appling computer-aided geometric design
6: Analysis of Isometric views
7: Creating working drawings

Suggested Text/ Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.
(ii) Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(iii) Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication
(iv) Engineering Graphics & Design, A.P. Gautam & Pradeep Jain, Khanna Publishing House
(v) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
(vi) (Corresponding set of) CAD Software Theory and User Manuals.

WORKSHOP PRACTICE

LIST OF EXPERIMENTS

Machine shop:

- Study of machine tools in particular Lathe machine
- Demonstration of different operations on Lathe machine
- Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting.
- Study of Quick return mechanism of Shaper.

Fitting shop:

- Preparation of T-Shape Work piece as per the given specifications.
- Preparation of U-Shape Work piece which contains: Filing, Sawing, Drilling, Grinding.
- Practice marking operations.

Carpentry:

- Study of Carpentry Tools, Equipment and different joints.
- Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

Electrical & Electronics

- Introduction to House wiring, different types of cables. Types of power supply, types of motors, Starters, distribution of power supply, types of bulbs, parts of tube light, Electrical wiring symbols.
- Soldering and desoldering of Resistor in PCB.
- Soldering and desoldering of IC in PCB.
- Soldering and desoldering of Capacitor in PCB

Welding:

- Instruction of BI standards and reading of welding drawings.
- Butt Joint
- Lap Joint
- TIG Welding
- MIG Welding

Casting:

- introduction to casting processes

Smithy

- Sharpening any arc and edge.
- Preparing small arc and edge,
- Repair of agricultural implements and power plough, use of power hammer etc.

Plastic Moulding& Glass Cutting

- Introduction to Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes
- Demo of mould preparation
- Practice – Preparation of mould
- Glass cutting

COURSE OUTCOMES

1. Study and practice on machine tools and their operations
2. Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
3. Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping
4. Welding and soldering operations
5. Apply basic electrical engineering knowledge for house wiring practice

Text Books:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. JeyapoovanT.and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008.

PROFESSIONAL ENGLISH

Module 1- Basics of Technical English:

Technical English: Definition; Extent& Coverage; Dimensions; Reading; Skimming; Scanning; Churning & Assimilation; Writing: Methods: Inductive; Deductive; Exposition; Linear; Interrupted; Spatial & Chronological etc; Technical Communication; Approaches: Brevity; Objectivity; Simplicity; Utility & Clarity. **Listening**: Active; Passive; Thinking strategies: Positive & Logical thinking; Speaking: Essentials Nuances & Modes of Speech Delivery.

Module 2- Components of Technical Writing:

Vocabulary Building: Select words; Concept of word formation; Word formation; Root words from foreign languages & their use in English; Prefixes & Suffixes: Derivatives; Synonyms; Antonyms; Abbreviations. Homophones. One word substitutes; Requisites of Sentences.

Module 3- Basic Technical Writing Skills:

Forms: Business writing: Principle; Purchase & Sales Letters; Drafts; Official Writing: Official Letter; D.O. Letter; Notices; Agenda; Minutes of Meeting; Sentence Structure; Phrases & Clauses in sentences; Coherence; Unity; Emphasis in Writing; Devices; Use of Writing methods in Documents; Techniques of writing.

Module 4- Common Grammatical Errors & Technical Style:

Subject-verb agreement; Correct usage: Noun; Pronoun; Agreement; Modifiers; Articles; Prepositions; Cliches; Redundancies; Technical Style: Features; Choice of words; Sentences: Descriptive; Narrative; Expository; Defining & Classifying; Length of paragraph; Writing of Introduction & Conclusion.

Module 5- Presentation Strategies & Oral Communications:

Analysis of locale; Audience; Modulating Style & Content; Speaking with confidence; Kinesics; Paralinguistic features of Voice-Dynamics: Pitch; Intonation; Stress & Rhythm; Conversation & dialogues; Communication at work-place; etc.

COURSE OUTCOMES

1. Students will be enabled to **understand** the basic objective of the course by being acquainted with specific dimensions of communication skills i.e. Reading, Writing, Listening, Thinking and Speaking.

2. Students would be able to **create** substantial base by the formation of strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading, writing and speaking etc.

3. Students will **apply** it at their work place for writing purposes such as Presentation/official drafting/administrative communication and use it for document/project/report/research paper writing.

4. Students will be made to **evaluate** the correct & error-free writing by being well-versed in rules of English grammar & cultivate relevant technical style of communication & presentation at their work place & also for academic uses.

5. Students will **apply** it forpractical and oral presentation purposes by being honed up in presentation skills and voice-dynamics. They will apply techniques for developing inter-personal communication skills and positive attitude leading to their professional competence.

Text Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.

Reference Books:

1. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. & Distributors, 2009, Delhi.
2. Manual of Practical Communication by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
3. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
4. English Grammar, Composition and Usage by N.K.Agrawal&F.T.Wood, Macmillan India Ltd., New Delhi.
5. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House
6. English Grammar & Composition by Wren & Martin, S.Chand& Co. Ltd., New Delhi.
7. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
8. Personality Development, Harold R. Wallace &L.Ann Masters, Cengage Learning, New Delhi
9. Personality Development & Soft Skills, BarunK.Mitra, Oxford University Press, 2012 New Delhi.
10. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
11. Developing Communication Skills by Krishna Mohan, MeeraBannerji- Macmillan India Ltd. 1990, Delhi.
12. Spoken English- A manual of Speech and Phonetics by R.K.Bansal&J.B.Harrison, Orient Blackswan, 2013, New Delhi.
13. Business English by Ken Taylor, Orient Blackswan, 2011, New Delhi.

AICTE B.Tech. Model Curriculum Structure

SEMESTER- III — **Annexure-B(i)**

Sl. No.	Subject Codes	Subject	Periods L	T	P	Evaluation Scheme CT	TA	Total	PS	End Semester TE	PE	Total	Credit
1		Engineering Science Course [ESC]/(Maths-III/ Maths-IV/ Maths-V)	3	1	0	30	20	50		100		150	4
2		Technical Communication/Universal Human Values and Professional Ethics	2 3	1 0	0 0	30	20	50		100		150	3
3		Departmental Course - 1	3	1	0	30	20	50		100		150	4
4		Departmental Course - 2	3	1	0	30	20	50		100		150	4
5		Departmental Course - 3	3	0	0	30	20	50		100		150	3
6		LAB-1	0	0	2				25		25	50	1
7		LAB-2	0	0	2				25		25	50	1
8		LAB-3	0	0	2				25		25	50	1
9		Mini Project or Internship Assessment*	0	0	2			50				50	1
10	NC+	Computer System Security/Python Programming	2	0	0	15	10	25		50			
11		MOOCs (Essential for Hons. Degree)											
		Total										**950**	**22**

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

SEMESTER- IV

Sl. No.	Subject Codes	Subject	Periods L	T	P	Evaluation Scheme CT	TA	Total	PS	End Semester TE	PE	Total	Credit
1		(Maths-III/ Maths-IV / Maths-V) /Engineering Science Course [ESC]	3	1	0	30	20	50		100		150	4
2		Universal Human Values and Professional Ethics/Technical Communication	3 2	0 1	0 0	30	20	50		100		150	3
3		Departmental Course - 4	3	0	0	30	20	50		100		150	3
4		Departmental Course - 5	3	1	0	30	20	50		100		150	4
5		Departmental Course - 6	3	1	0	30	20	50		100		150	4
6		LAB-1	0	0	2				25		25	50	1
7		LAB-2	0	0	2				25		25	50	1
8		LAB-3	0	0	2				25		25	50	1
9	NC+	Python Programming/ Computer System Security	2	0	0	15	10	25		50			
10		MOOCs (Essential for Hons. Degree)											
		Total										**900**	**21**

SEMESTER- V

Sl. No.	Subject Codes	Subject	Periods L	T	P	Evaluation Scheme CT	TA	Total	PS	End Semester TE	PE	Total	Credit
1		Departmental Course - 7	3	1	0	30	20	50		100		150	4
2		Departmental Course - 8	3	1	0	30	20	50		100		150	4
3		Departmental Course - 9	3	1	0	30	20	50		100		150	4
4		Departmental Elective-I	3	0	0	30	20	50		100		150	3
5		Departmental Elective-II	3	0	0	30	20	50		100		150	3
6		LAB-1	0	0	2				25		25	50	1
7		LAB-2	0	0	2				25		25	50	1
8		LAB-3	0	0	2				25		25	50	1
9		Mini Project or Internship Assessment*	0	0	2				50			50	1
10	NC+	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	15	10	25		50			
11		MOOCs (Essential for Hons. Degree)											
		Total	**17**	**3**	**8**							**950**	**22**

*The Mini Project or internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.

SEMESTER- VI

Sl. No.	Subject Codes	Subject	Periods L	T	P	Evaluation Scheme CT	TA	Total	PS	End Semester TE	PE	Total	Credit
1		Departmental Course - 10	3	1	0	30	20	50		100		150	4
2		Departmental Course - 11	3	1	0	30	20	50		100		150	4
3		Departmental Course - 12	3	1	0	30	20	50		100		150	4
4		Departmental Elective-III	3	0	0	30	20	50		100		150	3
5		Open Elective-I	3	0	0	30	20	50		100		150	3
6		LAB-1	0	0	2				25		25	50	1
7		LAB-2	0	0	2				25		25	50	1
8		LAB-3	0	0	2				25		25	50	1
9	NC+	Essence of Indian Traditional Knowledge/Constitution of India	2	0	0	15	10	25		50			
10		MOOCs (Essential for Hons. Degree)											
		Total	**0**	**3**	**6**							**900**	**21**

SEMESTER- VII

Sl. No.	Subject Codes	Subject	Periods L	T	P	Evaluation Scheme CT	TA	Total	PS	End Semester TE	PE	Total	Credit
1		HSMC -1 #/ HSMC-2 #	3	0	0	30	20	50		100		150	3
2		Departmental Elective-IV	3	0	0	30	20	50		100		150	3
3		Departmental Elective-V	3	0	0	30	20	50		100		150	3
4		Open Elective-II	3	0	0	30	20	50		100		150	3
5		LAB-1	0	0	2				25		25	50	1
6		Mini Project or Internship Assessment*	0	0	2				50			50	1
7		Project	0	0	8				150			150	4
8		MOOCs (Essential for Hons. Degree)											
		Total	**12**	**0**	**12**							**850**	**18**

*The Mini Project or internship (4 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.

SEMESTER- VIII

Sl. No.	Subject Codes	Subject	Periods L	T	P	Evaluation Scheme CT	TA	Total	PS	End Semester TE	PE	Total	Credit
1		HSMC-2#/HSMC-1#	3	0	0	30	20	50		100		150	3
2		Open Elective-III	3	0	0	30	20	50		100		150	3
3		Open Elective-IV	3	0	0	30	20	50		100		150	3
4		Project	0	0	18				100		300	400	9

5		MOOCs (Essential for Hons. Degree)											
		Total	**9**	**0**	**18**							**850**	**18**
												5400	**122**
#	HSMC-Humanties & Social Science including Managent Courses							**First Year Credit & Marks**				**1350**	**38**
+	Non Credit Course							**Total**				**6750**	**160**
$	Maths-III [Transform & Discrete] - To be offered to CE and allied branches												
$	Maths-IV [PDE & P&S]-To be offered to CSE, EE,EC,CH,ME,TX and allied branches												
$	Maths-V - To be offered to BT, AG and allied branches												

		Mother Branch	**Allied branches**
		Mechanical Engg. (ME)	Mechanical, Automobile, Aeronautical, Manufacturing Technology,
	1		Mechanical & Industrial, Plastic, Production, Industrial & Production Engg.
	2	Civil Engg. (CE)	Civil, Environmental Engg
	5	Electrical Engineering (EE)	Electrical, Electrical & Electronics Engg.
	6	Computer Science and Engg.(CSE)	Computer Science, Computer Science and Information Technology
			Computer Science Engg, Information Technology
	7	Electronics and Communication Engg.(ECE)	Biomedical , Electronics, Electronics and Communication,Electronics and Telecomunication,
			Electronics & Instrumentation , Instrumentation & Control, Electronics and Computer
			Applied Electronics & Instrumentation, Instumentation Engineering,
	8	Chemical Engg. (CH)	Chemical, Food Technology, Textile Chemistry, Textile Technology, Carpet & Textile Tech.

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

Evaluation Scheme & Syllabus

For

B.Tech. 2nd Year

(Bio Technology)

On

AICTE MODEL CURRICULUM

(Effective from the Session: 2019-20)

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

B.TECH (BIOTECHNOLOGY)

SEMESTER- III

Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KOE031-38/ KAS304	Engineering Science Course/Maths V	3	1	0	30	20	50		100		150	4
2	KAS301/ KVE 301	Technical Communication/Universal Human values	2 3	1 0	0 0	30	20	50		100		150	3
3	KBT301	Techniques in Biotechnology	3	1	0	30	20	50		100		150	4
4	KBT302	Microbiology & Immunology	3	1	0	30	20	50		100		150	4
5	KBT303	Biochemistry	3	0	0	30	20	50		100		150	3
6	KBT351	Techniques in Biotechnology Lab	0	0	2				25		25	50	1
7	KBT352	Microbiology & Immunology Lab	0	0	2				25		25	50	1
8	KBT353	Biochemistry Lab	0	0	2				25		25	50	1
9	KBT354	Mini Project or Internship Assessment*	0	0	2			50				50	1
10	KNC301/ KNC302	Computer System Security/Python Programming	2	0	0	15	10	25		50			0
11		MOOCs (Essential for Hons. Degree)											
		Total										**950**	**22**

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

SEMESTER- IV													
Sl. No.	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KAS404/ KOE041-48	Maths V/Engineering Science Course	3	1	0	30	20	50		100		150	4
2	KVE401/ KAS401	Universal Human Values/ Technical Communication	3 2	0 1	0 0	30	20	50		100		150	3
3	KBT401	Bioprocess Engineering I	3	0	0	30	20	50		100		150	3
4	KBT402	Genetics & Molecular Biology	3	1	0	30	20	50		100		150	4
5	KBT403	Enzyme Engineering	3	1	0	30	20	50		100		150	4
6	KBT451	Bioprocess Engineering I Lab	0	0	2				25		25	50	1
7	KBT452	Genetics & Molecular Biology Lab	0	0	2				25		25	50	1
8	KBT453	Enzyme Engineering Lab	0	0	2				25		25	50	1
9	KNC402/ KNC401	Python Programming/Computer System Security	2	0	0	15	10	25		50			0
10		MOOCs (Essential for Hons. Degree)											
		Total										**900**	**21**

TECHNIQUES IN BIOTECHNOLOGY

L	T
3	1

UNIT I Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, Electron microscopy: TEM and SEM, Atomic force microscopy and con focal scanning laser microscopy. Differential interference contrast microscopy

UNIT II Principle and Operations of Chromatography, Thin layer chromatography, Ion Exchange Chromatography, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), Gel Filtration Chromatography, Affinity Chromatography.

UNIT III Electromagnetic radiation and spectrum,Atomic absorption and Atomic emission spectroscopy,Principle, working and applications of UV-VIS, NMR, ESR and IR spectrometer, Principle and applications of Mass Spectroscopy, Circular Dichorism (CD) principles, Principle and applications of Positron Emission Tomography(PET), Basics of X-Ray diffraction analysis and their application in biotechnology .

UNIT IV Theory of Electrophoresis, Factors affecting the migration of substances Gel electrophoresis, PAGE, SDS-PAGE, Agarose Electrophoresis of Nucleic Acid, Isoelectric Focusing of Protein Pulse Gel Electrophoresis and Western Blotting. Theory of centrifugation and sedimentation. Types of centrifuges, Preparative and analytical centrifugation; Density gradient centrifugation. Application of centrifugation for preparative and analytical purpose.

UNIT V Principles of 3-D printing, 3-D Bioprinting of tissues, organs and bacteria.Ideal material properties for bioprinting, Biosensors: Principles and definition, characteristics of Ideal biosensors, Biochemical components of biosensors:Enzyme based biocatalyst sensors, Bioaffinity systems, Immunosensors. Principle and working of Flow Cytometry and cell sorter.

Text Books and Reference Books

1. Wilson, K, Walker, J., Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.
2. Sabari Ghosal&Anupama Sharma Awasthi., Fundamentals of Bioanalytical Techniques and Instrumentation, PHI learning Second edition (2018)
3. Bioanalytical Techniques by A. Shourie and S S Chapadgaonkar. TERI Press. 2015
4. Immunoassay and Other Bioanalytical Techniques.Jeanette M. van Emon. CRC press. 2006
5. 3D Bioprinting in Regenerative Engineering: Principles and Applications, Ali Khademhosseini &Gulden Camci-Unal, CRC Press (2018)

MICROBIOLOGY AND IMMUNOLOGY

L	T
3	1

UNIT I

Morphology and Ultra structure of bacterial cell, Classification of bacteria, Culture media, Isolation of microbes and its identification, culture techniques, Preservation of cultures, Methods for the control of microbes. Enumeration of bacteria. Microbial growth kinetics.

UNIT II

Basic features of transduction, conjugation and transformation, Viruses: Classification and structure of viruses, Viral reproduction: lytic and lysogenic cycle, Overview of biological nitrogen fixation, Bacterial photosynthesis and electron transport system.

UNIT III

Introduction to immune system: Innate and Adaptive immunity, Humoral and Cell mediated immune response, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, T &B cell maturation and its activation , Characteristics and types of Antigens, Haptens, adjuvants and Epitopes, Antibodies: Structure, functions and characteristics of different classes of antibodies. Monoclonal antibodies.

UNIT IV

Antigen and antibody interactions, precipitation reactions , Serological techniques: ELISA, RIA and western blotting, Structure and Function of MHC molecules, Exogenous and Endogenous pathways of antigen processing and presentation, Overview of Complement system and cytokines, immune tolerance.

UNIT V

Applications of microbiology and Immunology: Mirobiology of domestic water and waste water. Microbes in bioremediation, Microbes of industrial use, Immunity against: Bacterial disease- tuberculosis, typhoid, Protozoan disease- Malaria, Amebieosis and Viral diseases - AIDS, Dengue, Chikungunya,Vaccine's, Hypersensitivity and Immunotherapy

Reference Books:

1. Microbiology by Pelczar (W C Brown publication)
2. Genral Microbiology by stainer (Mac Millan Publication)
3. Microbiology by Pawar and Dagniwala (Himalaya publishing House).
4. Immunology and immunotechnology by Ashim K. Chakravarty (Oxford university Press)
5. Immunology by C. Fatima 3. Immunology by Kuby (Free man publication)

BIOCHEMISTRY

L	T
3	1

UNIT I

Water - Structure, unusual properties, non-covalent interactions, role in biological processes. Ionization of Water, pH scale, Weak Acids, and Weak Bases. Buffers and buffering mechanism, Henderson Hasselbalch equation. Buffering against pH Changes in Biological Systems: Phosphate buffer, Bicarbonate buffer, Protein buffer, Amino acid Buffer & Hemoglobin Buffer System.

UNIT II

Carbohydrates – classification, structure and functions of monosaccharides, disaccharides and polysaccharides. Ring structure and mutarotation, stereo isomers and structural isomers. Metabolism – Glycolysis & oxidation of Pyruvate, TCA cycle, Gluconeogenesis, Pentose Phosphate Pathway, Oxidative phosphorylation, Disorder/ diseases of carbohydrate metabolism.

UNIT III

Fats and lipids – Classification, structure and function: Simple, Compound & Derived lipids, Essential fatty acids. Fatty acid synthesis, origin of acetyl-Co A for fat synthesis, Elongation & desaturation of Fatty Acids. Activation & transport of fatty acid from cytosol to mitochondria for oxidation. Oxidation of saturated & unsaturated fatty acids. β, α, ω oxidation. Formation and utilization of ketone bodies. Disorder/ diseases of lipid metabolism.

UNIT IV

Amino acids and proteins - Classification & structure of amino acids. Essential amino acids. Peptide bond formation, Ramachandran plot, Primary, secondary, tertiary & quaternary structure of proteins. Biosynthesis of amino acids from intermediates of Citric Acid Cycle & other major pathways. Biodegradation of amino acids: Deamination, transamination. Urea Cycle, Glucose-Alanine cycle. Disorder/ diseases of amino acids metabolism.

UNIT V

Purines and pyrimidines – Structure and properties. Metabolism of Nucleotides: Purines & Pyrimidines synthesis : de Novo & salvage pathway, Conversion of nucleoside monophosphates to nucleoside triphosphates, Formation of deoxyribonucleotides. Catabolism & salvage of Purine and Pyrimidine nucleotides. Disorder of purines and pyrimidines metabolism.

Text books:

1. Principles of Biochemistry: A.L. Lehninger, Nelson and Cox, McMillan Worth Publishers.
2. Harper's Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange. Medical Books. 25th edition.
3. Biochemistry : S.C. Rastogi – Third Edition ; Tata McGraw Hill Education Pvt. Ltd. New Delhi.

Reference books & web sources:

1. Biochemistry: Stryer, W. H. Freeman
2. Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA
3. Biochemistry: Zubey, WCB.
4. Biochemistry: Garrett and Grisham, Harcourt.

TECHNIQUES IN BIOTECHNOLOGY LAB P 2

1. Demonstration of basic concept of precision and accuracy using appropriate experimental data

2. Study of Beer-Lambert's law-using UV-Visible spectrophotometer.

3. To study principle and working of laboratory microscope.

4. To analyze the isolated plant pigments using paper chromatography.

5. Separation of amino acids using thin layer chromatography.

6. Separation of a mixture of polar and non polar compounds using column chromatographic technique.

7. To study and analysis of DNA sample by agarose gel electrophoresis.

8. To study and analysis of protein sample by SDS- PAGE

9. To study the separation of compounds using liquid-liquid extraction experiments.

10. To study the separation of biological compounds using various membrane separation.

Reference book:

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis: Saroj Dua And Neera Garg: Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques : ML Srivastava; Narosa Publishing House, New Delhi.

MICROBIOLOGY& IMMUNOLOGY LAB P 2

1. Preparation of nutrient agar slants, plates and nutrient broth and their sterilization. (Microwave Oven, Heating mantles, Fridge, Heating Oven, Tube racks)
2. Inoculation of agar slants, agar plate and nutrient broth (Incubators, Water bath, Laminar hood, dry heat sterilizer i.e. bead sterilizer)
3. Culture of microorganisms using various techniques. (Shakers i.e. Cooling and Open shaker).
4. Simple and differential staining procedures, endospore staining, flageller staining, cell wallstaining, capsular staining, negative staining. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
5. Bacterial colony counting. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
7. Isolation of microbes from soil samples and determination of the number of colony forming units. (U.V. spectrophotometer, Colony counter etc.)
8. To determine the blood group and Rh of given blood sample.
9. To perform single radial immunodiffusion anddouble immunodiffusion
10. To perform rocket immune electrophoresis
11. To perform counter current immune electrophoresis
12. To perform ELISA

Practical Books and References

1. Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.).

BIOCHEMISTRY LAB

P
2

1. Preparation of solutions: 1)percentage solutions, 2) molar solutions, 3) normal solutions
2. Spectroscopy: determination of absorption maxima (λmax) of a given solution
3. Titration of weak acid-weak base
4. Quantitative estimation of carbohydrates
5. Distinguish reducing and non-reducing sugars
6. Quantitative estimation of proteins
7. Estimation of nucleic acids
8. Isoelectric precipitation
9. Separation of sugars, fatty acids and amino acids by paper chromatography
10. Extraction of lipids from plant material
11. Thin layer chromatography
12. Gel electrophoresis

Reference books

1. Wilson and Walker, “Principles and Techniques of Practical Biochemistry”, 4 Edn., Cambridge Knew pros 1997.
2. Plummer DT, “An Introduction to Practical Biochemistry”, III Edn., Tata McGraw hill.

Semester -IV

Bioprocess Engineering –I

L
3

Unit I: Fluid Properties: Viscosity, Newton's Law of viscosity, Kinematic Viscosity, Rheological Diagram, Euler Equation and its application, Derivation of Bernoulli Equation from Euler Equation, Applications of Bernoulli's Theorem, Pascal's Law, Hydrostatic Law. Measurement of Pressure: Definition of Gauge and & Absolute Pressure, Barometer, Various Manometers (Peizometer, U-tube manometer, Single column manometers, U-tube & Inverted U-tube differential manometers) & their industrial applications. (10)

Unit II: Flow Measuring Equipment: Head Flow Meters, Nozzel Meter, Orifice Meter, Venturi Meter, Area Flow Meters, Rotameter, Pitot Tube & Applications of these equipments. Pipe fittings, major and minor losses in pipe flow, Calculation of Pressure Drop in a Pipe, Equivalent Length & 'K' factor, Methods of finding dimensional numbers - methods of governing equations, Method of force ratios and Buckingham's π method. Reciprocating pump & its applications. Centrifugal Pumps and its applications. (10)

Unit III: Conduction and Convection Introduction. Basic concepts of conduction in solids, liquids and gases, One and two dimensional heat conduction. Critical and optimum insulation thickness. Introduction to unsteady state heat transfer. Principles of convection, Equations of forced and free convection, Heat flow due to conduction & convection .Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, solar radiations, combined heat transfer coefficients by convection and radiation. Heat Transfer Equipments: Double pipe, Shell & tube and Plate type heat exchanger, Evaporator, Condenser (8)

UnitIV : Diffusion: Fick's Law, steady state diffusion: Rectangular, cylindrical, spherical (1-D); diffusion with reaction, both at surfaces, and in the bulk medium.**Transient conduction and diffusion:** Basics of Fourier analysis, unsteady state conduction and diffusion (1-D), transient conduction/diffusion with generation/reaction.(6)

Unit V :Mass transfer coefficients, Mass transfer in fluidized bed reactor, flow past solids and boundary layers, Simultaneous heat and mass transfer system .Mass transport in Biomedical and Biological Engineering: Haemodialysis, Diffusion and uptake of ligands by cells, oxygen transport in tissue and capillaries.(6)

Reference Books:

1. Introduction of Fluid Mechanics by Robert W.Fox and Slan T. McDonald, John willey & sons, Ny. Fourth Ed.
2. Unit Operation in Chemical Engg., McCabe Smith Vth Ed.
3. Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980)

Books Recommended

1. Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).
2. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).

GENETICS & MOLECULAR BIOLOGY

L	T
3	1

UNIT I

Fundamental principles of genetics, gene interaction, multiple alleles, complementation, linkage, recombination and linkage mapping, extra-chromosomal inheritance, chromosomes basis of heredity, Sex determination, sex linked, sex limited and sex, influenced inheritance.

UNIT II

Genome organization: Genome organization in prokaryotes and eukaryotes - special features of eukaryotic gene structure and organization, genome organization in mitochondria and chloroplast, DNA content and C-value paradox. Methods to measure DNA content variation - Various types of DNA sequences (simple sequences, repetitive sequences, nonsense sequences, tandem gene clusters, satellites)

UNIT III

Gene structure, DNA & RNA as a genetic material, packaging of DNA as chromosome, central dogma of molecular biology, DNA replication**,** DNA repair. Linkage and recombination, crossing over and genetic mapping, gene mapping by two point and three point test crosses, Cell cycle regulation and apoptosis.

UNIT IV

Genetic mutation, micro-deletion, Genetic syndrome, Techniques to detect mutation, Transcription in prokaryotes and eukaryotes, genetic code, reverse transcription, mRNA processing. Role of sigma factor in transcription, role of promoters and enhancers, mechanism and regulation of transcription in prokaryotes and eukaryotes.

UNIT V

DNA replication process in prokaryotes & Eukaryotes, Activity of DNA polymerases and topoisomerases, Reverse transcriptase, Translation in prokaryotes and eukaryotes Basic principles of gene cloning and r-DNA technology, genetic code, properties of genetic code, wobble hypothesis, Molecular chaperones.

Text books:

1. Genetics a conceptual approach, 2nd Edition Benjamin A. Pierc WH freeman and, company, New York.
2. Benjamin Levin – Genes VIII, 8 th ed.

Reference books:

1. Albert B, Bray Denis et al.: Molecular Biology of The Cell, latest ed.
2. Watson, Hopkins, Roberts et al.: Molecular Biology of the Gene, 4 th ed.
3. Genetics- Strickberger, 2nd.
4. Baltimore- Molecular Biology of the Cell.
5. Advance Genetics by G.S. Miglani, Narosa Publishing House.

ENZYME ENGINEERING

L	T
3	1

UNIT I

Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate-lock and key model, induced fit model. Features of active site, activation energy, enzyme specificity and types. IUB system of classification and nomenclature of enzymes. Kinetics of single substrate reactions; Derivation of Michaelis -Menten equation, turnover number; determination of Km and Vmax (LB plot, ED plot), Importance of Km & Vmax; Numerical related to enzyme kinetics, Multi-Substrate reaction mechanisms.

UNIT II

Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators. Enzyme inhibition: irreversible; reversible (competitive, uncompetitive and non competitive inhibition); Substrate and Product inhibition, Allosteric regulation of enzymes, concerted & sequential model; Deactivation Kinetics.

UNIT III

Extraction of crude enzyme from plant, animal and microbial source; some case study. Purification of enzymes by the help of different methods. Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays.

UNIT IV

Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect. Overview of applications of immobilized enzyme systems.

UNIT V

Enzyme Biosensors: elements of biosensors, three generations of biosensors, Types of biosensors: calorimetric, potentiometric, amperometric, optical and piezoelectric. Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme Reactors- Stirred tank reactors(STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed- bed reactors (PBR), Fluidized-bed Reactors (FBR); Membrane reactors.

Text books:

1. Fundamentals of enzymology by Nicolas C. price and Lewis stevens. Oxford University Press
2. Enzymes by Trevor palmer, East west Press
3. Enzyme Technology by Messing

Reference books:

1. Enzymes: Dixon and Webb. (IRL Press)
2. Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
3. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition

Bioprocess Engineering Lab-I

P

2

1. To find the thermal conductivity of liquid / gases
2. To determine the local velocity pressure with the help of pilot tube
3. To find out the thermal conductivities of Metal rod
4. To study the characteristics of a centrifugal pump.
5. To determine the viscosity of a given viscous liquid by capillary tube flow method.
6. To differentiate between laminar and turbulent flow using Reynolds experiment.
7. To determine velocity through orifice meter, venture meter
8. To determine the overall heat transfer coefficient in Parallel flow heat exchanger/counter flow heat exchanger
9. To determine the drying characteristics of given sample
10. To determine the minimum fluidization velocity in a fluidized bed and verifyexperimentally

GENETICS & MOLECULAR BIOLOGY LAB

P 2

1. How to calculate genetics and allelic frequencies numeric problem analysis.
2. Isolation of Plasmid DNA
3. Isolation of Plant DNA
4. Estimation of DNA content in the given sample by spectrophotometer
5. Determination of Tm of DNA.
6. Isolation of bacterial genomic DNA.
7. Purification of DNA through Electrophoresis & visualization under UV transilluminator.
8. Polyacrylamide gel electrophoresis of DNA.
9. PCR amplification of DNA and visualization by gel electrophoresis.
10. Isolation and study of polytene chromosome in *Drosophila.*

ENZYME ENGINEERING LAB

P
2

1. Production of commercially important enzymes from microbial sources.
2. Isolation of alpha amylase from plant source
3. Determination of enzyme activity and specific activity.
4. Partial purification of isolated enzymes.
5. Method of checking the purity of the enzyme -SDS-PAGE
6. Characterization of enzymes-effect of pH , temperature and inhibitors on enzyme activity etc.
7. Identification of Enzyme by different assay
8. Purification of enzymes by different methods
9. Immobilization of enzymes –Different Techniques such as adsorption, entrapment, encapsulation and cross-linking.
10. Strain improvement techniques- physical, chemical and genetic manipulation methods.
11. Formulation of enzyme stability.
12. Enzyme inhibition

Reference books

1. "An Introduction to Practical Enzyme Engineering", Tata McGraw-Hill.
2. R. Eisenthal and M.J. Dansen, "Enzyme Assays –A Practical Approach", IRL Press, Oxford University Press, Oxford, 1993

Engineering Science Courses for B.Tech.(AICTE Model Curriculum) 3rd Year
(effective from the session 2019-20)

SEMESTER- III													
Sl.No.	Subject Codes	Subject	Periods	Evaluation Scheme					End Semester			Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KOE031/041	Engineering Mechanics	3	1	0	30	20	50		100		150	4
2	KOE032/042	Material Science	3	1	0	30	20	50		100		150	4
3	KOE033/043	Energy Science & Engineering	3	1	0	30	20	50		100		150	4
4	KOE034/044	Sensor & Instrumentation	3	1	0	30	20	50		100		150	4
5	KOE035 /045	Basics Data Structure & Algorithms	3	1	0	30	20	50		100		150	4
6	KOE036 /046	Introduction to Soft Computing	3	1	0	30	20	50		100		150	4
7	KOE037/047	Analog Electronics	3	1	0	30	20	50		100		150	4
8	KOE038 /048	Electronics Engineering	3	1	0	30	20	50		100		150	4

Sl.No.	Subject	
1	Engineering Mechanics	To be offered to any Engg. Branch except ME/CE/AG and allied branches
2	Material Science	
3	Energy Science & Engineering	To be offered to any Engg. Branch except EE and allied branches
4	Sensor & Instrumentation	
5	Basics Data Structure & Algorithms	To be offered to any Engg. Branch except CSE and allied branches
6	Introduction to Soft Computing	
7	Analog Electronics	To be offered to any Engg. Branch except EC and allied branches
8	Electronics Engineering	

Important Note: CH/BT/TX Engg. And allied branches can be offered any of the above listed ES

ENGINEERING MECHANICS

UNIT-I:

Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium.

Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.

UNIT-II:

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.

UNIT-III:

Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

UNIT-IV:

Kinematics of rigid body: Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity.

Kinetics of rigid body: Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.

UNIT-V:

Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy.

Pure bending of beams: Introduction, simple bending theory, stress in beams of different cross sections.

Torsion: Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque.

Books and References:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010).
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications.
4. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing.
5. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons (1993).
6. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3 rd Edition, Vikas Publishing House Pvt. Ltd., (2005).
7. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, (1998).
8. Engineering mechanics by Irving H. Shames, Prentice-Hall.

MATERIAL SCIENCE

UNIT-I:

Phase Diagrams:

Solid solutions – Hume Rothery's rules – the phase rule – single component system – one-component system of iron – binary phase diagrams – isomorphous systems – the tie-line rule – the lever rule – application to isomorphous system – eutectic phase diagram – peritectic phase diagram – other invariant reactions – free energy composition curves for binary systems – microstructural change during cooling.

UNIT-II:

Ferrous Alloys:

The iron-carbon equilibrium diagram – phases, invariant reactions – microstructure of slowly cooled steels – eutectoid steel, hypo and hypereutectoid steels – effect of alloying elements on the Fe-C system – diffusion in solids – Fick's laws – phase transformations – T-T-T-diagram for eutectoid steel – pearlitic, baintic and martensitic transformations – tempering of martensite – steels – stainless steels – cast irons.

UNIT-III:

Mechanical Properties:

Tensile test – plastic deformation mechanisms – slip and twinning – role of dislocations in slip – strengthening methods – strain hardening – refinement of the grain size – solid solution strengthening – precipitation hardening – creep resistance – creep curves – mechanisms of creep – creep-resistant materials – fracture – the Griffith criterion – critical stress intensity factor and its determination – fatigue failure – fatigue tests – methods of increasing fatigue life – hardness – Rockwell and Brinell hardness – Knoop and Vickers microhardness.

UNIT-IV:

Magnetic, Dielectric & Superconducting Materials:

Ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites – dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization – dielectric breakdown – insulating materials – Ferroelectric materials – superconducting materials and their properties.

UNIT-V:

New Materials:

Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics – metallic glasses: types , glass forming ability of alloys, melt spinning process, applications – shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top down approaches), properties and applications – carbon nanotubes: types.

Text Books & References:

1. Balasubramanian, R. ―Callister's Materials Science and Engineering‖. Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. ―Physical Metallurgy: Principles and Practice‖. PHI Learning, 2015.
3. Raghavan, V. ―Materials Science and Engineering: A First course‖. PHI Learning, 2015.
4. Askeland, D. ―Materials Science and Engineering‖. Brooks/Cole, 2010.

5.Smith, W.F., Hashemi, J. & Prakash, R. ―Materials Science and Engineering‖. Tata McGraw Hill Education Pvt. Ltd., 2014.
6. Wahab, M.A. ―Solid State Physics: Structure and Properties of Materials‖. Narosa Publishing House, 2009.

Energy Science and Engineering

Unit-I Energy and its Usage: Units and scales of energy use, Mechanical energy and transport, Heat energy: Conversion between heat and mechanical energy, Electromagnetic energy: Storage, conversion, transmission and radiation, Introduction to the quantum, energy quantization, Energy in chemical systems and processes, flow of CO2, Entropy and temperature, carnot and Stirling heat engines, Phase change energy conversion, refrigeration and heat pumps, Internal combustion engines, Steam and gas power cycles, the physics of power plants. Solid-state phenomena including photo, thermal and electrical aspects

Unit-II Nuclear Energy: Fundamental forces in the universe, Quantum mechanics relevant for nuclear physics, Nuclear forces, energy scales and structure, Nuclear binding energy systematics, reactions and decays, Nuclear fusion, Nuclear fission and fission reactor physics, Nuclear fission reactor design, safety, operation and fuel cycles

Unit-III Solar Energy: Introduction to solar energy, fundamentals of solar radiation and its measurement aspects, Basic physics of semiconductors, Carrier transport, generation and recombination in semiconductors, Semiconductor junctions: metal-semiconductor junction & p-n junction, Essential characteristics of solar photovoltaic devices, First Generation Solar Cells, Second Generation Solar Cells, Third Generation Solar Cells

Unit-IV Conventional & non-conventional energy source: Biological energy sources and fossil fuels, Fluid dynamics and power in the wind, available resources, fluids, viscosity, types of fluid flow, lift, Wind turbine dynamics and design, wind farms, Geothermal power and ocean thermal energy conversion, Tidal/wave/hydro power

Unit-V Systems and Synthesis: Overview of World Energy Scenario, Nuclear radiation, fuel cycles, waste and proliferation, Climate change, Energy storage, Energy conservation. Engineering for Energy conservation: Concept of Green Building and Green Architecture; Green building concepts, LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

Reference/Text Books

1. Energy and the Challenge of Sustainability, World Energy Assessment, UNDP, New York, (2000).
2. Perspective of Modern Physics, A. Beiser, McGraw-Hill International Editions (1968).
3. Introduction to Modern Physics, H.S. Mani and G.K.Mehta, East-West Press (1988).
4. Introduction to Electrodynamics, D. J. Griffiths, Fourth Edition, Prentice Hall (2013).
5. Introductory Nuclear Physics, R. K. Puri and V.K. Babbar, Narosa Publishing House (1996).
6. Physics of Solar Cells: From Basic Principles to Advanced Concepts by Peter Wurfel, John Wiley & Sons, 2016
7. Principles of Solar Engineering, D.Y. Goswami, F.Kreith and J.F. Kreider, Taylor and Francis, Philadelphia, 2000.

SENSORS AND INSTRUMENTATION

Pre-requisites of course: Basic Electrical Engineering

Course Outcomes:		**Knowledge Level, KL**
Upon the completion of the course, the student will be able to:		
CO 1	Apply the use of sensors for measurement of displacement, force and pressure.	K_3
CO2	Employ commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.	K_3
CO3	Demonstrate the use of virtual instrumentation in automation industries.	K_2
CO4	Identify and use data acquisition methods.	K_3
CO5	Comprehend intelligent instrumentation in industrial automation.	K_2

Detailed Syllabus:

Unit- I:
Sensors & Transducer: Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

Unit-II:
Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

Unit -III:
Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs,
Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.

Unit-IV:
Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

Unit V:
Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

Text Books:

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.
4. Gary Johnson / Lab VIEW Graphical Programing II Edition / McGraw Hill 1997.

Reference Books:

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2. A.D. Helfrick and W.D. cooper,Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001
3. Hermann K.P. Neubert, "Instrument Transducers" 2nd Edition 2012, Oxford University Press.

Basics Data Structure and Algorithms

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to understand		
CO 1	Understand and analyze the time and space complexity of an algorithm	K_2, K_4
CO 2	Understand and implement fundamental algorithms (including sorting algorithms, graph algorithms, and dynamic programming)	K_2, K_3
CO 3	Discuss various algorithm design techniques for developing algorithms	K_1, K_2
CO 4	Discuss various searching, sorting and graph traversal algorithms	K_2, K_3
CO 5	Understand operation on Queue , Priority Queue , D-Queue.	K_2

K_1- Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K6- Create

Basics Data Structure and Algorithms		
Detailed Syllabus		
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to data structure and Algorithms:** Performance analysis of Algorithm, time complexity, Big-oh notation, Elementary data organization data structure operations, Recurrences, Arrays, Operation on arrays, representation of arrays in memory, single dimensional and multidimensional arrays, spare matrices, Character storing in C, String operations.	08
II	**Stack And Queue and Link List:** Stack operation, PUSH and POP, Array representation of stacks, Operation associated with stacks Application of stacks, Recursion, Polish experession, Representation Queue, operation on Queue , Priority Queue , D-Queue , Singly and circularly linked list, List operations Lists implementations	08
III	**Trees** : Basic terminology, Binary Trees, Binary tree representation, Algebraic/expressions, Complete Binary Trees, Extended binary tree, representing binary tress in memory, linked representation of Binary trees, Traversing binary trees & Searching in binary trees, Inserting in binary search trees, Complexity of searching algorithm, Heaps, general trees, Threaded binary tree.	08
IV	**Graphs:** Terminology & representations, Graphs & Multigraphs, Directed Graphs, Sequential representation of graphs, adjacency Matrices, Transversal, connected component and spanning trees, Minimum Cost spanning tree, Prims and Kruskal Algorithm, BFS, DFS, Shortest path and transitive closure, Activity networks, topological sort and critical paths.	08
V	**Searching and Sorting:** Linear search, binary Search, Internal and External sorting, Bubble sorting, selection sort, Insertion sort, quick sort, Two way merge sort, Heap sort, sorting on different keys, practical consideration for internal sorting, External Sorting, Storage Devices : Magnetic tapes, Disk Storage, Sorting with disks and Indexing techniques, introduction to B tree and B+ tree, File organization and storage management, Introduction to hoisting.	08

Text books:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, Introduction to Algorithms, PHI.
2. Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publication.
3. Weiss, "Data Structure & Algorithm Analysis in C", Addision Wesley.
4. Basse, "computer Algorithms: Introduction to Design & Analysis", Addision Wesley.
5. Lipschutz, "Data structure, "Schaum series.
6. Aho, hopcropt, Ullman, “Data Structure & Algorithm", Addision Wesley.
7. Aho, Hopcraft, Ullman, “The Design and Analysis of Computer Algorithms” Pearson Education, 2008

Introduction to Soft Computing

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to understand		
CO 1	Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.	K_1, K_2
CO 2	Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic	K_2, K_3
CO 3	Describe with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations.	K_4
CO 4	Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications.	K_2, K_3
CO 5	Develop some familiarity with current research problems and research methods in Soft Computing Techniques.	K_5, K_6

K_1- Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K6- Create

Introduction to Soft Computing		
Detailed Syllabus		
Unit	**Topic**	**Proposed Lecture**
I	Introduction to Soft Computing, **ARTIFICIAL NEURAL NETWORKS** Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.	08
II	**FUZZY SYSTEMS** Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.	08
III	**NEURO - FUZZY MODELING** Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation	08
IV	**GENETIC ALGORITHMS** Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method.	08
V	**APPLICATION OF SOFT COMPUTING** Optimiation of traveling salesman problem using Genetic Algorithm, Genetic algorithm based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.	08

Text books:

1.An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)
2.Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
3.Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
4.Neural Networks and Learning Machines Simon Haykin (PHI)
5.Sivanandam, Deepa, " Principles of Soft Computing", Wiley
6.Jang J.S.R, Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall
7.Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill
8.Laurene Fausett, "Fundamentals of Neural Networks", Prentice Hall
9.D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley
10.Wang, "Fuzzy Logic", Springer

Electronics Engineering

Unit	Topics	Lectures
I	PN junction diode: Introduction of semiconductor materials; Semiconductor diode: Depletion layer, V-I characteristics, ideal and practical, diode resistance, capacitance, diode equivalent circuits, transition and diffusion capacitance, Zener diodes breakdown mechanism (Zener and avalanche).	8
II	Diode application: Series, parallel and series, parallel diode configuration, half and full wave rectification, clippers, clampers, Zener diode as shunt regulator, voltage-multiplier circuits special purpose two terminal devices : light-emitting diodes, Varactor (Varicap) diodes, tunnel diodes, liquid-crystal displays.	8
III	Bipolar junction transistors and field effect transistor: Bipolar junction transistor: Transistor construction, operation, amplification action, common base, common emitter, common collector configuration dc biasing BJTs: operating point, fixed-bias, emitter bias, voltage-divider bias configuration. Collector feedback, emitter-follower configuration. Bias stabilization. CE, CB, CC amplifiers and AC analysis of single stage CE amplifier (re Model), Field effect transistor: Construction and characteristic of JFETs. AC analysis of CS amplifier, MOSFET (depletion and enhancement) type, transfer characteristic.	8
IV	Operational amplifiers: Introduction and block diagram of Op-Amp, ideal & practical characteristics of Op-Amp, differential amplifier circuits, practical Op-Amp circuits (inverting amplifier, non-inverting amplifier, unity gain amplifier, summing amplifier, integrator, differentiator), Op-Amp parameters: input offset voltage, output offset voltage, input biased current, input offset current differential and common-mode operation.	8
V	Electronic instrumentation and measurements: Digital voltmeter: Introduction, RAMP techniques digital multimeters: Introduction Oscilloscope: introduction, basic principle, CRT, block diagram of oscilloscope, simple, measurement of voltage, current phase and frequency using CRO, introduction of digital storage oscilloscope and comparison of DSO with analog oscilloscope.	8

Text /Reference Books:

1. Robert L. Boylestand / Louis Nashelsky, “Electronic Devices and Circuit Theory,” Latest Edition, Pearson Education.
2. H S Kalsi, “Electronic Instrumentation”, Latest Edition, TMH Publication.
3. Meetidehran/ A.K. singh “fundamental of electronics Engineering”, New age international publisher.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the concept of PN junction and special purpose diodes.
2. Study the application of conventional diode and semiconductor diode.
3. Analyse the I-V characteristics of BJT and FET.
4. Analyzethe of Op-Amp, amplifiers, integrator, and differentiator.

5. Understand the concept of digital storage oscilloscope and compare of DSO with analog oscilloscope

Analog Circuits

Unit	Topics	Lectures
I	Diode circuits, amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.	8
II	High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier, various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues, feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.	8
III	Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.	8
IV	Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load, differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR, Op-Amp design: Design of differential amplifier for a given specification, design of gain stages and output stages, compensation.	8
V	Op-Amp applications: Review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications, active filters: Low pass, high pass, band pass and band stop, design guidelines.	8

Text/Reference Books:

1. J.V. Wait, L.P. Huelsman and GA Korn, "Introduction to Operational Amplifier theory and applications," McGraw Hill, 1992.
2. J. Millman and A. Grabel, "Microelectronics," 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, "The Art of Electronics," 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, "Microelectronic Circuits,"Saunder's College11 Publishing, 4th edition.
5. Paul R. Gray and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits," John Wiley, 3rd edition.
6. Muhammad H. Rashid, "Electronic Devices and Circuits," Cengage publication, 2014.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the characteristics of diodes and transistors.
2. Design and analyze various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Design LPF, HPF, BPF, BSF.

Mathematics-V

(B. Tech. Bio Technology/Agriculture Engineering)
(Effective from the Session: 2019-20)

Subject Code	KAS304/KAS404					
Category	Basic Science Course					
Subject Name	MATHEMATICS-V					
Scheme and Credits	**L-T-P**	**Theory Marks**	**Sessional**		**Total**	**Credit**
			Test	**Assig/Att.**		
	3—1—0	100	30	20	150	4
Pre- requisites (if any)	Knowledge of Elementary Mathematics I and II of B. Tech Bio Tech or equivalent					

Course Objectives:

The objective of this course is to familiarize the bio technological engineers with techniques of Integral transforms (Fourier and Z-Transforms), probability distribution, numerical computation, hypothesis testing and ANOVA, Design and Quality control and its applications in real world. It aims to equip the students with standard concepts and tools from B. Tech Bio. Technology/Agriculture Engineering. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines

The students will learn:

- The idea of Fourier Transforms, Z- Transform and application to solve numerical problems.
- The concept of probability distribution and their application.
- The concepts of numerical techniques.
- The concept of hypothesis and ANOVA, t – test, and χ^2 - test.
- The idea of design ,statistical quality control and control charts

Mathematics – V 3L 1T 0P

All India Council for Technical Education Mathematics Course (Agriculture Engineering and Bio-Technology)

MODULE I (**8**)

Integral Transforms: Fourier integral, Fourier Transform , Complex Fourier transform, Inverse Transforms, Convolution Theorems (without proof), Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat equations, wave equations and Laplace equations, Z-Transform and its application to solve difference equation.

MODULE II **(9)**

Probability Distributions: Review of probability Random variable, Probability mass function, Probability Density Function, Binomial distribution, Poisson distribution, Normal distribution and their applications.

MODULE III **(9)**

Numerical Techniques: Zeroes of transcendental and polynomial equations, Bisection method, Regula-falsi method, Newton-Raphson method, Rate of convergence of above methods.

Interpolation: Finite differences, Newton's forward and backward interpolation. Lagrange's and Newton's divided difference formula for unequal intervals.

MODULE IV (**10)**

Tests of Hypothesis and ANOVA: Hypothesis tests, Level of significance, critical region, Student's t-test, Chi-square test, (χ^2 – test), F-test, one way and two way analysis of variance.

MODULE V **(9)**

Design and Quality control: Principles of experimental design and analysis, completely randomized design, Randomized block design, Latin square design, Statistical quality control, Types of quality control, Control chart for variables, and Control chart for attributes.

Text Books:

1. S.P.Gupta, Statistical Methods, Sultan Chand and Sons Publishers.
2. Georgr W. and William G., Statistical Methods, IBH Publication.
3. Ipsen J et al., Introduction to Biostatistics, Harper and Row Publication.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.

Reference Books:

1. N.T.J Baily, Statistical methods in Biology, English University Press.
2. R. Rangaswami, A text book of Agricultural Statistics, New Age Int. Publication.
3. P.S.S. Sundar Rao: An Introduction to Biostatistics, Prentice Hall.
4. Zar J, Biostatistics, Prentice Hall, London.

COURSE OUTCOMES

	Course Outcome (CO)	Bloom's Knowledge Level (KL)
	At the end of this course, the students will be able to:	
CO 1	Understand the concept of Fourier Transform and Z- Transform to apply for solving with the help of transform problems.	K_2 & K_3
CO 2	Remember the concept of Probability to evaluate Probability distribution.	K_1 & K_3
CO 3	To analyze the concept of numerical techniques to evaluate the zero's of the function interpolation	K_4 & K_5
CO 4	Apply the concept of hypothesis to evaluate various hypothesis testing.	K_3 & K_5
CO 5	Remember the concept of design and statistical quality control to create control charts.	K_1 & K_6

K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5 – Evaluate, K_6 – Create

Evaluation methodology to be followed:

The evaluation and assessment plan consists of the following components:

a. Class attendance and participation in class discussions etc.
b. Quiz.
c. Home-work and assignments.
d. Sessional examination.
e. Final examination.

Award of Internal/External Marks:

Assessment procedure will be as follows:

1. These will be comprehensive examinations held on-campus (Sessional)
2. Quiz
   a. Quiz will be of type multiple choice, fill-in-the-blanks or match the columns.
   b. Quiz will be held periodically
3. Home works and assignments
   a. The assignments/home-works may be of multiple choice types or comprehensive type at least one assignment from each Module/Unit.
   b. The grades and detailed solutions of assignments (of both types) will be accessible online after the submission deadline.
4. Final examinations.
   These will be comprehensive external examinations held on-campus or off campus (External examination) on dates fixed by the Dr. APJ Abdul Kalam Technical University, Lucknow

KVE401	Universal Human Values and Professional Ethics	L	T	P	C
		3	0	0	3

Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Course Outcome:

On completion of this course, the students will be able to

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

Catalogue Description

Every human being has two sets of questions to answer for his life: a) what to do? and, b) how to do?. The first set pertains to the value domain, and the other to the skill domain. Both are complimentary, but value domain has a higher priority. Today, education has become more and more skill biased, and hence, the basic aspiration of a human being, that is to live with happiness and prosperity, gets defeated, in spite of abundant technological progress. This course is aimed at giving inputs that will help to ensure the right understanding and right feelings in the students in their life and profession, enabling them to lead an ethical life. In this course, the students learn the process of self-exploration, the difference between the Self and the Body, the naturally acceptable feelings in relationships in a family, the comprehensive human goal in the society, the mutual fulfillment in the nature and the co-existence in existence. As a natural outcome of such inputs, they are able to evaluate an ethical life and profession ahead.

UNIT-1 **Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT-2 **Understanding Harmony in the Human Being - Harmony in Myself**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-3 **Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!.

UNIT-4 **Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-5 **Implications of the above Holistic Understanding of Harmony on Professional Ethics**

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly

production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Mode of Evaluation:

Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

Technical Communication
(KAS301/401)
(Effective from the session 2019-20)

L T P
2 1 0

Unit -1 Fundamentals of Technical Communication:
Technical Communication: Features; Distinction between General and Technical Communication; Language as a tool of Communication; Dimensions of Communication: Reading & comprehension; Technical writing: sentences; Paragraph; Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication.

Unit - II Forms of Technical Communication:
Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration, C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Unit - III Technical Presentation: Strategies & Techniques
Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Unit - IV Technical Communication Skills:
Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Unit - V Dimensions of Oral Communication & Voice Dynamics:
Code and Content; Stimulus & Response; Encoding process; Decoding process; Pronunciation Etiquette; Syllables; Vowel sounds; Consonant sounds; Tone: Rising tone; Falling Tone; Flow in Speaking; Speaking with a purpose; Speech & personality; Professional Personality Attributes: Empathy; Considerateness; Leadership; Competence.

Reference Books

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Personality Development and Soft Skills by Barun K. Mitra, OUP, 2012, New Delhi.
3. Spoken English- A Manual of Speech and Phonetics by R.K.Bansal & J.B.Harrison, Orient Blackswan, 2013, New Delhi.
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.

6. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
7. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
8. Skills for Effective Business Communication by Michael Murphy, Harward University, U.S.
9. Business Communication for Managers by Payal Mehra, Pearson Publication, Delhi.

Course Outcomes

1. Students will be enabled to **understand** the nature and objective of Technical Communication relevant for the work place as Engineers.
2. Students will **utilize** the technical writing for the purposes of Technical Communication and its exposure in various dimensions.
3. Students would imbibe inputs by presentation skills to **enhance** confidence in face of diverse audience.
4. Technical communication skills will **create** a vast know-how of the application of the learning to promote their technical competence.
5. It would enable them to **evaluate** their efficacy as fluent & efficient communicators by learning the voice-dynamics.

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

STUDY, EVALUATION SCHEME & SYLLABUS

For

B.TECH. 3RD YEAR

(BIOTECHNOLOGY)

Based on

AICTE MODEL CURRICULUM

(EFFECTIVE FROM THE SESSION: 2020-21)

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR V SEMESTER BIOTECHNOLOGY

			SEMESTER- V							**SESSION2020-21**			
Sl. No	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KBT 501	**Genetic Engineering**	3	1	0	30	20	50		100		150	4
2	KBT 502	**Fermentation Biotechnology**	3	1	0	30	20	50		100		150	4
3	KBT 503	**Bioinformatics I**	3	1	0	30	20	50		100		150	4
4	KBT 051-054	Departmental Elective-I	3	0	0	30	20	50		100		150	3
5	KBT 055-058	Departmental Elective-II	3	0	0	30	20	50		100		150	3
6	KBT 551	**Genetic Engineering lab**	0	0	2				25		25	50	1
7	KBT 552	Fermentation Technology Lab	0	0	2				25		25	50	1
8	KBT 553	**Bioinformatics- I virtual lab**	0	0	2				25		25	50	1
9		Mini Project or Internship Assessment*	0	0	2				50			50	1
10	KNC501/ KNC502	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	15	10	25		50			
11		MOOCs (Essential for Hons. Degree)											
		Total	**17**	**3**	**8**							**950**	**22**

*****The Mini Project or internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR VI SEMESTER BIOTECHNOLOGY

SEMESTER-VI												SESSION2020-21	
Sl. No	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KBT-601	**Bioprocess Engineering -II**	3	1	0	30	20	50		100		150	4
2	KBT-602	**Plant Biotechnology**	3	1	0	30	20	50		100		150	4
3	KBT-603	**Bioinformatics -II**	3	1	0	30	20	50		100		150	4
4	KBT-061 To 064	**Departmental Elective-III**	3	0	0	30	20	50		100		150	3
5		**Open Elective-I**	3	0	0	30	20	50		100		150	3
6	KBT-651	**Bioprocess Engineering –II Lab**	0	0	2				25		25	50	1
7	KBT-652	**Plant Biotechnology Lab**	0	0	2				25		25	50	1
8	KBT-653	**Bioinformatics-II Lab**	0	0	2				25		25	50	1
9	KNC601/ KNC602	**Essence of Indian Traditional Knowledge/Constitution of India**	2	0	0	15	10	25		50			
10		**MOOCs (Essential for Hons. Degree)**											
		Total	**0**	**3**	**6**							**900**	**21**

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR BIOTECHNOLOGY

(DEPARTMENT ELECTIVE SUBJECTS)

DEPARTDEPARTMENTAL ELECTIVES -I

KBT051: Pharmaceutical Biotechnology
KBT052: Nano Biotechnology
KBT053: Biomedical Instrumentation
KBT054: Metabolic Engineering

DEPARTMENTAL ELECTIVES - II

KBT-055: Biofuels and alcohol technology
KBT-056: Descriptive Statistics & Process Control
KBT-057: 3-D Printing
KBT-058: Molecular modelling and drug design

DEPARTMENTAL ELECTIVES – III

KBT-061: Animal Biotechnology
KBT-062: Biomarker & Diagnostics
KBT-063: Food Biotechnology
KBT-064: Entrepreneurship in Biotechnology

DR. A.P. J ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

B.TECH. III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 501	**COURSE TITLE: GENETIC ENGINEERING**
EXAM DURATION: 3 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 3 : 1: 0 CREDITS: 4	**PREREQUISITE: Knowledge of Molecular Biology**

OBJECTIVE:

- To Provide knowledge of manipulation of Genetic Material and Recombinant Technology
- To teach the construction of genomic c-DNA libraries, cloning and strain improvement
- To develop understanding of DNA sequencing, Molecular markers and related techniques.
- Application of Genetic Engineering and its application
- To impart knowledge of cell signaling and Ethical issues

COURSE OUTCOME:

On successful completion of the course, the student will be able to:

- To be able to appraise the appropriate use of host and vector for gene cloning
- Identification of appropriate method for DNA delivery into the host
- Use of gene library for screening of desired gene sequence/protein
- Cloning process of whole organism and its application
- Process of recombinant protein expression, cell signaling and ethical issues related to Gene transfer

REFERENCE BOOKS:

S. NO.	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	T.A Brown (2006). Gene cloning and DNA analysis, WILEY-BLACKWELL	2006
2.	Molecular Biology of the Cell by Bruce Alberts.6th edition	2014
3.	Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis.3rd edition (Vol.1,2,3)	2001
4.	S.B Primrose (2001). Molecular biotechnology.Panima Publishing corporation, 2ndedition	2001
5.	Genetic Engineering by Dr Smita Rastogi & Dr Neelam Pathak, Oxford University Press	2009

COURSE DETAILS: GENETIC ENGINEERING

UNITS	CONTENTS	LECTURE HOURS
I	Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Prokaryotic and eukaryotic expression host systems, Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters, promoter analysis (EMSA and DNA footprinting); Introduction of recombinant DNA in to host cells and selection methods.	**8**
II	Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosome walking, Screening of DNA libraries using nucleic acid probes and antisera.;cloning of insulin gene and other genes of commercial interest, strain improvement of industrially important organisms.	**8**
III	Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons, Applications of PCR; Site directed mutagenesis.; molecular markers (RAPD, RFLP, AFLP, SNP)	**8**
IV	Applications of genetic engineering; Creation of recombinant microorganisms, transgenic plants and animals; cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Gene therapy; DNA drugs and vaccines.	**8**
V	Basic concepts of cell signaling, Extracellular signal molecule and their receptors, Operation ofSignaling molecules over various distances, Cellular response to specific combinations of extracellular signal molecules; Nuclear receptor; Ion channel linked, G-protein mediated receptors,Relay of signal by activated cell surface receptors via intracellular signaling proteins, IntracellularSignaling proteins as molecular switches.	**8**
		40

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 502	**COURSE TITLE: Fermentation Biotechnology**
EXAM DURATION: 3 HOURS	**SEMESTER : V (ODD)**
L: T: P :: 3 : 1:0 CREDITS: 4	**PRE REQUISITES: Knowledge of elementary microbiology and basic bioprocessing**

OBJECTIVE:

- To provide knowledge of fermentation technology and its industrial application.
- To teach the inoculums development, microbial kinetics and its measurement.
- To develop understanding of media component, sterilization and types of fermentation processes.
- To provide knowledge of regulation, control and overproduction of metabolites.
- To impart knowledge related to production and application metabolites.

COURSE OUTCOME:

After successful completion of the course the students will be able to:

- Understanding of the concepts and process technologies of fermentation.
- Application and use of different raw materials and its use in industrial scale production.
- Regulatory system in the microorganism.
- Strain improvement technologies and its role in Fermentation.
- Concepts of the scale up and scale down criteria of fermentation process and production of metabolites

REFERENCE BOOKS

S.NO	NAME OF AUTHORS/BOOKS /PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1	Murray Moo -Young , Comprehensive Biotechnology, Vol. 1 & III-latest ed.	2011
2	Principles of Fermentation Technology-Whitaker & Stanbury	1984
3	Industrial Fermentations-Leland, N. Y. Chemical Publishers.	1954
4	Prescott and Dunn's-Industrial Microbiology, 4 th, ed.	1959
5	Biotechnology Series, Rehm, Reed &Weinheim, Verlag-Chemie.	2001

COURSE DETAILS Fermentation Biotechnology		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	Introduction to fermentation technology: Interaction between Bio-chemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Microbial culture selection for fermentation processes, Strain development; Preservation and improvement of industrially important microorganisms.	**8**
II	Inoculum development for industrial fermentation & Microbial Kinetics: Introduction, Criteria for transfer of inoculum, development of inocula for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant fermenter, aseptic method of inoculation, achievement and maintenance of aseptic conditions. Fermentation Material and Energy balance, Microbial growth kinetics: Microbial growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, applications and examples.	**9**
III	Media ingredients, medium formulation, oxygen requirements, antifoams, medium optimization, Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media.	**9**
IV	Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crabtree effect, feedback inhibition and feedback repression;Concept for overproduction ofprimary and secondary metabolites.	**8**
V	Details of the process, parameters and materials -for the industrial manufacture of Antibiotics (β-lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.)-Microbial Transformations, Microbial leaching.	**8**
		42

DR. A.P. J ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

B.TECH. III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 503	**COURSE TITLE: Bioinformatics-I**
EXAM DURATION: 3 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 3 : 1: 0 CREDITS:4	**PRE-REQUISITE: Elementary knowledge of Molecular Biology, Mathematics and Computer**

OBJECTIVE:

- To teach the basic concept of Bioinformatics, databases and sequence analysis
- To develop understanding of sequence analysis
- To provide knowledge of scoring matrix and detection of functional sites etc.
- To impart knowledge related to phylogenetic analysis protein structure predicvtion

COURSE OUTCOME:

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

- Understand concepts and application of Bioinformatics, types of databases, sequence similarity, sequence patterns and profiles
- Use sequence alignment techniques, database searching, pairwise and multiple sequence alignment using various tools.
- Understand scoring matrices and its types including PAM , BLOSUM series and matrices for nucleic acid and protein sequences.
- Apply phylogeny and its concepts in molecular evolution and different methods of Phylogenetic tree construction
- Understand and apply the protein structure prediction and application of bioinformatics in drug designing

REFERENCE BOOKS:

S. NO	NAME OF AUTHORS / BOOKS / PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	D.W.Mount; Bioinformatics-Sequence and genome analysis; Cold Spring HarbourLab press.	2001
2.	B.N.Mishra; Bioinformatics: Concept and application, Pearson Education (in press)	2020
3.	O' Reilly; Developing Bioinformatics computer skills-1stIndian edition, SPD publication.	2001
4.	Anthony J.F. Griffiths et al; An introduction to genetic analysis, 1stEd	1976
5.	Michael Starkey and Ramnath Elaswarapu; Genomics protocols, Humana press	2001

COURSE DETAILS Bioinformatics-I**:**

UNITS	CONTENTS	LECTURE HOURS
I	Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for biomolecular sequences: Genbank, EMBL, FASTA, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles	**8**
II	Sequence Alignment And Database Searching: Introduction, Evolutionary Basis of Sequence Alignment, Optimal alignment method, Statistical Significance of Alignment. Database searching Artifacts; Database similarity searching: FASTA, BLAST, Various versions of basic BLAST and FASTA, Advance version of BLAST: PHI-BLAST and profile-based database searches using PSIBLAST; Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup (Algorithmic concepts).	**7**
III	Scoring Matrices: Basic concept of a scoring matrix, Similarity and distance matrix, Substitution matrices: Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, Principles based on which these matrices are derived and Gap Penalty; Predictive Method using Nucleotide Sequence: Introduction, Marking repetitive DNA, Database search, Codon bias detection, detecting functional site in DNA.	**7**
IV	Phylogenetics: Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis.	**8**
V	Protein identification based on composition, Physical properties based on sequence, Motif and pattern, Secondary structure (Statistical method: Chou Fasman and GOR method, Neural Network and Nearest neighbor method) and folding classes, specialized structure or features, Tertiary structures (Homology Modeling); Structure visualization methods (RASMOL, CHIME etc.); Protein Structure alignment and analysis. Application of bioinformatics in drug discovery and drug designing.	**10**
		40

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 051	**COURSE TITLE: Pharmaceutical Biotechnology**
EXAM DURATION: 3 HOURS	**SEMESTER : V (ODD)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PREREQUISITES: Basic knowledge of Molecular Biology, Biochemistry**

OBJECTIVES:

- To teach the basic concept of Pharmaceutical products and other therapeutic agents
- To develop understanding of drug manufacturing process, storage packaging and storage of APIs
- To provide knowledge of regulatory knowledge , approval of new drug and economics of drug development
- To develop understanding of marketing, regulation and control and scope of pharmaceutical industry

COURSE OUTCOME:

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

- Understand concepts and application of pharmaceutical industry,Therapeutic agents, biopharmaceuticals.
- Understand the process off drug manufacturing, processing, preservation, analytical methods and quality management.
- Apply the knowledge of new drug development, GMP and Economics of drug development in pharma industry
- Use knowledge of Drug regulation and control. Scope and applications of biotechnology in pharmacy.

REFERENCE BOOKS

S.NO	**NAME OF AUTHORS/BOOKS /PUBLISHERS**	**YEAROF PUBLICATION/ REPRINT**
1.	Walsh, G., Biopharmaceuticals: Biochemistry and Biotechnology, Wiley (1998).	1988
2.	Leon Lachman et al :Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986	1986
3.	Remington's Pharmaceutical Science, Mark Publishing and Co	1971

COURSE DETAILS: Pharmaceutical Biotechnology		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	Introduction to drugs and pharmacy: An overview and history of pharmaceutical industry. Introduction: Therapeutic categories such as Analgesics, Anticancer, Antiviral, Anticoagulant, Analgesics, Antibiotics, Use of therapeuticagents, Biopharmaceuticals.	**5**
II	Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Specialrequirement for bulk drug manufacture.	**3**
III	Compressed table, wet granulation-dry granulation or slugging-direct compression-tablet presses,coating of tablets, capsules, sustained action dosage forms-parental solution-oral liquidsinjections-ointment-topical applications, Preservation, analytical methods and test for variousdrug and pharmaceuticals, packing-packing techniques, quality management.	**15**
IV	New drug development and approval process: Strategies for new drug discovery, finding a lead compound, combinatorial approaches to new drug discovery, pre-clinical and clinical trials, GMP, Economics of drug development.	**9**
V	The business and the future of Biopharmaceuticals. Drug regulation and control.Scope and applications of biotechnology in pharmacy.	**10**
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DR. A.P. J ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

B.TECH. III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 052	**COURSE TITTLE: Nano Biotechnology**
EXAM DURATION: 3 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 3 : 0: 0 CREDITS: 3	**PREREQUISITE: Basic knowledge of Chemistry and Analytical Techniques.**

OBJECTIVE:

- To teach the concept of nanobiotechnology and nanofabrication techniques.
- To develop understanding synthesis of metallic nanoparticles.
- To provide knowledge of biological synthesis of nanoparticles
- To teach the analytical techniques used in nanotechnology and its application in characterization of nanomataterials of biomedical importance

COURSE OUTCOME:

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

- Explain and demonstrate the basics of nanoscience, nanobiotechnology and its techniques.
- Understand the synthesise of metal nanoparticles by chemical process.
- Perform the biological synthesis of metal nanoparticles.
- Estimate the toxicity, antibacterial property of metal nanoparticles.
- Understand the synthesize the carbon nanotubes from carbon source
- Explain the nano characterization tools and techniques

REFERENCE BOOKS:

S. NO.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1.	Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.	2003
2.	Guozhong Cao ,"Nanostructures and Nanomaterials , synthesis , properties and applications" , Imperial College Press ,2004.	2004
3.	Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press,2002	2001
4.	Microfabrication and Nanomanufacturing- Mark James Jackson.	2018
5.	MEMS and Nanotechnology – Based sensors and devices communication, Medical and Aerospace applications - A.R.Jha.	2008
6.	Drug Delivery: Engineering Principles for Drug Therapy, M. Salzman,	2001

COURSE DETAILS: Nano Biotechnology

UNITS	CONTENTS	LECTURE HOURS
I	Nanobiotechnology, History, Origin, Fundamental Concepts, Bottom-up versus Top-down approaches, Discussion on Micro and Nanofabrication, Current research, Tool and Techniques,Applications and Implications and Nanofabrication.	**7**
II	Carbon nanotubes and related structures, Properties, Synthesis, Applications, Metal nanoparticles types and their synthesis, Application of Gold, Silver and Zinc oxide nanoparticles and Nano chemicals.	**7**
III	Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), improved nanodiagnostic devices, Drug delivery tools through nanotechnology	**7**
IV	Synthesis and characterization of different classes of biomedical polymers- their uses inpharmaceutical, cardiovascular ophthalmologic orthopedic areas.	**7**
V	Micro and Nano biosensor, Bioavailability, Nanoimaging agents, Tumor Targeting through nanotechnology, Quantam dots technology and its applications	**7**
		35

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B.TECH. III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 053	**COURSE TITTLE: Biomedical Instrumentation**
EXAM DURATION: 3 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PREREQUISITE: Basic knowledge of Analytical Techniques.**

OBJECTIVES:

- To teach the concept and application of Biomedical instrumentation
- To develop understanding of biomedical instruments and its process involved in cardiovascular measurements.
- To provide knowledge non invasive diagnostic instrumentation, ultrasonic measurement and biotelemetry etc.
- To teach the instruments involved in clinical laboratory, biomedical instruments in surgery and medical imaging

COURSE OUTCOME:

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

- Explain and demonstrate the instrumentation involved in biomedicals.
- Understand the working and application of plethymography, electrocardiography and pacemakers etc.
- Explain the ultrasonic measurements, biotelemetry and other related instrumentation.
- Applications of Instrumentation for the clinical laboratory .
- Explain the Medical Imaging equipments and electrical safety of medical equipments

REFERENCE BOOKS:

S. NO.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Biomedical Instrumentation and Measurement by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer	1973
2.	Biomedical Instrumentation: Technology and Applications by Raghbir Singh	2004
3.	Medical Instrumentation for Health Care by Leslie Cromwell	1976
4.	Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation by Robert B. Northrop	2012
5.	Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Application by Clifford D. Ferris.	1978

COURSE DETAILS: Biomedical Instrumentation

UNITS	CONTENTS	LECTURE HOURS
I	History and development of biomedical instrumentation, biometrics, Basic transducer principles: active and passive transducers, tranducers for biomedical applications; origin of biopotential and its propagation, sources of bioelectric potentials, electrocardiogram, electro encephalogram, electromayogram and other bioelectric potentials. Biopotential Electrodes: types of electrodessurface, needle and microelectrodes, biochemical tranducers.	**9**
II	The Cardiovascular system, Cardiovascular measurements: electrocardiography, measurement of blood pressure, measurement of blood flow and cardiac output, plethymography, measurement of heart sounds; Patient care and monitoring: elements of intensive care unit, pacemakers and defibrillators ,Measurements in the respiratory system: mechanics of breathing, gas exchange and distribution, respiratory therapy equipment.	**6**
III	Non-invasive diagnostic instrumentation: Temperature measurements ultrasonic measurements, the nervous system and neuronal communication measurement in nervous systems,Instrumentation for sensory measurements and the study of behaviors, pshycophysiological measurements, Biotelemetry.	**7**
IV	Instrumentation for the clinical laboratory, Automation of chemical tests, Biomedical instruments for surgery, Haemodialysis machines. X-ray machines and digital radiography.	**6**
V	Medical Imaging equipments, the computer in biomedical instrumentation and applications, microprocessors, Electrical safety of medical equipment, physiological effects of electric current.	**7**
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DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
B.TECH III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 054	**COURSETITLE: Metabolic Engineering**
EXAM DURATION: 3 HOURS	**SEMESTER : V (ODD)**
L : T : P :: 3 : 0: 0 CREDITS: 3	**PRE REQUISITES: Basic knowledge of Biochemistry**

OBJECTIVES:

- To teach the concept and application of metabolic engineering
- To develop understanding metabolites production in different pathways and regulatory mechanism.
- To provide knowledge biosynthesis of metabolites
- To teach the bioconversions, product inhibition and factors affecting bioconversions.
- Concepts of regulation of enzyme production and metabolic pathway manipulations

COURSE OUTCOME:

Upon completion of this course, the students will be able to:

- Explain basic concepts of metabolism and importance of metabolic engineering
- Understand the production of metabolites and its regulatory mechanism
- Explain the applications, specificity and product inhibition of bioconversion.
- Regulation of enzyme production and strain imrovement

REFERENCE BOOKS

S.NO	NAME OF AUTHORS/BOOKS /PUBLISHERS	YEAROF PUBLICATION/ REPRINT
1.	G. Stephanopoulos, A. Aristidou and J. Nielsen, Metabolic Engineering Principles and Methodologies, Academic Press, 1998	1998
2.	Daniel I. C. Wang, Malcolm D. Lilly, Arthur E. Humphrey, Peter Dunnill, Arnold l.Demain, Fermentation and Enzyme Technology,1st edition John Wiley& Sons, Reprint, 2005	1979
3.	Christina Smolke, The Metabolic Pathway Engineering Handbook (Two Volume) Set 1st edition CRC press, 2009.	2009
4.	Stanbury P. F. and Whitaker A., Principles of Fermentation Technology, Pergamon Press,1984.	1984

COURSE DETAILS:

UNITS	CONTENTS	LECTURE HOURS
I	Basic concept of metabolism, anabolism & catabolism, Importance of metabolic engineering General Principles of IntermediaryMetabolism, Regulation of Pathways, Strategies for Pathway Analysis.Understanding the role of Bioinformatics in the study of metabolic pathways	**6**
II	Synthesis of primary metabolites: Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feedback regulation, Limiting accumulation of end products	**8**
III	Biosynthesis of secondary metabolites: Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, producers of secondary metabolites, applications of secondary metabolites.	**12**
IV	Bioconversions: Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances	**7**
V	Regulation of enzyme production: Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, Feedback repression, Catabolite Repression, optimization and control of metabolic activities.	**9**
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DR. A.P. J ABDUL KALAM TECHNICAL UNIVERSITY,

LUCKNOW B.TECH. III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 055	**COURSE TITTLE: Biofuels & Alcohol Technology**
EXAM DURATION: 3 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PREREQUISITE: Basic knowledge of Fermentation and Bioconversion**

OBJECTIVE:

- To teach the concept and application biofuels and alcohol technology
- To develop understanding different alcoholic fermentation techniques.
- To provide knowledge Biochemistry of alcohol production, recycling and quality control.
- Concepts of Biomass conversion to heat and power

COURSE OUTCOME:

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

- Explain basic concepts of metabolism and importance of metabolic engineering
- Understand the production of metabolites and its regulatory mechanism
- Explain the applications, specificity and product inhibition of bioconversion.
- Regulation of enzyme production and strain improvement

REFERENCE BOOKS:

S. NO.	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAROF PUBLICATION/ REPRINT
1.	Chemical Process Principles – Part I, Material and Energy Balances by Olaf A Hougen, Kwenneth M. Watson, and Roland A Ragatz, CBS Publishers and Distributors (1995).	1995
2.	He alcohol text book by Kathryn AnnJacques, T. P. Lyons, D. R. Kelsall	2003
3.	Product Recovery in Bioprocess Technology ", BIOTOL Series, VCH, 1990	1990
4.	Shreve's Chemical Process Industries , 5th Ed. Reference	1984
5.	Out lines of Chemical Technology by Charles E. Dryden	1973

COURSE DETAILS: Biofuels & Alcohol Technology

UNITS	CONTENTS	LECTURE HOURS
I	Introduction to Alcohol Technology, Raw Material of Alcohol Industry, Storage & handling of Raw material in detail, Study of different yeast strains used in alcohol industries, Study of yeast production as single protein cell.	**9**
II	Study of different alcoholic fermentation techniques, Batch fermentation, Continuous fermentation, Modem techniques of Continuous fermentation, Bio still fermentation, Encillium process, Wet milling of grain for alcohol production, Grain dry milling cooking for alcohol production, Use of cellulosic feed stocks for alcohol production, Scaling in distilleries, Fusel oil separation	**9**
III	Study of different recycling process, Biochemistry of alcohol production, The management of fermentation in the production of alcohol. Alcohol distillation-The fundamental, Parameters & affecting alcoholic fermentations, By product of alcoholic fermentation, Distillery quality control, Alcoholometry	**10**
IV	Various biofuels/ bioenergy from biomass. Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion. Biomass conversion to biofuel: thermochemical conversion, syngas fermentation.	**10**
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B.TECH. III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 056	**COURSE TITLE: Descriptive Statistics &Process Control**
EXAM DURATION: 3 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PREREQUISITE: Elementary knowledge of Mathematics**

OBJECTIVE:

- To teach and demonstrate the representation of numerical data
- To develop understanding different and concept of probability, Binomial distribution and testing of significance..
- Understand the Correlation and Regression analysis
- Concepts of Design of Experiments and statistical process control and capability analysis

COURSE OUTCOME:

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

- Diagrammatic and graphical representation of numerical data
- Apply concept of probability, binomial distribution and other statistical tools in solving complex scientific problems
- Understand the regression analysis
- Design the experiment using statistical methods.
- Explain statistical process control and capability analysis.

REFERENCE BOOKS:

S. NO.	**NAME OF AUTHORS/BOOKS/PUBLISHERS**	**YEAR OF PUBLICATION/ REPRINT**
1.	Snedecor G. W. and Chochran W. G., Statistical Methods, 1989.	1989
2.	Douglas C Montgomery: Statistical Quality Control 7thedn.	2013
3.	Douglas C Montgomery: Applied statistics and Probability for engineers, 4thedn.	1994
4.	TT Soong : Fundamentals of probability and statistics for engineers.	2004

COURSE DETAILS: Descriptive Statistics &Process Control

UNITS	CONTENTS	LECTURE HOURS
I	*Descriptive Statistics:* Diagrammatic and graphical representation of numerical data, Formation of frequency distribution, histogram, cumulative frequency distribution, polygon and O-give curve, measures of central tendencies – mean, median, mode. Measures of dispersion: mean deviation, standard deviation, variance, quartile deviation and coefficient variance, Moments (up to 4th), Measures of skewness and kurtosis for grouped and ungrouped data.	**8**
II	*Probability & Hypothesis Testing:* Concept of Probability – Classical definition, Basic theorems of probability, Types of probability, Conditional probability, Theorem of total probability, Normal Distribution, The Central Limit Theorem, Binomial distribution, Poisson's Distribution, The Poisson's approximation to the Binomial Distribution. Testing of significance, large sample test for population mean and proportions, Test of population means-single, two samples, and paired t-test, chi square test. ANOVA	**9**
III	*Correlation and Regression analysis:* Product moment and rank, correlation coefficient, simple regression, method of least squares for estimation of regression coefficients, concept of sampling and sampling distribution, sampling from nominal distribution, standard error	**6**
IV	*Design of Experiments (DOE):* Design of Experiments (DOE) approach to optimization - traditional (linear) approach (OFAT) and multi-dimensional approach (Box-Bhenken Design, central composite design, Plackett-Burman Design, Downhill Method, Full factorial, Fractional factorial design)	**8**
V	*Control Charts:* Introduction to statistical process control and capability analysis: Chance and assignable cause of quality variation, Statistical basis of process monitoring: control chart, choice of control charts, analysis of control chart, variable of control charts, X bar and R chart, Attribute control chart, Determining process and measurement capability	**7**
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B.TECH III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 057	**COURSE TITLE: 3-D PrintingTechniques**
EXAM DURATION: 3 HOURS	**SEMESTER : V (ODD)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PRE REQUISITES: Basic knowledge of instrumentation and statics**

OBJECTIVES:

- To teach the concept and application prototyping fundamental.
- To develop understanding models and specifications, stereo lithography apparatus and layering technology
- To provide knowledge of laminated object manufacturing and related techniques and process.
- Concepts of selective laser sintering, fused deposition modeling

COURSE OUTCOME:

Upon completion of this course, the students will be able to:

- Explain basic concepts of 3-D printing technology.
- Understand the application, case studies, working, principles of 3-D printing technology
- Explain the laminated object manufacturing and fused deposition modeling.
- Apply the knowledge of 3-D Printing techniques to develop novel engineering models

REFERENCE BOOKS

S.NO	NAME OF AUTHORS/BOOKS /PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles and Applications, World Scientific publications, 3rdEd., 2010	1997
2.	D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001	2001
3.	Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000	2000
4.	Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996	1996
5.	Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.	2014

COURSE DETAILS **:PrintingTechniques**		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	Introduction, Prototyping fundamentals, Historical development, Advantages of AMT, Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of AMT process, Applications to various fields	**8**
II	Liquid based systems: Stereo lithography apparatus (SLA): Models and specifications, process,working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications,advantages and disadvantages, case studies. Solid ground curing (SGC): Models and specifications, process, working ,principle, applications, advantages and disadvantages, case studies.	**12**
III	Solid based systems: Laminated object manufacturing(LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration	**10**
IV	Powder Based Systems: Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three dimensional printing (3DP): Models and specification, process, working principle, applications, advantages and disadvantages, case studies.	**12**
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B.TECH III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 058	**COURSE TITLE: Molecular Modeling & Drug Design**
EXAM DURATION: 3 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 3 : 0: 0 CREDITS: 3	**PRE-REQUISITE: Basic knowledge molecular biology, computer& mathematics**

OBJECTIVE:

- To teach the fundamental concept of molecular modeling and drug design.
- To develop understanding molecular mechanisms and protein folding
- To provide knowledge of homology modeling, model optimization & validation of protein models.
- Concepts of drug designing including QSAR modeling and molecular docking

COURSE OUTCOME:

Upon completion of this course, the students will be able to:

- Explain basic concepts and application of molecular modeling and drug development.
- Understand the application of molecular dynamics, molecular mechanism and its application in protein folding
- Explain the concept and application of homology modeling.
- Apply the knowledge of molecular modeling in drug designing and development

REFERENCE BOOKS:

S. NO.	NAME OF AUTHORS / BOOKS / PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	Molecular Modelling: Principles and applications byA. Leach	2013
2.	Molecular Modelling by Hans Peter, Heltje & Gerd Folkens, VCH.	2011
3.	Chemical Applications of Molecular Modelling by Jonathan Goodman.	2000
4. .	Computational Chemistry by Guy H, Grant & W. Graham Richards, Oxford University Press	1995

COURSE DETAILS: Molecular Modeling & Drug Design

UNITS	CONTENTS	LECTURE HOURS
I	Introduction to Molecular Modeling; What are models used for? Areas of application – Single molecule calculation, Assemblies of molecules; Reaction of the molecules; Drawbacks of mechanical models as compared to graphical models; Co-ordinate systems two – matrix, potential energy surface; Postulates of quantum mechanics, Electronic structure calculations, Ab initio, Semi-empirical and Density functional theory calculations, Molecular size versus accuracy; Approximate molecular orbital theories.	**8**
II	Molecular Modeling by Homology, construction of frame work, selecting variable regions, Back bone and side chain placement and refinement, Optimization and validation of protein models. Threading and Ab-initio modeling, Ramchandran plot.	**8**
III	Introduction to QSAR for lead module: Linear and nonlinear modeled equations, Biological activities, Physicochemical parameters and Molecular descriptors, Application of QSAR modeling in drug discovery.	**8**
IV	Molecular Mechanisms: Introduction to Force field, Use of various parameters for force field calculation (Bond length, angle angle, torsion angle, Electrostatic interaction, Vander waals interactions, Miscellaneous interaction); Introduction Molecular Dynamics using simple models, Dynamics with continuous potentials, Constant temperature and constant dynamics, Conformation searching, Systematic search, Applications to protein folding.	**8**
V	3D pharmacophores modeling, molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies; 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility.	**8**
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B.TECH III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 551	**COURSE TITLE: Genetic Engineering Lab**
EXAM DURATION: 2 HOURS	**SEMESTER: V**
L: T: P :: 0 : 0: 2 CREDIT: 1	**PRE-REQUISITE: Genetic Engineering theory course**

OBJECTIVE:

- To isolate the various bimolecules and genetic materials from cells and tissues
- To develop understanding of estimation of Genetic material
- To provide practical knowledge restriction digestion, transformation, screening and verification of cloning
- Practical knowledge of ligation, blotting and cloning.

COURSE OUTCOME:

On successful completion of the course, the student will be able to

- Demonstrate the isolation genetic materials
- Perform experiments related to cloning, ligation, restriction digestion and transformation etc.
- Demonstrate the Southern Blotting for identification of desired DNA in a pool DNA samples
- Perform the bacterial cell competent for transformation

REFERENCE BOOKS:

S. NO.	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION/REPRINT
1.	Laboratory manual on Molecular Biology & genetic Engineering-A new approach by R.S. Sengar	2012
2.	Laboratory Manual for Genetic Engineering by S. john Vennison. Prentics hall publication	2009

COURSE DETAILS: Genetic Engineering Lab

S. NO.	LIST OF EXPERIMENT
1	Isolation of RNA and its estimation by orcinol method
2	Isolation of plasmid DNA and its estimation by diphenylamine reaction
3	Elution of plasmid DNA from agarose gel
4	To perform restriction digestion of λ DNA
5	Dephosphorylation of restriction enzyme digested vector pUC18
6	To make bacterial cells competent for transformation
7	To perform of transformation of the desired bacterial strain with plasmid DNA
8	Screening of transformed colonies by X gal and IPTG
9	Verification of cloning by colony PCR and screening of the positive colonies
10	To perform a Southern Blotting for identification of desired DNA in a pool DNA samples
11	To perform ligation of λ EcoRI digest using T4DNA ligase

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B.TECH III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 552	**COURSE TITLE: Fermentation Biotechnology Lab**
EXAM DURATION: 2 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 0 : 0: 2 CREDIT:1	**PRE-REQUISITE: Fermentation Biotechnology theory course**

OBJECTIVE:

- To determine the growth pattern of microbial cell.
- Perform the production of antibiotics, enzymes and acids through fermentative process
- To provide practical knowledge for production of ethanol, and down streaming.
- Practical knowledge of solid state fermentation & submerged fermentation

COURSE OUTCOME:

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

- Demonstrate the growth pattern of E.coli.
- Perform experiments related to production of antibiotics, enzymes and acids through fermentation process.
- Demonstrate the downstream processing of fermentative products.
- Perform the solid state fermentation and submerged fermentation.

REFERENCE BOOKS:

S. NO.	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION/REPRINT
1.	Practical Manual on Fermentation Technology by S. Kulandaivelu, S. Janarthanan	2012
2.	J.Jayaraman , "Laboratory Manual in Biochemistry", New Age International Publications	2007
3.	Fermentation-A practical Approach by G T Banks-FEBS Press	1990

COURSE DETAILS: Fermentation Biotechnology Lab

S. No.	LIST OF EXPERIMENTS
1.	1. Determine the growth patterns and specific growth rate of E. coli
2.	Determine the effect of peptone concentration on E .coli growth
3.	Fermentative production of Penicillin Antibiotics using *Peniciliumchrysogenum*.
4.	To study the induction effect of β-galactosidase enzyme in E.coli.
5.	Upstream and Downstream of bioprocess for the production of Citric acid byAspergillusniger
6.	Citric acid production from whey with glucose as supplementary carbon source by Aspergillusniger
7.	Microbial production of citric acid by solid state fermentation process
8.	Microbial production of enzymes by (a) solid state and (b) submerged fermentation.
9.	Fermentative production of Ethanol using Saccharomyces cerevisiae

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B.TECH. III YEAR V SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 553	**COURSE TITTLE: Bioinormatics –I (Virtual Lab)**
EXAM DURATION: 2 HOURS	**SEMESTER: V (ODD)**
L: T: P :: 0 : 0: 2 CREDIT: 1	**PREREQUISITE: Genetic Engineering theory course**

OBJECTIVE:

- To retrieval of the sequence data
- Demonstration of locating the chromosome and retrieval of gene expression data
- To provide practical knowledge for retrieval of PubMed data.
- Practical knowledge of ORF finding, motif information and retrieval of Gene information

COURSE OUTCOME:

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

- Demonstrate the retrieval of sequence data
- Perform experiments related to locating chromosome and gene expression data.
- Demonstrate the data retrieval system of PubMed.
- Perform the ORF finding and retrieval of gene information

REFERENCE BOOKS:

S. NO.	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION/REPRINT
1	Alphey L. DNA sequencing: from experimental methods to bioinformatics. BIOS scientific publishers Ltd; 1997.	1997
2	Iftekhar M, Ghalib MR. Bioinformatics Practical Manual	2015
3	Karthikeyan M, Vyas R. Practical chemoinformatics. Springer; 2014 May 6	2014

COURSE DETAILS: Bioinormatics –I (Virtual Lab	
S.NO.	**LIST OF EXPERIMENTS**
1.	Retrieving sequence data from Entrez
2.	Locating the chromosome of a Gene
3.	Retrieve gene expression data from GEO
4.	Retrieving articles using PubMed
5.	Finding ORF of a Given Sequence
6.	Retrieving structural data of a protein using PDB database
7.	Retrieving Motif Information of a Protein Using Prosite
8.	Retrieving Gene Information from TAIR database

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B.TECH III YEAR V BIOTECHNOLOGY

SUBJECT CODE:	**COURSE TITLE: MINI PROJECT OR INTERNSHIP ASSESSMENT***
EXAM DURATION: 20 MINUTES PRESENTATION	**SEMESTER: V (ODD)**
L: T: P :: 0 : 0: 2 CREDIT:1	**PRE-REQUISITE: NIL**

OBJECTIVE:

- To inculcate research attitude amongststudents.
- To develop presentationskills.
- To teach how to study and solve practicalproblems

COURSE OUTCOME:

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

- Understand and workout the projectproblem.
- Gain experience to make a projectreport.
- Acquire the necessary confidence to carry out main project in the finalyear.

COURSE DETAILS:

- Thestudentjointlyorindividuallyisrequiredtoprepareaprojectreportbasedonexperimental or theoretical research work The key features such as literature survey, Problem formulation, solving methodologies and future aspects of industries are the major necessities of the report under the supervision of aguide.
- The project report is to be submitted by the end of the semester and the work will be assessed based on the report and the presentation of thework.
- The assessment of all the mini projects should be done by a committee consisting of three or four faculty members - the students will present their project work before the committee - the relative grading and group average marks for the various projects will be fixed by the committee - the guides will award the marks for the individual students in the project maintaining the groupaverage.
- Eachgroupwillsubmittheprojectreporttothedepartmentthroughtheguide-theheadofthe department will certify the copies and keep one copy in the departmentallibrary.

DR. A.P. J ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH. III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 601	**COURSE TITLE: BIOPROCESS ENGINEERING II**
EXAM DURATION: 3 HOURS	**SEMESTER: VI (EVEN)**
L: T: P :: 3 : 1: 0 CREDITS: 4	**PREREQUISITE: Basic knowledge of fermentation biotechnology, bioprocess engineering I and microbiology**

OBJECTIVE:

- To impart knowledge on fundamentals of bioprocessing and bioreactor operations.
- To explain the principles of bioreactors and their application to upstream and downstream processing.
- To describe the principles and operations of various bioreactor modes.

COURSE OUTCOME:

On successful completion of the course, the student will be able to:

- Understand the kinetics of microbial growth and the associated parameters.
- Utilize sterilization concepts necessary for proper bioreactor operation.
- Discuss the basics of ideal reactor operation.
- Explain the concept and mechanism of mass transfer in bioprocessing.
- Analyze the concept of bioreactor control mechanism and identify suitable control system.

REFERENCE BOOKS:

S. NO.	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	Principles of Microbe and cell cultivation- S. John Pirt, John Wiley & Sons	1975
2.	Bioprocess Engineering Principles by P. M. Doran, Academic Press	1995
3.	Hand Book Of Bioengineering- Skalak R &ShuChien, McGraw-Hill.	1986
4.	Biochemical Engineering Fundamentals by Bailey &Ollis, McGraw-Hill College Publishers	1986
5.	Chemical Engineering: An Introduction by Morton Denn, Cambridge University Press	2011
6.	Biochemical & Biological Engg. Science, N. Blakebraugh, Academic Press.	1967

7.	Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press.	1986
8.	Bioprocess Technology - Kinetics & Reactors" by A Moser, Springer-Verlag.	1988
9.	Biochemical Engineering and Biotechnology Handbook" by B. Atkinson & F. Mavituna, 2nd Ed.Stockton Press.	1992
10.	Biochemical Engineering- S. Aiba , A.E. Humphray, University of Tokyo Press.	1973
11.	Bioreactor Design & Product Yield, BIOTOL Series, Butterworth-Heinemann Ltd	1992
12.	Bioreactors in Biotechnology: A Practical approach by Scragg, E. Horwood.	1991
13.	Process Biotechnology Fundamentals by S.N. Mukopadhyay, Viva Books Private Limited	2009
14.	Bioprocess Engineering: Basic Concepts by Shuler &Kargi, Prentice Hall India Learning Private Limited	2002

COURSE DETAILS: BIOPROCESS ENGINEERING II		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	**Microbial growth and Media preparation:** Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in batch culture, Microbial growth parameters, Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.	**8**
II	**Sterilization:** Concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods &Mechanism, Design of depth filter and estimation of its efficiency. Stoichiometric calculations, Theoretical prediction of yield coefficients, Stoichiometry of growth and product formation, Maximum possible yield, Theoretical oxygen demand, Stoichiometry of single-cell protein synthesis. .	**8**
III	**Ideal Reactor Operation:** Batch, Fed Batch & Continuous operation of mixed bioreactors, Microbial pellet formation, Kinetics and dynamics of pallet formation. Chemostate with immobilized cells, Chemostate with cell recycle, substrate utilization and product formation in bioreactor, Scale up of Bioreactors.	**8**
IV	**Role of diffusion in Bioprocessing:** Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.	**8**
V	**Bioreactor control mechanism:** Physical, Chemical and Biological environment of bioreactor, Manual control system, Role of physical, chemical & biological sensors, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers and artificial neural network based Controllers. Basic concepts of computer modeling and optimization in bioprocess applications.	**8**
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DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 602	**COURSE TITLE: PLANT BIOTECHNOLOGY**
EXAM DURATION: 3 HOURS	**SEMESTER : VI (EVEN)**
L: T: P :: 3 : 1:0 CREDITS: 4	**PRE REQUISITES: Basic knowledge of genetic engineering ,biochemistry and elementary biology**

OBJECTIVE:

- To impart the basic concepts of plant tissue culture.
- To develop understanding about tissue culture techniques and involved culturing strategies.
- To impart knowledge about the importance of tissue culture in crop improvement.

COURSE OUTCOME:

After successful completion of the course the students will be able to:

- Understand the principle and basic requirements for plant tissue culture.
- Explain the difference between tissue and organ culture and their applicability.
- Understand haploid culture and in vitro selection of mutants.
- Analyze somaclonal variation for improved crop varieties in vitro cultures.
- Identify suitable cryopreservation and reculture technique for the cultured tissue.
- Understand the development of transgenic plants through genetic manipulations.

REFERENCE BOOKS

S.NO	NAME OF AUTHORS/BOOKS /PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	Hudson T Hartmann: Plant Propagation-Principle and Practices, Pearson Education India; 8 edition	2015
2.	Principles of Plant Biotechnology- An Introduction of Genetic Engineering in Plants by S.H. Mantell, J.W. Mathews and R.A. Mckee, Blackwell Scientific Publications.	1985
3.	Chopra V L, Sharma R P &Swaminathan M S: Agricultural Biotechnology by Science Pub Inc	1996
4.	Hamish A, Collin & Sue Edwards: Plant Cell Culture, BIOS Scientific Publishers	1998
5.	Razdan M K: An Introduction to Plant Tissue Culture, Science Publishers	2003
6.	Plant Tissue Culture: Theory and Practice by S.S. Bhojwani M.K. Razdan, Elsevier Science	1996
7.	H.S. Chawla. Plant Biotechnology, Oxford & IBH Publishing	2020

COURSE DETAILS: PLANT BIOTECHNOLOGY		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	Introductory history of plant biotechnology: Laboratory organization; Principles of Plant Tissue Culture. Concepts of totipotency, explants, inoculums, acclimatization. Nutrition of plant cells; Nutrient media: Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents. An appraisal of different media, selection of media, Sterilization of the media. Hormones: Auxins, Cytokinins, Gibberellins, Abscisic Acid, Ethylene etc. Explant preparation and Surface sterilization. Basic procedure for Aseptic Tissue transfer.	**10**
II	Culture of plant materials- explants selection and technique of culturing. Organogenesis, Embryogenesis, Somaclonal variation, germiclonal variation. Establishment, growth and maintenance of Callus and cell suspension culture, Methods of sub culturing and transfer of regenerated plants to the field. Tissue and organ culture; Cellular differentiation and regulation of morphogenesis; Somatic embryogenesis; Control of organogenesis and embryogenesis; Single cell culture	**10**
III	Haploid production: Androgenesis; Anther and microspore culture; Gynogenesis; Embryo culture and rescue in agricultural and horticultural corps; Protoplast isolation; Culture– regeneration; Somatic hybrid-cybrids; In vitro selection of mutants – mutants for salts, disease, cold, drought, herbicide and other stress conditions; Micropropagation: Application of micropropagation in agriculture and forestry. Meristem culture and virus elimination; Shoot tip culture.	**8**
IV	Improved crop varieties through somaclonal variation in invitro cultures. Application of tissue culture for crop improvement in agriculture, horticulture and forestry. Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture. Application of plant tissue culture production of secondary metabolites and other industrial products. .	**8**
V	Genetic transformation using Ti plasmid Manipulation of gene expression in plants; Production of marker free transgenic plants. Developing insect-resistance, disease-resistance, herbicide resistance plants. Genetic manipulation of flower pigmentation, Developing quality of seed storage, Provitamin A, iron proteins in rice, modification of food plant taste and appearance, yield increase in plants.	**8**
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B.TECH. III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 603	**COURSE TITLE: BIOINFORMATICS II**
EXAM DURATION: 3 HOURS	**SEMESTER: VI (EVEN)**
L: T: P :: 3 : 1: 0 CREDITS:4	**PRE-REQUISITE: Elementary knowledge of bioinformatics I , molecular biology and computer**

OBJECTIVE

- To provide knowledge to analyze various computational methods involved in protein modeling, RNA structure prediction and drug designing
- To teach various concepts of machine learning, , Artificial Neural Networks, document clustering

COURSE OUTCOME:

On completion of this course, the students will be able to

- Understand the various tools and techniques related to insilico modeling of biomolecules along with methods of drug designing, protein docking
- Analyze problems related to collection and analysis of biological data
- Develop steady and time dependent solutions along with theirlimitations

REFERENCE BOOKS:

S. NO	NAME OF AUTHORS / BOOKS / PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science	1998
2.	D.W.Mount; Bioinformatics- Sequence and genome analysis; Cold Spring HarbourLabpress	2004
3.	Protein Structure Prediction-A Practical Approach, MJE Sternberg, Oxford University Press.	1996
4.	Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag, NY.	2006
5.	Purifing Protein for Proteomics, Richard J. Sinpson, I.K. International Pvt. Ltd.	2004
6.	Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co., 1997. 18/ 24	1997

COURSE DETAILS:

UNITS	CONTENTS	LECTURE HOURS
I	Inference problems and techniques for molecular biology. Overview of key inference problems in biology: Homology identification, Genomic sequence annotation (Genes and ORFs identification), Protein structure prediction (Secondary and Tertiary structure prediction), Protein function prediction, Biological network identification, Next generation sequencing, Microarray data analysis	**10**
II	Basics of RNA Structure prediction and its limitations, Features of RNA Secondary Structure, RNA structure prediction methods: Based on self-complementary regions in RNA sequence, Minimum free energy methods, Suboptimal structure prediction by MFOLD, Prediction based on finding most probable structure and Sequence co-variance method. Application of RNA structure modeling	**8**
III	Machine learning: Decision tree induction, Artificial Neural Networks, Hidden Markov Models, Genetic Algorithms, Simulated Annealing, Support vector machines; The relation between statistics and machine learning; Evaluation of prediction methods: Parametric and Nonparametric tests, cross-validation and empirical significance testing (empirical cycle), Clustering (Hierarchical and K-mean).	**10**
IV	Basic concept of Force field in molecular modeling (Potential energy calculation); Overview of key computational simulation techniques: Introduction to simulation, Computer simulation techniques, Types of computer simulation (Continuous, Discrete-event and Hybrid simulation), Differential equation solvers, Parameter estimation, and Sensitivity analysis.	**6**
V	Overview of key techniques for the management of large document collections and the biological literature: Document clustering, Information retrieval system; Natural Language Processing: Introduction, Major areas of NLP, Natural language information extraction; Insilico Drug Designing: Major steps in Drug Designing, Ligand and Structure based drug designing, Protein-ligand docking, QSAR Modeling, Pharmacodynamics (Efficacy & Potency) &Pharmacokinetics (ADME), Lipinski's rule of five, Pharmacogenomics	**8**
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DR. A.P. J ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH. III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 061	**COURSE TITLE: ANIMAL BIOTECHNOLOGY**
EXAM DURATION: 3 HOURS	**SEMESTER : VI (EVEN)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PREREQUISITES: Basic knowledge of genetic engineering and immunology**

OBJECTIVES:

- To introduce invitro culture techniques of animal cells and tissues
- To learn different types of culture systems and reactors used for culturing of animal cells
- To elaborate various applications of animal tissue cultures with specific reference to transgenic animal production

COURSE OUTCOME:

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

- Understand basics of animal tissue culture and its importance
- Understand techniques to establish animal cell cultures invitro as well as different types of reactors and their working
- learn the strategies involved in developing clones in lab
- Understand the methods of transgene delivery and production of transgenic animals
- Understand the process of stem cell differentiation and their applications with case studies

REFERENCE BOOKS

S.NO	NAME OF AUTHORS/BOOKS /PUBLISHERS	YEAROF PUBLICATION/ REPRINT
1.	B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7th Edition, Wiley Blackwell	2000
2.	G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO	1991
3.	I. Gordon, Laboratory production of cattle embryos, 2nd edition, CAB International	2003
4.	Louis-Marie Houdebine, Transgenic Animals: Generation and Use 5th Edition, CRC Press	1997
5.	Animal cell culture: Ian Freshney	2015

COURSE DETAILS: ANIMAL BIOTECHNOLOGY		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	Basic cell culture techniques, Types of cell culture media; Ingredients of media; Physiochemical properties; CO2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.	**8**
II	Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants	**8**
III	Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins	**8**
IV	Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures; Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Microencapsulation; Growth monitoring	**8**
V	Transgenic animal production; Methods of transgene delivery; Integration of foreign genesand their validation; Gene targeting; Methods and strategies; Improving transgene integration efficiency; Cell lineages and developmental control genes in drosophila and mice; Differentiation of germ layers; Cellular polarity; Stem cell differentiation; Blood cell formation; Fibroblasts and their differentiation; Differentiation of cancerous cells and role of protooncogenes	**8**
		40

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 062	**COURSE TITLE: BIOMARKER & DIAGNOSTICS**
EXAM DURATION: 3 HOURS	**SEMESTER : VI (EVEN)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PREREQUISITES: Basic knowledge of molecular biology, Immunology and analytical techniques**

OBJECTIVES:

- To introduce basics of molecular diagnostics, its scope and applications
- To learn various pathways of cell signaling, eukaryotic cell control system and their components
- To learn different molecular mechanisms of generation of metabolic disorders
- To elaborate various applications of biomarkers in disease diagnostics
- To understand advanced molecular techniques: FISH, CGH, flow cytometry, genome mapping methodology

COURSE OUTCOME:

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

- Understand importance of biomarkers in molecular diagnostics
- Understand molecular oncology with specific emphasis on cancer and its relevant cause
- Learn principles and applications of some of advanced molecular diagnostic techniques

REFERENCE BOOKS

S.NO	**NAME OF AUTHORS/BOOKS /PUBLISHERS**	**YEAROF PUBLICATION/ REPRINT**
1.	Molecular biology of the cell. Bruce Alberts, 6th Edition	2014
2.	Principles of tissue engineering. Robert Lanza. Elsevier Publications	2000
3.	Introduction to Tissue engineering, applications and challenges. Ravi Birla.Wiley Publications	2014
4.	Molecular Cell Biology: Darnell J, Lodish H and Baltimore D	1990
5.	Cell and Molecular Biology: De Robertis EDP and De Robertis EMF	1980
6.	An introduction to Human Molecular Genetics by Pasternak et al., John Wiley & Sons	2005
7.	Human Chromosomes by Miller &Tharman, Springer Publishing Company	2001
8.	Molecular Biology of the cell by Alberts et al., Garland Press	2008
9.	Genes IX, by Lewin B, Pearson India	2007
10.	Cell and Molecular Biology by De Robertis and De Robertis, Lipincott&Wilkins	2007
11.	Genome III by Brown TA, Garland Press	2006
12.	Elements of medical Genetics by Turnpenny and Ellard, Churchill Livingstone	1995
13.	Animal cell culture: Ian Freshney	2015

COURSE DETAILS: BIOMARKER & DIAGNOSTICS		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	Introduction to Molecular Diagnostics: History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario, Cellular Complexity: Cell components, Cell Differentiation, Cellular communication – endocrine signaling, paracrine signaling and autocrine signaling, contact dependent and synaptic communications, Intracellular networks – transport pathways, signaling pathways and metabolic networks. Eukaryotic Cell Control System and their Components, Intracellular cell cycle control system, Extracellular Cell Cycle Control System, Regulation of Cell Growth and Apoptosis, Genetic and epigenetic factors that regulate these pathways, their abnormalities that alter the pathways and cellular functions.	**12**
II	Molecular Oncology Mitochondrial disorders: Cancer – Benign and Malignant neoplasms, multifactorial disposition, Cancer pathogenesis, positive and negative mediators of neoplastic development, Proto-oncogenes, Oncogenes and Tumor suppressors. Allele loss and loss of Heterozygosity. Mitochondrial inheritance, Mitochondrial myopathy, lactic acidosis, MELAS, LHONs, identity testing	**8**
III	Biomarkers in disease diagnostics: FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour& cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders	**6**
IV	Chromosomes, Human disorders, and Cytogenetic analysis:Structure, types andorganization; Chromosome organization, Euchromatinand heterochromatin and Histone modifications.Chromosome banding and nomenclature; Nomenclature and functional significances of chromosome bands.GC and AT rich isochores.Structural and Numerical aberrations and its consequences.X-chromosome dosage compensation and inactivation mechanism.Sex determination and Y chromosome; function, and diseases.Uniparentaldisomy, Genomic Imprinting and disorders. FISH, CGH, Flow cytometry techniques and clinical diagnostics.	**10**
V	Genomic instability, Chromosome mapping & Genome plasticity: Common fragile sites and methods of induction, Heritable fragile sites and FXS. Genomic Instability, mechanism and diseases. Trinucleotide Repeats; Mechanism of expansion and triplet repeats and related disorders. Genetic linkage maps, Relation to the probability of recombination, Pedigree analysis with genetic markers and overview of human genome project	**10**
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DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 063	**COURSE TITLE: FOOD BIOTECHNOLOGY**
EXAM DURATION: 3 HOURS	**SEMESTER : VI (EVEN)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PREREQUISITES: Basic knowledge of fermentation biotechnology and microbiology**

OBJECTIVES:

- To introduce significance of microbes in food and food industry
- To learn basic principles of the equipment involved in the commercially important food processing methods and unit operations
- To learn different techniques of food preservation
- To impart knowledge about indicators of food safety and HACCP system

COURSE OUTCOME:

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

- Understand importance of microbes and their products in food industry
- Acquire knowledge of types of foods and their production methodologies
- Learn the Hazard Analysis Critical Control Point System (HACCP system) and Predictive Microbiology/Microbial Modeling.

REFERENCE BOOKS

S.NO	**NAME OF AUTHORS/BOOKS /PUBLISHERS**	**YEAROF PUBLICATION/ REPRINT**
1.	Frazier, W.S. and Weshoff, D.C., 2017. Food Microbiology, 5th Edn., McGraw Hill Book Co., New York.	2017
2.	Mann &Trusswell , 2007. Essentials of human nutrition.3rd edition .oxford university press	2007
3.	Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi	1987
4.	Lindsay, 1988. Applied Science Biotechnology.Challenges for the flavour and Food Industry.Willis Elsevier	1988
5.	Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology	1989

COURSE DETAILS: FOOD BIOTECHNOLOGY		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	History of Microorganisms in food: Historical Developments. Role and significance of microorganisms in foods. Intrinsic and Extrinsic parameters of foods that affect microbial growth. Basic principles of the equipment involved in the commercially important food processing methods and unit operations	**8**
II	Microorganisms in food: spoilage of fresh meats and poultry, processed meats, seafood's, fruits and vegetables. Fermented food products, Medical foods, Probiotics and health benefits of fermented milk and foods products. Dehydrated Foods, Enteral Nutrient Solutions (Medical Foods), Single-Cell Protein. Starter cultures, Production process of cheeses, beer, wine and distilled spirits. Process of Brewing, malting, mashing, primary & secondary fermentation. Problems in food industry: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl.	**10**
III	Determining Microorganisms and/or their Products in Foods: Microbiological Examinationof surfaces, Air Sampling, Metabolically Injured Organisms .Enumeration and Detection of Food-borne Organisms .Bioassay and related Methods. Common Food borne diseases. Nutritional boosts and flavor enhancers: Emerging processing and preservation technologies for milk and dairy products.	**8**
IV	Food Preservation: Food preservation by various methods especially Irradiation, Characteristics of radiations in food preservation, principles underlying the destruction of microorganisms by Irradiation. Application of radiations in food (processing for irradiation).Radappertization, Radicidation, and Radurization of Foods. Effect of Irradiation on Food quality and storage ability. Miscellaneous Food Preservation Methods: High- Pressure Processing, Pulsed Electric Fields, Aseptic Packaging, Manothermosonication (Thermo-ultrasonication).	**8**
V	Indicators of Food Safety and Quality: Indicators of Food microbial quality, product quality and food safety. Fecal Indicator Organisms, Predictive Microbiology/Microbial Modeling.The Hazard Analysis Critical Control Point System (HACCP System), Microbiological Criteria.Food borne intoxicants and mycotoxins.	**6**
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DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 064	**COURSE TITLE: ENTREPRENEURSHIP IN BIOTECHNOLOGY**
EXAM DURATION: 3 HOURS	**SEMESTER : VI (EVEN)**
L: T: P :: 3 : 0: 0 CREDITS:3	**PREREQUISITES: Elementary knowledge of biotechnology and managerial economics**

OBJECTIVES:

- To introduce entrepreneurship opportunities in biotechnology
- To learn concepts of entrepreneurs, business development strategies, market
- To understand role of government schemes in development of Bio-entrepreneurship
- To discuss emerging biotechnology based industries related to drug development, transgenics, environmental biotechnology
- To understand ethics and IPR in biotech industries

COURSE OUTCOME:

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

- Understand the importance of Bio-entrepreneurship and its scope
- Understand the important aspects of establishing bio-industries
- learn fundamental aspects of Intellectual property Rights to students who are going to playa major role in development and management of innovative projectsin industries
- Pave the way for the students to catch up Bio-entrepreneurship as ancareer option

REFERENCE BOOKS

S.NO	**NAME OF AUTHORS/BOOKS /PUBLISHERS**	**YEAROF PUBLICATION/ REPRINT**
1.	Biotechnology Entrepreneurship1st Edition.Starting, Managing, and Leading Biotech Companies.CraigShimasaki. Academic Press.2014	2014
2.	Introduction to Biotech Entrepreneurship: From Idea to Business. A European Perspective. Matei**,** Florentina**,** Zirra, Daniela (Eds.).Springer nature publication.2019	2019
3.	Biotechnology Entrepreneurship from Science to Solutions -- Start-Up, Company Formation and Organization, Team, Intellectual Property, Financing, Part 1st Edition. Michael L. Salgaller. Logos Press (August 25, 2010)	2010
4.	How to Start a Biotech Company. SourishSaha et.al., Independently published (September 4, 2019)	2019

COURSE DETAILS: ENTREPRENEURSHIP IN BIOTECHNOLOGY		
UNITS	**CONTENTS**	**LECTURE HOURS**
I	Entrepreneur - Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Development of Entrepreneurship steps in entrepreneurial process, Biotech Entrepreneurship in India, Identification of Business Opportunities, Qualities, skills and attributes that successful biotech entrepreneurs possess. Case studies of successful and unsuccessful bio-entrepreneurs	**8**
II	Business development in biotechnology - Factors affecting biotech business: (finance, infrastructure, equipment, manpower , resources , project location, end product, quality issues, etc) Basic principles and practices of management - Definition, concepts and application; Organization types, coordination, control and decision making in management	**8**
III	Core concept of Market: Identification and evaluation of market potential of various bioentrepreneur sectors. Marketing, Marketing research- concept and techniques, Considerations in establishment of biotechnological start-up - Different models of biotechnological start-ups .The budget for a biotechnological start-up company. Seed capital raising for a biotechnological startup company	**8**
IV	Role of government and schemes, financial institutions in fostering Bio-entrepreneurship, Skills in bio-entrepreneurship-Personality and attitude, Organizational behavior, Leadership, Principles of effective communication Body language, public speaking, presentations, business proposal writing.	**8**
V	Biotechnology: emerging industries with examples from Transgenic, Environmental biotechnology, New drug development, DNA chip technology, Stem cell research, Tissue engineering. Contract Research Organization, marketing consultancy, bio-learning module. Ethics and IPR in biotech-Industries - Fundamentals of ethics in business, Ethical dilemmas in biotech industry, IPR- Introduction, Forms of IPR.	**8**
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DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 651	**COURSE TITLE: BIOPROCESS ENGINEERING II LAB**
EXAM DURATION: 2 HOURS	**SEMESTER: VI (EVEN)**
L: T: P :: 0 : 0: 2 CREDIT: 1	**PRE-REQUISITE: Bioprocess Engineering theory course**

OBJECTIVE:

- To impart knowledge about the basic fundamental principles of bioprocess engineering by performing differentexperiments
- To make them correlate theory and practical process byexperimentation.

COURSE OUTCOME:

On successful completion of the course, the student will be able to

- Analyze the data on growth kinetics of *E.coli*.
- Discuss the upstream and downstream bioprocessing for citric acid and α- amylase production.
- Analyze the volumetric liquid mass transfer coefficient (KLa) using sodium sulphite method.
- Perform immobilization of enzymes and cells.
- Develop computational design for fermentative production of L- lysine.

REFERENCE BOOKS:

S. NO.	**NAME OF AUTHORS/BOOKS/PUBLISHERS**	**YEAR OF PUBLICATION/REPRINT**
1.	Practical Manual on Fermentation Technology by S. Kulandaivelu, S. Janarthanan	2012
2.	J.Jayaraman , "Laboratory Manual in Biochemistry", New Age International Publications	2007
3.	Eisenthal, R. &Danson N.J. (Eds) Enzyme Assays: "A Practical Approach", IRI Press, Oxford, UK	1992

COURSE DETAILS: BIOPROCESS ENGINEERING II LAB

S. NO.	LIST OF EXPERIMENT
1	Determine the growth patterns and specific growth rate of *E.coli*
2	Determine the effect of peptone concentration on *E.coli* growth
3	Determination of specific thermal death rate constant (Kd) for *E.Coli*

4	Determine the effects of temperature & pH on *Psuedomonasputida*
5	Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillusniger*
6	Citric acid production from whey with glucose as supplementary carbon source by *Aspergillusniger*
7	Upstream and Downstream of bioprocess for the production of α-amylase by *Aspergillusnudulans*
8	Estimation of volumetric liquid mass transfer coefficient (KLa) using sodium sulphite method
9	Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.
10	Computational Design of Fermentative Process for L-lysine production.

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B.TECH III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 652	**COURSE TITLE: PLANT BIOTECHNOLOGY LAB**
EXAM DURATION: 2 HOURS	**SEMESTER: VI (EVEN)**
L: T: P :: 0 : 0: 2 CREDIT:1	**PRE-REQUISITE: Plant Biotechnology theory course**

OBJECTIVE:

- To provide knowledge to apply fundamental principles of plant tissue culture.
- To teach concepts behind culturing techniques from different explants.
- To inculcate the hands on practice attitude in students to perform explants selection, media preparation, sterilization and callus culture initiation.

COURSE OUTCOME:

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

- Operate and handle the plant biotechnology lab equipments.
- Perform tissue culture media preparation, sterilization and explants selection.
- Understand in vitro cultures through axillary bud induction
- Analyze plant secondary metabolites from selected medicinal plants.

REFERENCE BOOKS:

S. NO.	NAME OF AUTHORS / BOOKS / PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	Plant Biotechnology: Practical Manual by C.C. Giri, ArchanaGiri I. K. International Publications.	2007
2.	A Practical Manual For Plant Biotechnology by Tejovathi G, CBS Publishers and Distributors.	1996
3.	Plant Biotechnology: Laboratory Manual For Plant Biotechnology by H.S. Chawla, Oxford and IBH Publishing	2004

COURSE DETAILS: PLANT BIOTECHNOLOGY LAB	
S. No.	**LIST OF EXPERIMENTS**
1.	Preparation of Stocks solution for plant tissue culture media.
2.	Preparation of MS/B5 medium (semi-solid) and sterilization.
3.	Explant selection, preparation and surface sterilization.
4.	To learn culturing, sub culturing and maintenance using selected explants.
5.	Initiation of in vitro cultures through axillary bud induction.
6.	Initiation of callus cultures from different explants.
7.	Preparation of artificial seed/synthetic seed for conservation of germplasm.
8.	Extraction of DNA/RNA from plants and its estimation.
9.	Isolation and characterization of plant secondary metabolites from selected medicinal plants.
10.	Extraction of proteins from plants and its estimation.

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B.TECH III YEAR VI SEMESTER BIOTECHNOLOGY

SUBJECT CODE: KBT 653	**COURSE TITLE: BIOINFORMATICS II LAB**
EXAM DURATION: 2 HOURS	**SEMESTER: VI(EVEN)**
L: T: P :: 0 : 0: 2 CREDIT: 1	**PRE-REQUISITE:Bioinformatics theory course**

OBJECTIVE:

- To introduce the fundamental principles of bioinformatics
- To make them correlate theory and practical processes throughexperimentation.

COURSE OUTCOME:

After successful completion of this course, the students will be able to:

- Understand the basic software and tools used in structure prediction of biomolecules
- Conduct experimental procedure for Ramachandran plot and its analysis
- Construct and analyse of restriction maps, QSAR model and homology model
- Identify and structurally modify a natural product, to design a compound with the desired properties and to assess its therapeutic effects, theoretically .
- Enhance their practical knowledge and thus theiremployability

REFERENCE BOOKS

S.NO	NAME OF AUTHORS/BOOKS /PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1	Alphey L. DNA sequencing: from experimental methods to bioinformatics. BIOS scientific publishers Ltd; 1997.	1997
2	Iftekhar M, Ghalib MR. Bioinformatics Practical Manual	2015
3	Karthikeyan M, Vyas R. Practical chemoinformatics. Springer; 2014 May 6	2014
4	Brown FK. Chemoinformatics: what is it and how does it impact drug discovery. Annual reports in medicinal chemistry. 1998 Jan 1;33:375-84	1998

COURSE DETAILS: BIOINFORMATICS II LAB

S. No.	LIST OF EXPERIMENTS
1	Identification of Distantly related homologous sequences of a given query protein sequence using PSI-BLAST
2	Construct Phylogenetic tree of five evolutionary related protein/nucleotide sequences
3	Prediction of secondary structure of RNA using any web server.
4	Construction and analysis of Ramachandran Plot using any suitable web server
5	Align two homologous protein structure and calculation the RMSD for the superposition result
6	Comparative assessment of best available tools for genome annotation
7	Construction of restriction maps for various vectors used in genetic engineering using tool "NEB cutter".
8	Primer Design: Construct primers for the given DNA sequence using any suitable web based tool
9	Generate 2D QSAR model of a set of legend descriptor data

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Evaluation Scheme & Syllabus

For

B.Tech. 2nd

Syllabus of Non Credit Courses

On

Choice Based Credit System

(Effective from the Session: 2018-19)

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

DETAILED SYLLABUS

COMPUTER SYSTEM SECURITY		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to understand		
CO 1	To discover software bugs that pose cyber security threats and to explain how to fix the bugs to mitigate such threats	**K_1, K_2**
CO 2	To discover cyber attack scenarios to web browsers and web servers and to explain how to mitigate such threats	**K_2**
CO 3	To discover and explain mobile software bugs posing cyber security threats, explain and recreate exploits, and to explain mitigation techniques.	**K_3**
CO 4	To articulate the urgent need for cyber security in critical computer systems, networks, and world wide web, and to explain various threat scenarios	**K_4**
CO 5	To articulate the well known cyber attack incidents, explain the attack scenarios, and explain mitigation techniques.	**K_5, K_6**
DETAILED SYLLABUS		**3-1-0**

Unit	Topic	Proposed Lecture
I	**Computer System Security Introduction**: Introduction, What is computer security and what to l earn? , Sample Attacks, The Marketplace for vulnerabilities, Error 404 Hacking digital India part 1 chase. **Hijacking & Defense:** Control Hijacking ,More Control Hijacking attacks integer overflow ,More Control Hijacking attacks format string vulnerabilities, Defense against Control Hijacking - Platform Defenses, Defense against Control Hijacking - Run-time Defenses, Advanced Control Hijacking attacks.	08
II	**Confidentiality Policies:** Confinement Principle ,Detour Unix user IDs process IDs and privileges , More on confinement techniques ,System call interposition ,Error 404 digital Hacking in India part 2 chase , VM based isolation ,Confinement principle ,Software fault isolation , Rootkits ,Intrusion Detection Systems	08
III	**Secure architecture principles isolation and leas:** Access Control Concepts , Unix and windows access control summary ,Other issues in access control ,Introduction to browser isolation . **Web security landscape :** Web security definitions goals and threat models , HTTP content rendering .Browser isolation .Security interface , Cookies frames and frame busting, Major web server threats ,Cross site request forgery ,Cross site scripting ,Defenses and protections against XSS , Finding vulnerabilities ,Secure development.	08
IV	**Basic cryptography:** Public key cryptography ,RSA public key crypto ,Digital signature Hash functions ,Public key distribution ,Real world protocols ,Basic terminologies ,Email security certificates ,Transport Layer security TLS ,IP security , DNS security.	08
V	**Internet Infrastructure:** Basic security problems , Routing security ,DNS revisited ,Summary of weaknesses of internet security ,.Link layer connectivity and TCP IP connectivity , Packet filtering firewall ,Intrusion detection.	08

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Text books:

1. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010.

2. Michael T. Goodrich and Roberto Tamassia, Introduction to Computer Security, Addison Wesley, 2011.

3. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010.

4. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press, 2001.

Mapped With : https://ict.iitk.ac.in/product/computer-system-security/

PYTHON PROGRAMMING		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to understand		
CO 1	To read and write simple Python programs.	K_1, K_2
CO 2	To develop Python programs with conditionals and loops.	K_2, K_4
CO 3	To define Python functions and to use Python data structures –- lists, tuples, dictionaries	K_3
CO 4	To do input/output with files in Python	K_2
CO 5	To do searching ,sorting and merging in Python	K_2, K_4
DETAILED SYLLABUS		**3-1-0**

Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** The Programming Cycle for Python , Python IDE, Interacting with Python Programs , Elements of Python, Type Conversion. **Basics:** Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.	**08**
II	**Conditionals:** Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and Elif statement in Python, Expression Evaluation & Float Representation. **Loops:** Purpose and working of loops , While loop including its working, For Loop , Nested Loops , Break and Continue.	**08**
III	**Function:** Parts of A Function , Execution of A Function , Keyword and Default Arguments ,Scope Rules. **Strings :** Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings. **Python Data Structure :** Tuples , Unpacking Sequences , Lists , Mutable Sequences , List Comprehension , Sets , Dictionaries **Higher Order Functions:** Treat functions as first class Objects , Lambda Expressions	**08**

IV	**Sieve of Eratosthenes:** generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes. **File I/O :** File input and output operations in Python Programming **Exceptions and Assertions** **Modules :** Introduction , Importing Modules , **Abstract Data Types :** Abstract data types and ADT interface in Python Programming. **Classes :** Class definition and other operations in the classes , Special Methods (such as _init_, _str_, comparison methods and Arithmetic methods etc.) , Class Example , Inheritance , Inheritance and OOP.	**08**
V	**Iterators & Recursion:** Recursive Fibonacci , Tower Of Hanoi **Search :** Simple Search and Estimating Search Time , Binary Search and Estimating Binary Search Time **Sorting & Merging:** Selection Sort , Merge List , Merge Sort , Higher Order Sort	**08**

Text books:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)

2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

3.John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013

4.Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

5.Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

6.Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.

7.Charles Dierbach, ―Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.

8.Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

Mapped With : https://ict.iitk.ac.in/product/python-programming-a-practical-approach/

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

OPEN ELECTIVES I
(VI SEMESTER)

AS PER

AICTE MODEL CURRICULUM
[Effective from the Session: 2020-21]

B.Tech. VI Semester

OPEN ELECTIVE-I

KOE061	REAL TIME SYSTEMS
KOE062	EMBEDDED SYSTEM
KOE063	INTRODUCTION TO MEMS
KOE064	OBJECT ORIENTED PROGRAMMING
KOE065	COMPUTER BASED NUMERICAL TECHNIQUES
KOE066	GIS & REMOTE SENSING
KOE067	BASICS OF DATA BASE MANAGEMENT SYSTEM
KOE068	SOFTWARE PROJECT MANAGEMENT
KOE069	*UNDERSTANDING THE HUMAN BEING COMPREHENSIVELY-HUMAN ASPIRATIONS AND ITS FULFILLMENT

Note:

1. The Student shall choose an open Elective Subject from the list of open elective courses in such a manner that he/she has not studied the same course in any form during the degree programme.
2. The students shall choose an Open Elective course from the prescribed list of open elective courses available at University website for 3rd year (2020-21) in such a manner that he/she has not studied the same subject or allied subject in any semester during the entire degree program.
3. Subject to aforesaid condition, the open Elective courses may be offered from the department to all students irrespective of branch. There is no restriction related to branch. The students of any branch (irrespective of department) can select the open elective subjects from the prescribed list of open elective courses.
4. * It is mandatory that for subjects (KOE069) only trained Faculty (who had done the FDP for these courses) will teach the courses.

KOE-061 REAL TIME SYSTEMS

Unit	Topics	Lectures
I	**Introduction** Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Dead-lines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.	8
II	**Real Time Scheduling** Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.	8
III	**Resources Sharing** Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Module Resources, Controlling Concurrent Accesses to Data Objects.	8
IV	**Real Time Communication** Basic Concepts in Real time Communication, Soft and Hard RT Communication systems, Model of Real Time Communication, Priority-Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols.	
V	**Real Time Operating Systems and Databases** Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of Temporal data, Temporal Consistency, Con-currency Control, Overview of Commercial Real Time databases.	8

Text Books:

1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication.

Reference Books:

1. Real Time Systems – Mall Rajib, Pearson Education
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Describe concepts of Real-Time systems and modeling.
2. Recognize the characteristics of a real-time system in context with real time scheduling.
3. Classify various resource sharing mechanisms and their related protocols.
4. Interpret the basics of real time communication by the knowledge of real time models and protocols.
5. Apply the basics of RTOS in interpretation of real time systems.

KOE-062 EMBEDDED SYSTEM

COURSE OBJECTIVE: *After completion of the course student will be able to:*

1. Attain the knowledge of embedded system and its development environment.
2. Gain the knowledge of RTOS based embedded system design and its applications.

COURSE OUTCOME: *After completion of the course student will be able to:*

CO1: Understand the basics of embedded system and its structural units.
CO3: Analyze the embedded system specification and develop software programs.
CO3: Evaluate the requirements of the programming embedded systems, related software architecture.
CO3: Understand the RTOS based embedded system design.
CO3: Understand all the applications of the embedded system and designing issues.

KOE-062 EMBEDDED SYSTEM		
Unit	**Topic**	**Lectures**
1	Introduction to Embedded Systems: Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.	**8**
2	Embedded Networking: Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.	**8**
3	Embedded Firmware Development Environment: Embedded Product Development Life Cycle objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.	**8**
4	RTOS Based Embedded System Design: Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, чC/OS-II, RT Linux.	**8**
5	Embedded System Application Development: Design issues and techniques Case Study of Washing Machine- Automotive Application- Smart card System Application.	**8**

Text Books:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
2. Michael J. Pont, "Embedded C", Pearson Education , 2007.
3. Steve Heath, "Embedded System Design", Elsevier, 2005.
4. Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051
5. Microcontroller and Embedded Systems", Pearson Education, Second edition, 2007.

KOE-063 INTRODUCTION TO MEMS

COURSE OBJECTIVE: *After completion of the course student will be able to:*

1. Understand the Basic concept of MEMS, Mechanics of Beam and Diaphragm Structures, Air Damping and Electrostatic Actuation.
2. Know the knowledge of Thermal Effects and the Applications of MEMS in RF.

COURSE OUTCOME: *After completion of the course student will be able to:*

CO1: Understand the Basic concept of MEMS Fabrication Technologies, Piezoresistance Effect, Piezoelectricity, Piezoresistive Sensor.
CO2: Explain Mechanics of Beam and Diaphragm Structures.
CO3: Understand the Basic concept of Air Damping and Basic Equations for Slide-film Air Damping, Couette-flow Model, Stokes-flow Model.
CO4: Know the concept of Electrostatic Actuation.
CO5: Understand the applications of MEMS in RF

KOE-063 INTRODUCTION TO MEMS		
Unit	**Topic**	**Lectures**
1	**Introduction to MEMS:** MEMS Fabrication Technologies, Materials and Substrates for MEMS, Processes for Micromachining, Characteristics, Sensors/Transducers, Piezoresistance Effect, Piezoelectricity, Piezoresistive Sensor.	**8**
2	**Mechanics of Beam and Diaphragm Structures:** Stress and Strain, Hooke's Law. Stress and Strain of Beam Structures: Stress, Strain in a Bent Beam, Bending Moment and the Moment of Inertia, Displacement of Beam Structures Under Weight, Bending of Cantilever Beam Under Weight.	**8**
3	**Air Damping:** Drag Effect of a Fluid: Viscosity of a Fluid, Viscous Flow of a Fluid, Drag Force Damping, The Effects of Air Damping on Micro-Dynamics. Squeeze-film Air Damping: Reynolds' Equations for Squeeze-film Air Damping, Damping of Perforated Thick Plates. Slide-film Air Damping: Basic Equations for Slide-film Air Damping, Couette-flow Model, Stokes-flow Model.	**8**
4	**Electrostatic Actuation:** Electrostatic Forces, Normal Force, Tangential Force, Fringe Effects, Electrostatic Driving of Mechanical Actuators: Parallel-plate Actuator, Capacitive sensors. Step and Alternative Voltage Driving: Step Voltage Driving, Negative Spring Effect and Vibration Frequency.	**8**
5	**Thermal Effects:** Temperature coefficient of resistance, Thermo-electricity, Thermocouples, Thermal and temperature sensors. **Applications of MEMS in RF** MEMS Resonator Design Considerations, One-Port Micromechanical Resonator Modeling Vertical Displacement Two-Port Microresonator Modeling, Micromechanical Resonator Limitations.	**8**

Text & Reference Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Atre, "Micro and smart systems", Wiley India, 2010.
2. S.M. Sze, "Semiconductor Sensors", John Wiley & Sons Inc., Wiley Interscience Pub.
3. M.J. Usher, "Sensors and Transducers", McMillian Hampshire.
4. RS Muller, Howe, Senturia and Smith, "Micro sensors", IEEE Press.

KOE-064 OBJECT ORIENTED PROGRAMMING

COURSE OBJECTIVE: After completion of the course student will be able to:

1. Understand the Basic concept of Object Orientation, object identity and Encapsulation.
2. Know the knowledge of Basic Structural Modeling, Object Oriented Analysis and C++ Basics.

COURSE OUTCOME: After completion of the course student will be able to:

CO1: Understand the Basic concept of Object Orientation, object identity and Encapsulation.
CO2: Understand the Basic concept of Basic Structural Modeling.
CO3: Know the knowledge of Object oriented design, Object design.
CO4: Know the knowledge of C++ Basics.
CO5: Understand the Basics of object and class in C++.

KOE-064 OBJECT ORIENTED PROGRAMMING		
Unit	**Topic**	**Lectures**
1	Introduction: The meaning of Object Orientation, object identity, Encapsulation, information hiding, polymorphism, generosity, importance of modelling, principles of modelling, object oriented modelling, Introduction to UML, conceptual model of the UML, Architecture.	**8**
2	Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Class &Object Diagrams: Terms, concepts, modelling techniques for Class & Object Diagrams. Collaboration Diagrams: Terms, Concepts, depicting a message, polymorphism in collaboration Diagrams, iterated messages, use of self in messages. Sequence Diagrams: Terms, concepts, depicting asynchronous messages with/without priority, call-back mechanism, broadcast messages. Basic Behavioural Modeling: Use cases, Use case Diagrams, Activity Diagrams, State Machine , Process and thread, Event and signals, Time diagram, interaction diagram, Package diagram. Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams	**8**
3	Object Oriented Analysis: Object oriented design, Object design, Combining three models, Designing algorithms, design optimization, Implementation of control, Adjustment of inheritance, Object representation, Physical packaging, Documenting design considerations. Structured analysis and structured design (SA/SD), Jackson Structured Development (JSD).Mapping object oriented concepts using non-object oriented language, Translating classes into data structures, Passing arguments to methods, Implementing inheritance, associations encapsulation. Object oriented programming style: reusability, extensibility, robustness, programming in the large. Procedural v/s OOP, Object oriented language features. Abstraction and Encapsulation.	**8**
4	C++ Basics : Overview, Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures C++ Functions : Simple functions, Call and Return by reference, Inline functions, Macro Vs. Inline functions, Overloading of functions, default arguments, friend functions, virtual functions	**8**
5	Objects and Classes : Basics of object and class in C++, Private and public members, static data and function members, constructors and their types, destructors, operator overloading, type conversion. Inheritance : Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class Polymorphism : Pointers in C++, Pointes and Objects, this pointer, virtual and pure virtual functions, Implementing polymorphism	**8**

Text Books:

1. James Rumbaugh et. al, “Object Oriented Modeling and Design”, PHI
2. Grady Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Language User Guide”, Pearson Education
3. Object Oriented Programming with C++, E Balagurusamy, TMH

Reference Books:

1. R. S. Salaria, Mastering Object Oriented Programming with C++, Khanna Publishing House
2. C++ Programming, Black Book, Steven Holzner, dreamtech
3. Object Oriented Programming in Turbo C++, Robert Lafore, Galgotia
4. Object Oriented Programming with ANSI and Turbo C++, Ashok Kamthane, Pearson
5. The Compete Reference C++, Herbert Schlitz, TMH
6. C++ and Object Oriented Programming Paradigm, PHI
7. C++ : How to Program, 9th Edition, Deitel and Deitel, PHI

KOE 065: COMPUTER BASED NUMERICAL TECHNIQUES

Course Objectives:

The objective of this course is to familiarize the graduate engineers with techniques in errors, approximations, approximates roots, Interpolation, finite differences, numerical differentiation and integration programming, numerical solution of differential equations and boundary value problems. It aims to equip the students with standard concepts and tools from previously gained knowledge to an advanced level that will enable them to tackle more advanced level of Optimization techniques and applications that they would find useful in their disciplines.

The students will learn:

- To apply the knowledge of errors, roots and application in the field of engineering.
- To deal deals with finite differences and interpolation to solve engineering problems involving complicated real life situations etc.
- To deal with numerical integration and differentiation that is required in different branches of Engineering to graduate engineers for applying more difficult problems in case of complex structures.
- To deals with numerical solution of differential Equations for engineering problems involving real life situations etc.
- To deal with boundary value problems of real life systems and Engineers.

KOE 065 COMPUTER BASED NUMERICAL TECHNIQUES		
Unit	**Topic**	**Lectures**
1	**Error and roots of Algrabraic and Transcendental Equations:** Introduction of Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation. Solution of Algebraic and Transcendental Equation**:** Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Methods of finding real and complex roots, Muller's method, Rate of convergence of Iterative methods, Polynomial Equations.	**8**
2	**Interpolation:** Introduction Finite Differences, Difference tables Polynomial Interpolation: Newton's forward and backward formula Central Difference Formulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula. Interpolation with unequal intervals: Lagrange's Interpolation, Newton Divided difference formula, Hermite's Interpolation.	**8**
3	**Numerical Integration and Differentiation**: Introduction: Numerical differentiation of Newton's forward and backward formula, Stirling's, Bessel's, Everett's formula, Lagrange's Interpolation and Newton Divided difference formula. **Numerical Integration**: Newton cotes formula, Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Boole's rule, Waddle's rule.	**8**
4	**Solution of differential Equations:** Introduction, Picard's Method, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution.	**8**
5	**Boundary Value problems:** Introduction, Finite difference method, solving Eigen value problems, polynomial method and power methods. Numerical solution of Partial Differential equations. Elliptic, Parabolic and hyperbolic PDEs. Distillation in a Plate Column, Unsteady-state Operation, Starting a Stirred-tank Reactor, Rate at which a Plate Absorber Approaches Steady State.	**8**

Note: PS: Practice session: Students should practice the Flow Charts and algorithm of some important programs

Text Books:

1. Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age International.
2. Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, Delhi**.**

Reference Books

1. Rajaraman V, Computer Oriented Numerical Methods, Pearson Education
2. T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods, McGraw Hill
3. Pradip Niyogi, Numerical Analysis and Algorithms, McGraw Hill.
4. Francis Scheld, Numerical Analysis, McGraw Hill.
5. Sastry S. S, Introductory Methods of Numerical Analysis, Pearson Education.
6. Kiusalaas, J.: Numerical methods in engineering with MATLAB, Cambridge University Press
7. Woodford, C and Phillips, C: Numerical methods with worked examples: MATLAB Edition, Springer

COURSE OUTCOMES: At the end of this course, the students will be able to:

	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
CO 1	Understand the concept of errors to evaluate approximate roots of several types of equations	K_2& K_5
CO 2	Analyze the problem and evaluate data by different interpolation methods and creating interpolating graphs	K_4, K_5&K_6
CO 3	Understand the concept of interpolation to analyze and evaluate the numerical differentiation and integration	K_2 & K_5
CO 4	Remember the concept of formula based the solution of ordinary differential equations to evaluate differential equations withy initial conditions	K_1&K_5
CO 5	Apply the concept of partial differential equation to evaluate the partial differential equations	K_3& K_5

K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5 – Evaluate, K_6 – Create

KOE 066 GIS & REMOTE SENSING

COURSE OBJECTIVE: *Students undergoing this course are expected to-*

1. Understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

COURSE OUTCOME: *After completion of the course student will be able to-*

CO1: Understand about the principles of Remote Sensing and its advantages and limitations.
CO2: Retrieve the information content of remotely sensed data.
CO3: Apply problem specific remote sensing data for engineering applications.
CO4: Analyze spatial and attribute data for solving spatial problems.
CO5: Create GIS and cartographic outputs for presentation

KOE-066 GIS & REMOTE SENSING		
Unit	**Topic**	**Lectures**
1	Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil and water, spectral signatures.	**8**
2	Different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap; stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation- interpretation elements;	**8**
3	Photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography; satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices.	**8**
4	Microwave remote sensing. GI Sand basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties. .	**8**
5	Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, Application of remote sensing and GIS for the management of land and water resources.	**8**

Text & Reference Books:

1. Reddy Anji, M. 2006. Textbook of Remote Sensing and Geographical Information Systems. BS Publications, Hyderabad.
2. Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
3. George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
4. Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.
5. Lillesand, T., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. 7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.
6. Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland Press Inc., Illinois, USA.

KOE-067 BASICS OF DATA BASE MANAGEMENT SYSTEM

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to:		
CO 1	Describe the features of a database system and its application and compare various types of data models.	K_2
CO 2	Construct an ER Model for a given problem and transform it into a relation database schema.	K_5, K_6
CO 3	Formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus.	K_5, K_6
CO 4	Explain the need of normalization and normalize a given relation to the desired normal form.	K_2, K_3
CO 5	Explain different approaches of transaction processing and concurrency control.	K_2

DETAILED SYLLABUS		3-0-0
Unit		**Lecture**
I	**Introduction:** An overview of database management system, database system vs file system, database system concepts and architecture, views of data – levels of abstraction, data models, schema and instances, data independence, database languages and interfaces, data definition languages, DML, overall database structure, transaction management, storage management, database users and administrator. **Data Modeling using the Entity Relationship Model:** ER model concepts, notation for ER diagram, mapping constraints, keys, concepts of super key, candidate key, primary key, generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationships of higher degree.	**08**
II	**Relational Database Concepts:** Introduction to relational database, relational database structure, relational model terminology – domains, attributes, tuples, relations & relational database schema, integrity constraints, entity integrity, referential integrity, keys constraints, domain constraints, Relational algebra - relational calculus, tuple and domain calculus, basic operations – selection and projection, set-theoretic operations, join operations. **Data Base Design & Normalization:** Functional dependencies, normal forms, first, second, & third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design	**08**
III	**Structured Query Language (SQL):** Basics of SQL, DDL, DML, DCL, advantage of SQL, SQL data type and literals, types of SQL commands, SQL operators and their procedure, tables – creation & alteration, defining constraints, views and indexes, queries and sub queries, aggregate functions, built-in functions, insert, update and delete operations, joins, unions, intersection, minus, transaction control commands. **PL/SQL:** Introduction, features, syntax and constructs, SQL within Pl/SL, DML in PL/SQL Cursors, stored procedures, stored function, database triggers, indices	**08**
IV	**Transaction Processing Concepts:** Transaction concepts, properties of transaction, testing of serializability, Serializability of schedules, conflict & view serializable schedule, recoverability, recovery from transaction failures, two-phase commit protocol, log based recovery, checkpoints, deadlock handling. **Concurrency Control Techniques:** Concurrency control, locking techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity, multi-version schemes, recovery with concurrent transaction.	**08**

V	**Database Security** – Types of security, system failure, backup & recovery techniques, authorization & authentication, system policies, levels of security – physical, OS, network & DBMS, privileges – grant & revoke. **Recent Trends in Database Management Systems:** Centralized and Client-Server Architectures, Distributed Databases, Object-Oriented Database, Spatial & Temporal Databases, Decision Support Systems, Data Analysis, Data Mining & Warehousing, Data Visualization, Mobile Databases, OODB & XML Databases, Multimedia & Web Databases, Spatial and Geographical Databases, Web and Mobile Databases, Active Databases	**08**

Text books:

1. Elmasri, Navathe, "Fundamentals of Database System", Addision Wesley.
2. Korth, Silbertz, Sudarshan, "Database Concepts", Mc Graw Hill.
3. Bipin C. Desai, "An Introduction to Database System", Galgotia Publication.
4. Majumdar & Bhattacharya, "Database Management System", McGraw Hill.
5. Date C.J., "An Introduction to Database System", Addision Wesley.
6. Ramakrishnan, Gehrke, "Database Management System", McGraw Hill.
7. Atul Kahate, "Introduction to Database Management Systems", Pearson Education.
8. Paul Beynon Davies, "Database System", Palgrave Macmillan.
9. Bharti P.K., " An Introduction to Database Systems", JPNP.
10. Rajesh Narang, "Database Management System", PHI.
11. Singh, S.K., "Database System Concepts – design & application", Pearson Education.
12. Leon & Leon, "Database Management Systems", Vikas Publishing House.
13. O'Neil, "Databases", Elsevier Pub.
14. Ivan Bayross, "SQL, PL/SQL – The Programming Language of Oracle", BPB Publications.
15. P.S. Deshpande, "SQL and PL/SQL for Oracle 10g, Black Book", Dreamtech Press.
16. George Koch, Kevin Loney, "Oracle: The Complete Reference", McGraw Hill.
17. Coronel, Morris and Rob, "Database Principles: Fundamentals of Design, Implementation and Management", Cengage Learning.
18. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley.
19. G. K. Gupta, "Database Management Systems", McGraw Hill.
20. Shraman Shah, "Oracle for Professional", SPD.

KOE-068 SOFTWARE PROJECT MANAGEMENT		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able :		
CO 1	Identify project planning objectives, along with various cost/effort estimation models.	K_3
CO 2	Organize & schedule project activities to compute critical path for risk analysis.	K_3
CO 3	Monitor and control project activities.	K_4, K_5
CO 4	Formulate testing objectives and test plan to ensure good software quality under SEI-CMM.	K_6
CO 5	Configure changes and manage risks using project management tools.	K_2, K_4

DETAILED SYLLABUS		3-0-0
Unit		**Lecture**
I	**Project Evaluation and Project Planning :** Importance of Software Project Management – Activities – Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	**08**
II	**Project Life Cycle and Effort Estimation :** Software process and Process Models – Choice of Process models – Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II – a Parametric Productivity Model.	**08**
III	**Activity Planning and Risk Management :** Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning – Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.	**08**
IV	**Project Management and Control:** Framework for Management and control Collection of data Visualizing progress – Cost monitoring Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control Software Configuration Management – Managing contracts – Contract Management.	**08**
V	**Staffing in Software Projects :** Managing people – Organizational behavior – Best methods of staff selection Motivation – The Oldham Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams Decision making Organizational structures Dispersed and Virtual teams – Communications genres Communication plans Leadership.	**08**

Text books:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, McGraw Hill, New Delhi, 2012.
2. Robert K. Wysocki ―Effective Software Project Management – Wiley Publication, 2011.
3. Walker Royce: ―Software Project Management- Addison-Wesley, 1998.
4. Gopalaswamy Ramesh, ―Managing Global Software Projects – McGraw Hill Education (India), Fourteenth Reprint 2013.

KOE-069 UNDERSTANDING THE HUMAN BEING COMPREHENSIVELY – HUMAN ASPIRATIONS AND ITS FULFILLMENT

Course Objectives:

1. To help the students having the clarity about human aspirations, goal, activities and purpose of life.
2. To facilitate the competence to understand the harmony in nature/existence and participation of human being in the nature/existence.
3. To help the students to develop the understanding of human tradition and its various components.

Course Methodology:

1. The methodology of this course is exploration and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or set of do's and don'ts related to values.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their preconditioning and present beliefs.

KOE-069 UNDERSTANDING THE HUMAN BEING COMPREHENSIVELY- HUMAN ASPIRATIONS AND ITS FULFILLMENT		
Unit	**Topic**	**Lectures**
1	**Introduction:** The basic human aspirations and their fulfillment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.	**8**
2	**Understanding Human being and its expansion:** The domain of right understanding starts from understanding the human being (the knower, the experience and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).	**8**
3	**Activities of the Self:** Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self.	**8**
4	**Understanding Co-existence with other orders:** The need and the process of inner evolution (through self-exploration, selfawareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	**8**
5	**Expansion of harmony from self to entire existence:** Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.	**8**

Reference Books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Sangal, G. P. Bagaria (2010), Excel Books, New Delhi [ISBN 978-8-174-46781-2]
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
3. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
4. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA
5. Ishandi Nau Upnishad, Shankaracharya, Geeta press, Gorakhpur,
6. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
7. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. FOURTH (IV) YEAR

BIOTECHNOLOGY

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2021-22]

B.Tech. VII Semester
BIOTECHNOLOGY

SEMESTER- VII													
Sl. No.	**Subject**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
	Codes		**L**	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KHU701/ KHU702	HSMC -1 #/ HSMC-2 #	3	0	0	30	20	50		100		150	3
2	KBT-071-074	Departmental Elective-IV	3	0	0	30	20	50		100		150	3
3	KBT-075-078	Departmental Elective-V	3	0	0	30	20	50		100		150	3
4		Open Elective-II	3	0	0	30	20	50		100		150	3
5	KBT751X	LAB-1	0	0	2				25		25	50	1
6	KBT752	Mini Project or Internship Assessment*	0	0	2				50			50	1
7	KBT753	Project I	0	0	8				150			150	4
8		MOOCs (Essential for Hons. Degree)											
		Total	12	0	12							850	18

*The Mini Project or internship (4 - 6 weeks) conducted during summer break after VI semester and will be assessed during VIIsemester.

SEMESTER- VIII													
Sl. No.	**Subject**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
	Codes		**L**	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KHU801/ KHU802	HSMC-2#/HSMC-1#	3	0	0	30	20	50		100		150	3
2		Open Elective-III	3	0	0	30	20	50		100		150	3
3		Open Elective-IV	3	0	0	30	20	50		100		150	3
4	KBT851	Project II	0	0	18				100		300	400	9
5		MOOCs (Essential for Hons. Degree)	9	0	18								
		Total										850	18

B.TECH IV YEAR BIOTECHNOLOGY
(DEPARTMENT ELECTIVE SUBJECTS)

DEPARTMENTAL ELECTIVE- IV

KBT071: Genomics and Proteomics

KBT072: Bioseparation and Downstream Processing

KBT073: Environmental Biotechnology

KBT074: Industrial Biotechnology

DEPARTMENTAL ELECTIVE- V

KBT075: Biosafety, Bioethics, IPR & Patents

KBT076: Quality Control and Regulatory affairs

KBT077: Biomaterials

KBT078: Biostatistics & design of experiments

LAB (DEPARTMENTAL ELECTIVE)

KBT751A: Genomics and Proteomic Lab

KBT751B: Bioseparation and Downstream Processing

KBT751C: Environmental Biotechnology Lab

KBT751D: Industrial Biotechnology Lab

B.TECH IV YEAR VII SEMESTER

BIOTECHNOLOGY

SUBJECT CODE: KBT071	**COURSE TITLE: Genomics & Proteomics**
EXAM DURATION: 3 HOURS	**SEMESTER: VII (ODD)**
L: T: P :: 3 : 0: 0 CREDIT: 3	**PRE-REQUISITE: Molecular Biology & Biochemistry**

OBJECTIVE:

- Understand the structural principles governing the protein structures and their classifications.
- Identification of key motifs and domains in protein structures, and their interaction with ligands orsubstrates; DNA-protein interactions.
- Explain and distinguish various genomic features
- Explain molecular markers, various approaches for genetic and physical mapping of genomes; andalso analyze recombinant frequency of molecular markers to create genetic maps

COURSE OUTCOME: After completion of this course successfully, the students will be able to:

- Acquire the knowledge for interactions of proteins and other macromolecules along with methods fortheir identification.
- Comprehend the basics of determination and prediction of three-dimensional structure of proteins.
- Describe various chemistries/platforms for Next-generation sequencing (NGS); and analyze NGS datato assemble genomes, annotate the assembly, and predict various kinds of variants.
- Identify genes/pathways/biological processes underlying a phenotype through differential gene expression analysis (using RNA-seq).

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	Voet D, Voet JG & Pratt CW, Fundamentals ofBiochemistry, 2nd ed. Wiley	2006
2.	Brown TA, Genomes, 3rd ed. Garland Science	2006
3.	Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd ed. Benjamin Cummings	2007
4.	Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th ed, Blackwell	2006
5.	Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd ed, ASM Press	1998

COURSE DETAIL: GENOMICS & PROTEOMICS

S N	CONTANT	LECTURE
I.	Introduction Structural organization of genome in Prokaryotes and Eukaryotes; Organelle DNA mitochondrial, chloroplast; DNA sequencing-principles and translation to large scale projects; Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree analysis-physical and genetic mapping	10
II.	Genome sequencing projects Microbes, plants and animals; Accessing and retrieving genome project information from web; Comparative genomics, Identification and classification using molecular markers-16S rRNA typing/sequencing, EST's and SNP's.	8
III.	Proteomics Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Microscale solution iso-electric focusing; Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDITOF; SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid system.	8
IV.	Pharmacogenetics High throughput screening in genome for drug discovery-identification of gene targets, Pharmacogenetics and drug development.	6
V.	Functional genomics and proteomics Analysis of microarray data; Protein and peptide microarray-based technology; PCR-directed protein in situ arrays; Structural proteomics	8

SUBJECT CODE: KBT072	**COURSE TITLE: Bioseparation & Down Stream Processing**
EXAM DURATION: 3 HOURS	**SEMESTER: VII (ODD)**
L: T: P :: 3 : 0: 0 CREDITS: 3	**PREREQUISITE: Knowledge of Molecular Techniques**

OBJECTIVE:

- The major objective of this course is to impart in students the skills to operate bioprocesses for production of various Bio-products
- This course is formulated to teach various methods of product separation, isolation and purification To teach the construction of genomic c-DNA libraries, cloning and strain improvement

COURSE OUTCOME: After completion of the course the students will be able

- to operate, design and optimize the productionmedium, they will gain the ability to handle bioreactors to carry out different separation processes involving various types of bioproducts.
- After completion of this course the students will be skilled in choosing a process of separation for a particular product, they will know how to design the relevant equipment, calculate the yield, and degree ofpurification.

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	Raja Ghosh, "Principles of Bioseparations Engineering", WorldScientific Publishing	2006
2.	Ladisch. M. R, "Bioseparation Engineering: Principles, Practice and Economics", John Wiley & sons, New York.	2001
3.	Asenjo.J.M, "Separation processes in Biotechnology" Marcel DekkerInc.	1993
4.	Bailey & oils, Biochemical Engg. Fundamentals, McGraw-Hill	1990
5.	Roger G. Harrison, Paul Todd, Scott R. Rudge, Demetri P. Petrides, "Bioseparation science and Engineering" Oxford University press.	2003

COURSE DETAILS: **BIOSEPARATION & DOWNSTREAM PROCESSING**

S N	CONTANT	LECTURE
I.	INTRODUCTION TO BIOSEPARATION PROCESS: Role and importance of bioseparation in biotechnological processes: RIPP scheme, Problems and requirements of bioproducts purification - Properties of Biomolecules - Characteristics of fermentation broth - Biological activity, Analysis of purity-Process economics: Capital and operating cost analysis.	8
II.	REMOVAL OF INSOUBLES: Cell disruption methods for intracellular products: Physical, chemical and mechanical - Removal of insolubles: Biomass and particulate debris separation techniques - flocculation - sedimentation - centrifugation and filtration methods.	8
III.	ISOLATION OF PRODUCTS: Adsorption: Principles - Langumir - Freundlich isotherms - Extraction: Basics- Batch and continuous, aqueous two-phase extraction - supercritical extraction - in situ product removal - Precipitation: Methods of precipitation with salts - organic solvents and polymers - Membrane based separations: Micro and ultra filtration - theory - design and configuration of membrane separation equipments and its applications.	8
IV.	PURIFICATION OF BIOPRODUCTS: Basic principles of Chromatographic separations: GC-HPLC - gel permeation - ion- exchange -affinity - reverse phase and hydrophobic interaction chromatography - Electrophoretic separation techniques: capillary -isoelectric focusing-2D gel electrophoresis - Hybrid separation technologies: GC-MS and LC-MS.	8
V.	PRODUCT POLISHING: Crystallization: Principles-Nucleation- Crystal growth-Kinetics-Batch crystallizers: Scale-up and design, Drying: Principles-Water in biological solids- Heat and mass transfer- Drying equipments: description and operation-Vacuum shelf - rotary dryer-Freeze dryer-Spray dryer. Biomolecules of Commercial importance Ethanol, citric acid, lysine, steroids, penicillin, dextran, trehalose, subtilisin, chymosin, vitamin B12, hepatitis B vaccine, insulin, erythropoietin, monoclonal antibodies.	8

SUBJECT CODE: KBT073	COURSE TITLE: Environmental Biotechnology
EXAM DURATION: 3 HOURS	SEMESTER: VII (ODD)
L: T: P: 3: 0: 0 CREDITS: 3	PREREQUISITE: Microbiologyand Bioprocess Engineering

OBJECTIVE:

- To teach basics of environment and its challenges in terms of pollution due to various activities
- To develop understanding of biotechnology and microbiology in treating various kind of wasteLeading to production of various useful products
- To Impart knowledge of core engineering design in environmental waste treatment usingbiological processes
- To develop mathematical and analytical skills required to design and operate system for source-based waste treatment
- To Impart knowledge in the area of regulatory framework and environmental compliance

COURSE OUTCOME: On successful completion of the course, the student will be able to:

- Distinguish the exact root cause of environmental pollution problems
- Apply the biotechnology core principles in waste treatment system
- Design the novel biological treatment system at institutional as well as industrial scale
- Analyze the outcome of designed system based on mathematical analysis of result
- Understand the regulatory mechanism in the area of environmental compliance laid down byvarious agencies

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	WasteWater Engineering Metcalf & Fuddy, 3rd ed.	2013
2.	Environmental Processes I-III, J. Winter, 2nd ed., Wiley Publications	2005
3.	Environmental Studies-Dwivedi & Mishra, Ed	2007
4.	Environmental Biotechnology B.C. Bhattacharya & RituBanerjee, Oxford Press	2007
5.	Essentials of Ecology & Environmental Science, S.V.S. Rana, Prentic-Hall India,	2006
6.	Perspectives in Environmental Studies, Anubha Kaushik & C P Kaushik,	2004
7.	Agarwal S.K. (1998), Environmental Biotechnology, APH Publishing Corporation, New Delhi	1998
8.	Environmental Sciences – Purohit, Shammi & Agrawal, New Age International Publishers,Student Edition	2004

COURSE DETAILS: ENVIRONMENTAL BIOTECHNOLOGY

S N	CONTANT	LECTURE
I.	Environmental pollution: An overview, Land, water, air, and noise, Marine (introduction, sources, effects and measurements). Thermal Pollution, Nuclear and Radiation Pollution, Type of Radiation, Radioactivity in nature, Decay chains, Toxic Hydrocarbon, Radioactive waste sunk, Genetic Consequences.	10
II.	Biotechnology for waste treatment: Biological waste treatments and biofuel production. Microbiology of waste water treatments, Anaerobic digestion process for Methanogenesis: methanogenic, acetogenic, and fermentative microbe. Minimalnational standards for waste disposal.	8
III.	Engineering design and kinetics behavior analysis of various waste treatments methods, with advanced bioreactor configuration: activated sludge process, trickling filter, fluidized expanded bed reactor, upflow anaerobic sludge blanket reactor, contact process, fixed / packed bed reactor, hybrid reactor, sequential batchreactor	8
IV.	Waste to wealth: bioconversion of agricultural and other highly organic waste materials into gainfully utilizable products – biogas, H2, celluloses and food and feed stocks. Bioremediation & Biomineralization: land, water, Contaminated Soil, industries, organic contaminants, heavy metals, Bioleaching of ores, Recovery of metals, Economical and social aspects of waste treatment.	6
V.	Environmental Impact Assessment: Relation between development and environment. Sustainable development and carrying capacity. Screening, scoping. Baseline studies and monitoring. Impact analysis. Public participation. Methodologies. Environmental Protection Act, 1986, Water Prevention and Control of Pollution Act, 1974, Water Prevention and Control of Pollution Cess Act, 1974, Air Prevention and Control of Pollution Act, 1981, Hazardous Wastes (Management and Handling) Rules. International environmental laws.	8

SUBJECT CODE: KBT074	COURSE TITLE: Industrial Biotechnology
EXAM DURATION: 3 HOURS	SEMESTER : VII (ODD)
L: T: P :: 3:0:0 CREDITS: 3	PRE REQUISITES: Knowledge of Microbiology, Biochemistry

OBJECTIVE:

- To provide the knowledge of Industrial Biotechnology.
- To understand the use of living cells such as bacteria, yeast, algae or component of cells like enzymes, plants and animals to generate industrial products and processes.
- To study techniques for genetic improvement of micro-organisms to improve yield of bioproducts.
- To provide the knowledge of microbial production of pharmaceuticals.
- To provide knowledge about biofuels.

COURSE OUTCOME: After successful completion of the course the students will be able to:

- Understand the role of industrial biotechnology in improving microbial cells as factories.
- Understand the different types of bioreactors and the production aspects of commodity chemicals, pharmaceuticals and fine chemicals.
- Apply knowledge of microorganisms in commercial production of flavours, fragrance, and microbial pigment in textile and industry.
- Apply the process for commercial production of enzyme.
- Understand the concept of biofuels and the process of Microbial Enhanced Oil Recovery and Microbial Leaching.

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	C. Vogel and C.L. Tadaro, Fermentation and Biochemical Engineering Handbook: Principles, Process, Design and Equipment, NoyesPublications	1996
2.	P.F. Stansbury and A. Whitaker, Principles of Fermentation Technology: An Introduction to Current Concepts, Pergamon Press	1993
3.	Glazer AN, Nikaido H : Microbial Biotechnology: Fundamentals of Applied Microbiology	2007
4.	Wulf Cruger and Anneliese Crueger, Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation	2003
5.	Malden MA: Industrial Microbiology: An introduction; Blackwell Science	2001
6.	H.W. Blanch, S. Drew, D.I.C.Wang and M. Moo-Young, Comprehensive Biotechnology: The Practice of Biotechnology:Current Commodity Products, Pergamon Press.	1985

COURSE DETAILS: INDUSTRIAL BIOTECHNOLOGY

S N	CONTANT	LECTURE
I.	**Introduction to Industrial Biotechnology:** Overview of fermentation and other industries with their commercial products employing the use of microorganisms; strain improvement through mutation and recombination in industrial microorganisms, Integrated Strain improvement program (Precision Engineering Technology), biosynthetic technology.	8
II.	**Microbes in agriculture and food industry:** beneficial soil microorganisms, biofertilizers and biopesticides, SCP, microbial production of wine, beer and vinegar; biopreservatives (Nisin), cheese, biopolymers (xanthan gum, PHB etc), vitamins; Bioflavours and biopigments; microbial production of flavours and fragrances; microbial pigments in textile and food industry.	8
III.	**Bioreactors, Production of cell biomass, primary metabolites and enzymes:** Different type of Bioreactors and Bioreactor design, Production of ethanol, acetone, butanol, citric acid, dextran and amino acids, Production of industrial enzymes such as proteases, amylases, lipases, cellulases, whole cell biocatalysis, Applications of bioconversion, transformation of steroids and sterols.	8
IV.	**Microbial production of pharmaceuticals and other bioproducts**: Antibiotics, enzyme inhibitors and specialty chemicals; production of Vitamin E, K, B2 and B12, glutamic acid, L-Lysine. Transformation of non-steroidal compounds, antibiotics, genetic engineering of microorganisms for production of nonribosomal peptides (NRPS) and polyketides (PKS), anticancer drugs.	8
V.	**Bioenergy**-fuel from biomass, production and economics of biofuels, biogas, bio-refineries, Microbial Enhanced Oil Recovery (MEOR).	8

SUBJECT CODE: KBT-075	COURSE TITLE: Biosafety, Bioethics, IPR & Patents
EXAM DURATION: 3 HOURS	SEMESTER : VII (ODD)
L: T: P :: 3:0:0 CREDITS: 3	PRE REQUISITES: Basic biology, GMO's and bioethics.

OBJECTIVE:

- To learn about the IPR and its legal provisions and to know about the significance of biosafety in different system.
- To learn about concepts of Patent, Copyright, Trademarks and related IP
- To learn about patent system, biosafety regulatory framework and basics of bioethics

COURSE OUTCOME: After successful completion of the course the students will be able to:

- Get an adequate knowledge on biosafety-regulatory framework for GMO's in India
- Understand biosafety-regulatory framework for GMOS at international level
- Identify the role bioethics in IPR
- Disseminate knowledge on different tools of IPR o make students aware about current trends in IPRand Govt. supports in promoting IPR
- Identify the role of Patent and Patent law

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford andIBH Publishing Co. New Delhi.	2007
2.	Intellectual property rights and Bio-Technology (Biosafety and Bioethics), Anupam Singh, Ashwani Singh, NPH, New Delhi	2012
3.	Sasson A, Biotechnologies and Development, UNESCO Publications..	1988
4.	Regulatory Framework for GMOs in India,Ministry of Environment and Forest, Government of India, New Delhi	2006
5.	Cartagena Protocol on Biosafety , Ministry of Environment and Forest, Government of India, New Delhi	2006

COURSE DETAILS: BIOSAFETY, BIOETHICS, IPR & PATENTS

S N	CONTANT	LECTURE
I.	BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS IN INDIA Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC). Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), PlantQuarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, (1989)	8
II.	BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS AT INTERNATIONAL LEVEL Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol – Advanced Information Agreement (AIA) procedure – procedures for GMOs intended for direct use-risk assessment-risk management-handling, transport, packaging and identification of GMOs-Biosafety Clearing House-unintentional transboundary movement of GMOs-Benefits of becoming a party to the Cartagena Protocol- status of implementation in India.	8
III.	BIOETHICS Distinction among various forms of IPR, ,Prior art for a patent, Patenting live microorganism, Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues, Experimenting on animals. Public education of producing transgenic organism, legal and socioeconomic impacts of biotechnology, testing drugs on human volunteers, Hazardous materials used in biotechnology, their handling and disposal.	8
IV.	INTELLECTUAL PROPERTY RIGHTS Concept of property, rights, duties and Jurisprudential definition, Introduction to patent, copy right, trademarks, Design, geographical indication. History and evolution of IPR, Economic importance of IPR, Indian patent act 1970 (amendment 2000), Distinction among various forms of IPR, invention step, biopiracry and bioprospecting-Appropriate case studies. Infringement/violation of patent, remedies against infringement (civil, criminal, administrative)	8
V.	PATENTS AND PATENT LAWS Plant and Animal growers rights patents trade secrets, and plant genetic recourses GATT and TRIPS, Dunkels Draft Patenting of biological materials, Current Issues of Patents for higher animal and higher plants, patenting of transgenic organisms, isolated genes and DNA sequences..	8

SUBJECT CODE: KBT076	COURSE TITLE: Quality Control & Regulatory affairs
EXAM DURATION: 3 HOURS	SEMESTER: VII (ODD)
L: T: P :: 3 :0: 0 CREDIT: 3	PRE-REQUISITE: IPR & Industrial Management

OBJECTIVE:

- This course is designed with an objective to provide an understanding of the knowledge of Quality control and Quality management
- To learn the concepts of GMP,GLP, standard test procedure and CPCSEA guidelines in Biological samples
- To provide the knowledge of Quality review and batch release document, audits of quality control etc.
- To develop understanding of Good documentation processes, clinical studies guidelines, IP generation pharmacovigilance and product registration guidelines etc.

COURSE OUTCOME: After completion of this course successfully, the students will be able to:

- Understand basic concept of QC and Quality management
- Explain GLP, GMP, Standard Operating Process and CPCSEA guidelines
- Understand of the quality review and audits of QC practices
- Explain the clinical studies guidelines, Good documentation practices, IPR and product Registration guidelines etc.

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	Sharp J. Good Pharmaceutical Manufacturing Practice: Rationale and Compliance. CRC Press	2005
2.	Haider SI. Pharmaceutical Master Validation Plan: The Ultimate Guide to FDA, GMP, andGLP Compliance. St. Lucie Press	2002
3.	Swarbrick J. Encyclopedia of Pharmaceutical Technology. Informa Healthcare	2007
4.	Kolman J, Meng P, Scott G. Good Clinical Practice: Standard Operating Procedures forClinical Researchers. Wiley	1998
5.	Signore AA, Jacobs T. Good Design Practices for GMP Pharmaceutical Facilities. Taylor&Francis Group	2005

COURSE DETAILS: QUALITY CONTROL AND REGULATORY AFFAIRS

S N	CONTANT	LECTURE
I.	Concept and evolution of quality control and quality assurance. Quality control laboratory responsibilities: GLP protocols on non-clinical testing control on animal house, data generation, integration and storage, standard test procedure, retention of sample records. CPCSEA guidelines.	8
II.	Quality review and batch release document of finished products, annual product quality review and parametric release, Audits, quality audits of manufacturing processes and facilities, audits of quality control.	8
III.	Good documentation practices, route cause analysis, corrective action preventive action (CAPA), out of specifications (OOS) and out of trend (OOT), Clinical studies- ICH GCP (E6) guidelines, post marketing surveillance, Pharmacovigilance	8
IV.	BABE (bioavailability and bioequivalence) studies, Concepts and management of contract manufacturing guidelines, Statistical Tools for Quality Control and Precision, Tools of Problem Solving and Continuous Improvement.	8
V.	Introduction, scope and importance of IPR, Concept of trade mark, copyright and patents Product registration guidelines – CDSCO, USFDA, Concept of ISO 9001:2008, 14000, OSHAS guidelines, Quality Strategy for Indian Industry, Brief concept of IND, NDA, ANDA, SNDA and PAT.	8

SUBJECT CODE: KBT077	COURSE TITLE: Biomaterials
EXAM DURATION: 3 HOURS	SEMESTER: VII (ODD)
L: T: P :: 3 : 0: 0 CREDITS: 3	PREREQUISITE: Knowledge Of Chemistry, Biochemistry, Molecular Biology

OBJECTIVE:

- This course is designed with an objective to provide an understanding of the basicconcepts and properties required for a material to be biocompatible.
- To learn about testing & quality assessment of the biomaterials.
- Students will get exposure to latest biomaterials and their application in the area of biomedical.

COURSE OUTCOME: After successful completion of the course the students will beable to:

- Differentiate whether a material has the compatibility with biological system to be usedfor applications.
- To assess the quality of biomaterials,
- To design aspects of new biomaterials or modify existing material for enhancement of biocompatibility.

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	Biomaterials: An Introduction by Park J.B. andLakes R.S., Plenum Press, New York	2007
2.	Biomaterials, Medical Devices & Tissue Engineering: An Integrated Approach by Silver F.H., Chapman and Hall publication.	1994
3.	Biomaterials science: an introduction to materials in medicine by Buddy D. Ratner.,Elsevier Academic Press	2012
4.	Biomaterials: A Tantalus Experience by Jozef A.Helsen., Yannis Missirlis Springer	2010
5.	Biomaterials by Temenoff Johnna S., Dorling Kindersley India Pvt Ltd.	2007

COURSE DETAILS: Biomaterials

S N	CONTANT	LECTURE
I.	Introduction and overview of biomaterials: Definition of biomaterials – biologically derived materials or materials compatible with biology. Biomaterials: Classification of bio-materials (based on tissue response), Tissue engineering, Biosensor.	8
II.	Interactions of materials: Interactions of materials with human body, bio-compatibility of materials, metals (stainless steels, cobalt-chromium alloys, titanium based alloys, nitinol), Ceramics (carmons, alumina, resorbable ceramics, surface reactive ceremics), bio polymers(collagens, elastin, mucopolysachharides, cellulose and derivatives, chitin and other polysaccharides and composites as biomaterials.	8
III.	Biomaterials for human use :Metallic biomaterials as implants, Bioceramics and ceramic biomaterials, Polymeric biomaterials – classification, natural and synthetic materials; biomedical applications, Composite biomaterials – classification, biological responses to composite biomaterials, biomedical applications..	8
IV.	Quality and Testing of Biomaterials Degradation, Corrosion, Deformation, Fracture, Brittle to ductile transition, Fatigue, Tribology. Recent developments in biomaterials, legal issues related to development of biomaterials	8
V.	Nanobiomaterials : Definition and classes of nanobiomaterials Polymeric, ceramic and composite nanobiomaterials Scaffolding, tissue engineering (including stem cells), growth factor delivery with nanobiomaterials	8

SUBJECT CODE: KBT078	COURSE TITLE: Biostatistics & design of experiments
EXAM DURATION: 3 HOURS	SEMESTER: VII (ODD)
L: T: P :: 3 : 0: 0 CREDIT: 3	PRE-REQUISITE: Mathematics

OBJECTIVE:

This course is designed with an objective to provide an understanding of the knowledge of Biostatistics to students so that they can apply statistics in defining the type and quantity of data need to be collected as well as organizing and summarizing the data. This course will also be helpful to analyzing the data,drawing conclusions, and assessing the strengths of the conclusions and evaluating their uncertainty.

COURSE OUTCOME: After completion of this course successfully, the students will be able to:

- Understand basic concept of handling univariate, bivariate, correlation & regression
- Explain probability, variance and theoretical distribution etc. Understand sampling , statistical quality control and data analysis
- Explain design of experiment and process control

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	S.C.Gupta & V.K.Kapoor, Fundamentals of Mathematical Statistics,Sultan Chand and Sons, New Delhi ,	2003
2.	W.Ewans & G.Grant, Statistical Methods in Bio informatics – An Introduction. Springer	2005
3.	Chap T. Le and Lynn E. Eberly, Introductory Biostatistics, Wiley	2016

COURSE DETAILS: BIOSTATISTICS & DESIGN OF EXPERIMENTS

S N	CONTANT	LECTURE
I.	Introduction to bio-statistics, Handling univariate and bivariate data – Measuresof central tendency – Measures of dispersion –Skewness & Kurtosis – Correlation and Regression.	8
II.	Probability concepts, conditional probability, Baye's theorem, one – dimensional random variables, expectation, variance, moments. Theoreticaldistributions: Binomial, Poisson, Normal (Problems only).	8
III.	Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , Sampling Theory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, T-test, F-test and Chi-square test.	8
IV.	The Analysis of Variance: Concept – Assumptions-One way classification andtwo-way classifications. Designing Engineering Experiment: Concept of Randomization, Replication and local control - Completely Randomized Design -Randomized Block Design –Latin square Design.	8
V.	Basic concepts of statistical quality control. Process control – control charts forvariables - X and R, X and s charts control charts for attributes : p chart, np chart, c chart.	8

SUBJECT CODE: KBT751A	COURSE TITLE: Genomics & Proteomics Lab
EXAM DURATION: 2 HOURS	SEMESTER: VII (ODD)
L: T: P :: 0 : 0: 2 CREDIT: 1	PRE-REQUISITE: Molecular Biology & Biochemistry

OBJECTIVE:

- To isolate genetic materials from bacterial cells
- To determine and characterization of enzyme kinetics

COURSE OUTCOME: After completion of this course successfully, the students will be able to:

- Express and purify recombinant protein in bacterial system
- Characterized purified protein through enzymatic activity and kinetics
- Work with publically available genome sequencing data
- Perform genomic DNA and RNA isolation from bacteria and independently setup qRT-PCR

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	Application of DNA microarrays in Biology	2005
2.	Functional Proteomics	2005
3.	Proteomic to study genes and genomes	2000

COURSE DETAILS: GENOMICS & PROTEOMICS LAB

S N	LIST OF EXPERIMENTS
1.	Expression of heterologous protein in bacterial system.
2.	Detection of expressed protein.
3.	Purification of recombinant protein.
4.	Characterization of purified protein using enzymatic activity.
5.	Determination of kinetic parameters.
6.	Browsing through various publically available genome databases, retrieving and working with genome data. KEGG genomes, retrieval of genes, proteins and intergenic regions.
7.	Genomic DNA isolation from bacterial strains and estimation of DNA concentration using Nanodrop, agarose gel electrophoresis.
8.	RNA isolation from Synechocystis and quality check (RIN number) using Bioanalyser chip, cDNA synthesis and qRT-PCR analysis.
9.	Demonstration of Agilent's microarray scanner and DNA microarray protocol.
10.	Raw data processing, scatter plots, global normalization of data, fold changes and finding differentially expressed genes.

SUBJECT CODE: KBT751B	COURSE TITLE: Bioseparation & DownstreamProcessing Lab
EXAM DURATION: 2 HOURS	SEMESTER: VII (ODD)
L: T: P :: 0 : 0: 2 CREDIT: 1	PRE-REQUISITE: Basic Knowledge of molecular biology Techniques

OBJECTIVE:

- To isolate the various bioproducts.
- To develop understanding of bioseparation
- To provide practical knowledge of purification of target bioproducts

COURSE OUTCOME: On successful completion of the course, the student will be able to:

- Understand and explain the bio-separation principles involved in purification of bio-products.
- Evaluate concepts selection of membranes and assess the results of protein purification.
- Design the method for bio-separation of proteins.
- Recover and subsequent purification of target bioproducts.

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	J. Jayaraman, "Laboratory Manual in Biochemistry", 1stEdition, New Age International.	1993
2.	Keith Wilson and John Walker, Practical Biochemistry—Principlesand Techniques, Cambridge, 5th Ed.	2000

COURSE DETAILS: BIOSEPARATION & DOWNSTREAMPROCESSING LAB

S N	LIST OF EXPERIMENTS
1.	Characteristics of Bioproducts: Flocculation and conditioning of broth
2.	Mechanical separation: Filtration and Centrifugation
3.	Determination of volumetric mass transfer coefficient (k_La)
4.	Membrane based separation
5.	Protein precipitation and its separation: Aqueous two phase extraction, Ultra filtration and Adsorption
6.	Chromatography separation based on size, charge, hydrophobic interaction
7.	Gel analysis/ assay for dialyzed product
8.	Product crystallization and drying
9.	Estimation of Alcohol Content in Wine by Dichromate Oxidation followed by Redox TitrationChemical Concepts and Techniques
10.	Product preservative methods -chemical, physical and natural

SUBJECT CODE: KBT753C	COURSE TITLE: Environmental Biotechnology Lab
EXAM DURATION: 2 HOURS	SEMESTER: VII (ODD)
L: T: P :: 0 : 0: 2 CREDIT: 1	PRE-REQUISITE: Basic knowledge of Microbiologyand Bioprocess engineering

OBJECTIVE:

- Hands on experience on water & soil treatments using environmental friendly methods.
- This course is designed to give the students hands-on experience regarding monitoring of environmental parameters as part of field studies

COURSE OUTCOME: On successful completion of the course, the student will be able to

- Learn about various environment friendly methods for Environmental Biotechnology.
- Identify and appreciate the parameters for assessing environment.

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	Hurst, C.J., Crawford, R.L., Knudsen, G.R., MacInerney, M.J. and Stetzenbach, L.D., "Manual of Environmental Microbiology", 2nd Ed., ASM press	2002

COURSE DETAILS: ENVIRONMENTAL BIOTECHNOLOGY LAB

S N	LIST OF EXPERIMENTS
1.	Isolation, Identification, characterization of microbes collected from nearby polluted area/ industries and study of their enzymes.
2.	Environmental influence and control of microbial growth.
3.	Microbial degradation of textile dyes/pesticides/hydrocarbons and oils
4.	To determine BOD value for determining biodegradability of solution
5.	To determine COD value for determining organic strength of solution (Closed Reflux Method)
6.	Determination of metals in waste water and their removal.
7.	Effluent treatment plant (ETP): Primary, chemical and biological treatment
8.	Soil Quality analysis.
9.	Water Quality analysis
10.	Field Trip : (A) Wastewater Treatment Plant (B) How the community deals with domestic solid waste (Collection, disposal and treatment)

SUBJECT CODE: KBT751D	COURSE TITLE: Industrial Biotechnology Lab
EXAM DURATION: 2 HOURS	SEMESTER : VII (ODD)
L: T: P :: 0:0:2 CREDITS: 1	PRE REQUISITES: Knowledge of Microbiology, Biochemistry

OBJECTIVE:

- To produce various bioproducts from cells and tissues.
- To isolate the industrially important microorganisms.
- To study techniques for isolation and purification of bioproducts.
- To provide the knowledge about determining the various important characteristic of industriallyimportant enzymes.

COURSE OUTCOME: After successful completion of the course the students will be able to:

- Demonstrate the production of bioproducts like amylase and citric acid and ethanol.
- Isolate the amylolytic microorganism.
- Purify the industrially important enzymes and proteins.
- Can perform the enzymatic assay.

REFERENCE BOOKS:

S.N	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION
1.	Glazer AN, Nikaido H : Microbial Biotechnology: Fundamentals of Applied Microbiology Eisenthal, R. & Danson N.J. (Eds) Enzyme Assays: "APractical Approach", IRI Press, Oxford, UK	1992
2.	Industrial Biotechnology: Products and Processes	2016
3.	Laboratory Manual In Industrial BiotechnologyBy P. Chellapandi	2007
4.	Practical Manual on Fermentation Technology by S. Kulandaivelu, S. Janarthanan	2012

COURSE DETAILS: INDUSTRIAL BIOTECHNOLOGY LAB

S N	LIST OF EXPERIMENTS
1.	Production and partial purification of Amylase in shake flask culture.
2.	Isolation of amylolytic microorganisms.
3.	Production of Citric acid using Aspergillus species.
4.	Protein precipitation and membrane based separation using dialysis.
5.	Purification of Enzyme by ammonium sulphate fractionation.
6.	Comparative studies of ethanol production using different substrates.
7.	Determination of cellulolytic activity by DNS method.
8.	Enzyme assay; activity and specific activity determination of amylase.

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

OPEN ELECTIVES II LIST

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session:2021-22]

Note:

1. The Student shall choose an open Elective from the list in such a manner that he/she has not studied the same course in any form during the degree programme.
2. * It is mandatory that for these subjects (KOE069, KOE076, KOE087,KOE097 & KOE098) only Trained Faculty (who had done the FDP for these courses) will teach the courses.

B.Tech. VII Semester (2021-22)

OPEN ELECTIVE-II

KOE071	FILTER DESIGN
KOE072	BIOECONOMICS
KOE073	MACHINE LEARNING
KOE074	RENEWABLE ENERGY RESOURCES
KOE075	OPERATIONS RESEARCH
KOE076	VALUE RELATIONSHIP & ETHICAL HUMAN CONDUCT- FOR A HAPPY & HARMONIOUS SOCIETY
KOE077	DESIGN THINKING
KOE078	SOIL AND WATER CONSERVATION ENGINEERING
KOE078	INTRODUCTION TO WOMEN'S AND GENDER STUDIES

KOE-071	**FILTER DESIGN**	**3L:0T:0P**	**3 Credits**

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand about the characteristics of different filters.
2. Understand the concept of Approximation Theory.
3. Learn about the switched capacitor filter.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Choose an appropriate transform for the given signal.
CO2	Choose appropriate decimation and interpolation factors for high performance filters.
CO3	Model and design an AR system.
CO4	Implement filter algorithms on a given DSP processor platform.

Unit	Topics	Lectures
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulationand modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	8
II	First order filter: Bilinear transfer functions and frequency response – Bilinear transfer function and its parts, realization of passive elements,Bode plots, Active realization, The effect of A(s), cascade design.	8
III	Second order low pass and band pass filters: Design parameters, Second order circuit, frequency response of low pass and band pass circuits, Integrators and others biquads.	8
IV	Second order filters with arbitrary transmission zeros: By using summing, By voltage feed forward, cascade design revisited. Low pass filters with maximally flat magnitude: the ideal low pass filter, Butterworth response, Butterworth pole locations, low pass filter specifications, arbitrary transmission zeros.	8
V	Low pass filter with equal ripple (Chebyshev) magnitude response: The chebyshev polynomial ,The chebyshev magnitude response, Location of chebyshev poles, Comparison of maximally flat & equal–ripple responses, Chebyshev filter design Inverse chebyshev and cauer filters: Inverse chebyshev response, From specifications to pole and zero locations, Cauer magnitude response, Chebyshev rational functions, Cauer filter design.	8

Text Book:

1. Rolf. Schaumann, Haiqiao Xiao, Mac. E. Van Valkenburg, "Analog Filter Design", 2ndIndianEdition, Oxford University Press.

Reference Books:

1. J. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Second edition,Pearson.
2. T. Deliyannis, Yichuang Sun, J.K. Fidler, "Continuous-Time Active Filter Design",CRC Press.

KOE-072	**BIOECONOMICS**	**3L:0T:0P**	**3 Credits**

OBJECTIVE:
This course is designed with an objective to provide an understanding of the basic knowledge of bioecomics to students so that they can explore entrepreneurship opportunities in the bio based industry. This course also serves interdisciplinary innovation in terms of sustainable bioeconomy

COURSE OUTCOME: After completion of the course student will be able to:

1. Students will be able to understand basic concept of Bioeconomics, challenges, opportunities& regulations
2. Students will be able to understand development and innovation in terms of bioeconomy towards sustainable development
3. Students will be able to understand Inter- and transdisciplinarity in bioeconomy &research approaches
4. Students will be able to explain biobased resources ,value chain, innovative use of biomass and biological knowledge to provide food, feed, industrial products

Unit	**Topics**	**Lectures**
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulationand modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	8
II	Economic Growth, Development, and Innovation in terms of bioeconomy, Environmental Economics and the Role of Government, Modelling and Tools Supporting the Transition to a Bioeconomy, Role of biobased Economy in sustainable development.	8
III	Inter- and transdisciplinarity in Bioeconomy &research approaches, primary production, processing of biobased resources,Markets, Sustainability Management and Entrepreneurship in biobased products.	8
IV	Biobased Resources and Value Chains, Processing of Biobased Resources, Markets, Sustainability Management and Entrepreneurship opportunity in biobased product. Food Security and Healthy Nutrition in the Context of the Bioeconomy, Use of Biomass for the Production of Fuel and Chemicals, The importance of Biotechnology for the Bioeconomy.	8
V	sustainable and innovative use of biomass and biological knowledge to provide food, feed, industrial products, bioenergy and ecological services, importance of bioeconomy-related concepts in public, scientific, and political discourse, Dynamic Management of Fossil Fuel, Biofuel.	8

Text Book:

1. Principles of Bioeconomics by I. Sundar, Vedams eBooks (P) Ltd New Delhi, India
2. Bioeconomy:Shaping the Transition to a Sustainable, Biobased Economy by Iris Lewandowski, Springer.
3. Sociobiology and Bioeconomics by **Koslowski**, Peter
4. Modeling, Dynamics, Optimization and Bioeconomics I, by **Pinto**, Alberto Adrego, **Zilberman**, David, Springer.

KOE-073	MACHINE LEARNING	**3L:0T:0P**	**3 Credits**

Unit	Topics	Lectures
I	INTRODUCTION – Well defined learning problems, Designing a Learning System, Issues in Machine Learning; THE CONCEPT LEARNING TASK - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias.	8
II	DECISION TREE LEARNING - Decision tree learning algorithm- Inductive bias- Issues in Decision tree learning; ARTIFICIAL NEURAL NETWORKS – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of backpropagation rule Backpropagation AlgorithmConvergence, Generalization.	8
III	Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm.	8
IV	Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning.	8
V	Genetic Algorithms: an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules- sequential covering algorithms-General to specific beam search-FOIL; REINFORCEMENT LEARNING - The Learning Task, Q learning.	8

Text Book:

1. Tom M. Mitchell,―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin,―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer- Verlag.

KOE-074	**RENEWABLE ENERGY RESOURCES**	**3L:0T:0P**	**3 Credits**

Unit	Topics	Lectures
I	Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.	8
II	Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energystorage for solar heating and cooling, limitations.	8
III	Geothermal Energy: Resources of geothermal energy, thermodynamics of geo- thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Cells: Principle of working of various types of fuel cells and their working, performance and limitations.	8
IV	Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.	8
V	Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.	8

Text Book:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “Energy Resources: Conventional & Non-Conventional” BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International.
5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle,“ Renewable Energy Power For A Sustainable Future”, Oxford University Press.

KOE-075	OPERATIONS RESEARCH	**3L:0T:0P**	**3Credits**

Unit	**Topics**	**Lectures**
I	Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.	8
II	Transportation Problems: Types of transportation problems, mathematical models, transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines.	8
III	Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT	8
IV	Theory of Games : Rectangular games, Minimax theorem, graphical solution of 2x n or mx2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queing model, single server models.	8
V	Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipments that deteriorate with time, equipments that fail with time.	8

Text Book:

1. Wayne L. Winston,"Operations Research" Thomson Learning, 2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education, 2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V.K.Khanna, "Total Quality Management" New Age International, 2008.

KOE-076	**VALUES, RELATIONSHIP & ETHICAL HUMAN CONDUCT–FOR A HAPPY & HARMONIOUS SOCIETY**	**3L:0T:0P**	**3 Credits**

Pre-requisites- for this subject only those faculty will teach these courses who had done the FDP for these courses.

Course Objectives:

1. To help the students to understand the importance and types of relationship with expressions.
2. To develop the competence to think about the conceptual framework of undivided society as well as universal human order.
3. To help the students to develop the exposure for transition from current state to the undivided society and universal human order.

Course Methodology:

1. The methodology of this course is exploration and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or set of do's and don'ts related to values.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre- conditionings and present beliefs.

Unit	Topics	Lectures
I	Introduction to the course: Basic aspiration of a Human Being and program for its fulfilment, Need for family and relationship for a Human Being, Human-relationship and role of work in its fulfilment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order, an appraisal of the Current State, Appraisal of Efforts in this Direction in Human History.	8
II	Understanding Human-Human Relationship & its fulfilment: Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfilment, Expression of feelings, Types of relationship and their purpose, mutual evaluation in relationship, Meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.	8
III	Justice from family to world family order: Undivided Society as continuity and expanse of Justice in behaviour – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order, Universal Human Order as continuity and expanse of order in living: from family order to world family order, a conceptual framework for universal human order.	8

IV	Program for Ensuring Undivided Society and Universal Human Order: Education –Sanskar, Health –Sanyam, Production-work, Exchange – storage, Justice-preservation.	8
V	Human Tradition: Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.	8

Text books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Asthana, G. P. Bagaria (2010), Excel Books, New Delhi.
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
3. An Appeal by the Dalai Lama to the World: Ethics Are More Important Than Religion, Dalai Lama XIV, 2015.
4. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India.
1. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA.
2. Human Society, Kingsley Davis, 1949.
3. Hind Swaraj or, Indian home rule Mohandas K. Gandhi, 1909.
4. Integral Humanism, Deendayal Upadhyaya, 1965.
5. Lohiya Ke Vichar, Lok Bharti , Rammanohar Lohiya, 2008.
6. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
7. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
8. Samadhanatmak Bhautikvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India
9. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher,1973, Blond & Briggs, UK.
10. Slow is Beautiful, Cecile Andrews (http://www.newsociety.com/Books/S/Slow-is- Beautiful)
11. Sociology Themes and Perspectives, Harper Collins; EIGHT edition (2014), Martin Holborn and Peter Langley, 1980.
12. Samagra kranti: Jaya Prakash Narayan's philosophy of social change, Siddharth Publications Renu Sinha, 1996.
13. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
14. Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
15. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
16. The Communist Manifesto, Karl Marx, 1848.
17. Toward a True Kinship of Faiths: How the World's Religions Can Come Together Dalai Lama XIV, 2011

Reference Videos.

1. Kin school (30 minutes)
2. Technology (Solar City etc.).
3. Natural Farming.
4. Economics of Happiness (1h 8m).

KOE-077	Design Thinking	3L:0T:0P	3Credits

Objective: The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems

Unit	*Topics*	Lectures
I	Introduction to design thinking, traditional problem solving versus design thinking, history of design thinking, wicked problems. Innovation and creativity, the role of innovation and creativity in organizations, creativity in teams and their environments, design mindset. Introduction to elements and principles of design, 13 Musical Notes for Design Mindset, Examples of Great Design, Design Approaches across the world	8
II	Understanding humans as a combination of I (self) and body, basic physical needs up to actualization, prosperity, the gap between desires and actualization. Understanding culture in family society, institution, startup, socialization process. Ethical behavior: effects on self, society, understanding core values and feelings, negative sentiments and how to overcome them, definite human conduct: universal human goal, developing human consciousness in values, policy, and character. Understand stakeholders, techniques to empathize, identify key user problems. Empathy tools- Interviews, empathy maps, emotional mapping, immersion and observations, customer journey maps, and brainstorming, Classifying insights after Observations, Classifying Stakeholders, Do's & Don'ts for Brainstorming, Individual activity- 'Moccasin walk'	8
III	Defining the problem statement, creating personas, Point of View (POV) statements. Research- identifying drivers, information gathering, target groups, samples, and feedbacks. Idea Generation-basic design directions, Themes of Thinking, inspirations and references, brainstorming, inclusion, sketching and presenting ideas, idea evaluation, double diamond approach, analyze – four W's, 5 why's, "How Might We", Defining the problem using Ice-Cream Sticks, Metaphor & Random Association Technique, Mind-Map, ideation activity games - six thinking hats, million-dollar idea, introduction to visual collaboration and brainstorming tools - Mural, JamBoard	8
IV	Fundamental concepts of critical thinking, the difference between critical and ordinary thinking, characteristics of critical thinkers, critical thinking skills-linking ideas, structuring arguments, recognizing incongruences, five pillars of critical thinking, argumentation versus rhetoric, cognitive bias, tribalism, and politics. Case study on applying critical thinking on different scenarios.	8
V	The argument, claim, and statement, identifying premises and conclusion, truth and logic conditions, valid/invalid arguments, strong/weak arguments, deductive argument, argument diagrams, logical reasoning, scientific reasoning, logical fallacies, propositional logic, probability, and judgment, obstacles to critical thinking. Group activity/role plays on evaluating arguments.	8

Text Book:

1. Vijay Kumar, 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, 2013, John Wiley and Sons Inc, New Jersey
2. BP Banerjee, Foundations of Ethics and Management, 2005, Excel Books
3. Gavin Ambrose and Paul Harris, Basics Design 08: Design Thinking, 2010, AVA Publishing SA
4. Roger L. Martin, Design of Business: Why Design Thinking is the Next Competitive Advantage, 2009, Harvard Business Press, Boston MA

Course Outcome: After successful completion of the course the students will be able to:

1. Develop a strong understanding of the design process and apply it in a variety of business settings
2. Analyze self, culture, teamwork to work in a multidisciplinary environment and exhibit empathetic behavior
3. Formulate specific problem statements of real time issues and generate innovative ideas using design tools
4. Apply critical thinking skills in order to arrive at the root cause from a set of likely causes
5. Demonstrate an enhanced ability to apply design thinking skills for evaluation of claims and arguments.

KOE-078	Soil and Water Conservation Engineering	3L:0T:0P	3Credits

Unit	*Topics*	Lectures
I	Definition and scope of soil conservation, cause of soil erosion, Mechanism of erosion, universal soil loss equation, soil erosion due to wind and its control, vegetation management, i.e., strip cropping, stubble mulching and other practices.	8
II	Types of soil erosion due to water- sheet erosion, rill erosion, gully erosion, sediment transport in channels, sediment deposition in reservoirs. Methods of soil erosion control: bounding and terracing on agriculture land for gully control, bench terraces, vegetated water ways, chute spillways, drop inlet spillways, check dams, river training works.	8
III	Biological methods of soil erosion control, grass land management, forest management. Soil quality management, drainage works, reclamation of salt affected soils. Water conservation: water harvesting, rainfall- run off relation, water storage in ponds, lakes, reservoirs and aquifers, groundwater recharge through wells, check dams and storage works.	8
IV	Water losses: filtration, seepage and evaporation losses, pollution/ contamination of water quality due to agricultural practices i.e., fertilizers and pesticides, self purification of surface water, sources of agricultural water pollution, pollutant dispersion in ground water.	8
V	Need of planned utilization of water resources, economics of water resources utilization. Flood plain zones management, modifying the flood, reducing susceptibility to damage, reducing the impact of flooding.	8

Suggested reading:

1. Alam Singh – Modern Geotechnical Engineering
2. K. R. Arora – Soil Mechanics and foundation Engineering.
3. N. C. Brady – Principles of Soil Sciences
4. B. C. Punmia – Soil Mechanics and Foundation Engineering

KOE-079	Introduction to Women's and Gender Studies	3L:0T:0P	3Credits

Unit	*Topics*	Lectures
I	**Women and Society:** Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Private and Public dichotomy, Sexual Division of Work, Patriarchy practices in different institutions and Text Books.	8
II	**Feminist Theory:** Rise of Feminism, Introduction to various stands of Feminism- Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post Colonial Feminism, Post Modern Feminism. Waves of Feminism.	8
III	**Women's Movement:** The socio-economic conditions of women during the age of Industrial revolution the Call for Women's Rights 1848, Women's rights movement 1848-1920,Historical Developments of Social Reform Movements in India , Women's groups and organizations, Women's Movement Movements for Uniform Civil code and ShahBano case, Dalit women and the question of double marginality.	8
IV	**Gender Roles and Psychology of Sex:** Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic, Relationships Sex Differences in Mental Health Trauma relating to Rape , Taboo , Childhood Sexual Abuse , Domestic Violence , Sexual Harassment at Work Place, Educational Institutions, Eve Teasing etc.	8
V	**Gender and Representation:** Gender and Mass Media- Print Media, Gender and Mass Media-Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.	8

Suggested reading:

5. Basab iChakrabarti, Women's Studies: Various Aspects. UrbiPrakashani2014
6. Arvind Narrain. Queer: Despised Sexuality Law and Social Change. Book for Change. 2005
7. Chandra Talpade Mohanty, Feminism without Borders: Decolonizing Theory, Practicing Solidarity. Duke University Press.
8. Flavia Agnes. Law and Gender Inequality: The Politics of Women's Rights in India. Oxford University Press, 2001
9. Sonia Bathla, Women, Democracy and the Media: Cultural and Political Representations in the Indian Press, Sage, New Delhi, 1998.

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

III & IV
OPEN ELECTIVES LIST

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2021-22]

Note:

1. The Student shall choose an open Elective from the list in such a manner that he/she has not studied the same course in any form during the degree programme.
2. ** It is mandatory that for these subjects (KOE089, KOE098 & KOE099) only Trained Faculty (who had done the FDP for these courses) will teach the courses.

B. TECH.
VIII Semester (2021-22)

OPEN ELECTIVE –III

KOE-081	CLOUD COMPUTING
KOE-082	BIO MEDICAL SIGNAL PROCESSING
KOE-083	ENTREPRENEURSHIP DEVELOPMENT
KOE-084	INTRODUCTION TO SMART GRID
KOE-085	QUALITY MANAGEMENT
KOE-086	INDUSTRIAL OPTIMIZATION TECHNIQUES
KOE-087	VIROLOGY
KOE-088	NATURAL LANGUAGE PROCESSING
KOE-089	**HUMAN VALUES IN MADHYASTH DARSHAN

OPEN ELECTIVE –IV

KOE-090	ELECTRIC VEHICLES
KOE-091	AUTOMATION AND ROBOTICS
KOE-092	COMPUTERIZED PROCESS CONTROL
KOE-093	DATA WAREHOUSING & DATA MINING
KOE-094	DIGITAL AND SOCIAL MEDIA MARKETING
KOE-095	MODELING OF FIELD-EFFECT NANO DEVICES
KOE-096	MODELLING AND SIMULATION OF DYNAMIC SYSTEMS
KOE-097	BIG DATA
KOE-098	**HUMAN VALUES IN BUDDHA AND JAIN DARSHAN
KOE-099	**HUMAN VALUES IN VEDIC DARSANA

OPEN ELECTIVE –III

KOE-081	**CLOUD COMPUTING**
KOE-082	**BIO MEDICAL SIGNAL PROCESSING**
KOE-083	**ENTREPRENEURSHIP DEVELOPMENT**
KOE-084	**INTRODUCTION TO SMART GRID**
KOE-085	**QUALITY MANAGEMENT**
KOE-086	**INDUSTRIAL OPTIMIZATION TECHNIQUES**
KOE-087	**VIROLOGY**
KOE-088	**NATURAL LANGUAGE PROCESSING**
KOE-089	****HUMAN VALUES IN MADHYASTH DARSHAN**

** It is mandatory that for these subjects (KOE089) only Trained Faculty (who had done the FDP for these courses) will teach the courses.

KOE081: CLOUD COMPUTING		
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed, History of Cloud Computing - Cloud Architecture - Types of Clouds - Business models around Clouds – Major Players in Cloud Computing- issues in Clouds - Eucalyptus - Nimbus - Open Nebula, CloudSim.	08
II	**Cloud Services:** Types of Cloud services: Software as a Service- Platform as a Service –Infrastructure as a Service - Database as a Service - Monitoring as a Service –Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force.	08
III	**Collaborating Using Cloud Services:** Email Communication over the Cloud - CRM Management – Project Management-Event Management - Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networks and Groupware.	08
IV	**Virtualization for Cloud:** Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization –System VM, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - supervisors – Xen, KVM, VMware, Virtual Box, Hyper-V.	08
V	**Security, Standards and Applications:** Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud. Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine	08

Text Books:

1. David E.Y. Sarna, “Implementing and Developing Cloud Application”, CRC press 2011.
2. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, Draft cloud computing synopsis and recommendation, May 2011.
3. Anthony T Velte, Toby J Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, McGrawHill 2010.
4. Haley Beard, “Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs”, Emereo Pty Limited, July 2008.

KOE082: BIOMEDICAL SIGNAL PROCESSING		
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	Introduction to Bio-Medical Signals: Classification, Acquisition and Difficulties during Acquisition. Basics of Electrocardiography, Electroencephalography, Electromyography & electro-retinography Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field.	08
II	ECG: Measurement of Amplitude and Time Intervals, QRS Detection (Different Methods), ST Segment Analysis, Removal of Baseline Wander and Power line Interferences, Arrhythmia Analysis, Portable Arrhythmia Monitors.	08
III	Data Reduction: Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length. Coding.	08
IV	EEG: Neurological Signal Processing, EEG characteristic, linear prediction theory, Sleep EEG, Dynamics of Sleep/Wake transition. Study of pattern of brain waves, Epilepsy-Transition, detection and Estimation. EEG Analysis By Spectral Estimation: The Bt Method, Periodogram, Maximum Entropy Method & AR Method, Moving Average Method. The ARMA Methods, Maximum Likelihood Method.	08
V	EP Estimation: by Signal Averaging, Adaptive Filtering:- General Structures of Adaptive filters, LMS Adaptive Filter, Adaptive Noise Cancelling, Wavelet Detection:- Introduction, Detection By Structural features, Matched Filtering, Adaptive Wavelet Detection, Detection of Overlapping Wavelets.	08

Text Books:

1. Willis J. Tomkin, “Biomedical Digital Signal Processing”, PHI.
2. D. C. Reddy, “Biomedical Signal Processing”, McGraw Hill
3. Crommwell Weibel and Pfeifer, “Biomedical Instrumentation and Measurement”, PHI

Reference Books:

1. Arnon Cohen, “Biomedical Signal Processing (volume-I)”, Licrc Press\
2. Rangaraj M. Rangayyan, “Biomedical Signal Analysis A Case Study Approach”, John Wiley and Sons Inc.
3. John G. Webster, “Medical instrumentation Application and Design”, John Wiley & Sons Inc

KOE083: ENTREPRENEURSHIP DEVELOPMENT		
DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	Entrepreneurship- definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.	08
II	Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.	08
III	Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.	08
IV	Project Planning and control: The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.	08
V	Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.	08

Text Books:

1. Forbat, John, “Entrepreneurship” New Age International.
2. Havinal, Veerbhadrappa, “Management and Entrepreneurship” New Age International
3. Joseph, L. Massod, “Essential of Management", Prentice Hall of India

KOE084: INTRODUCTION TO SMART GRID		
DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.	08
II	**Smart Grid Technologies:** Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.	08
III	**Smart Grid Technologies:** Smart Substations, Substation Automation, Feeder Automation, Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU), PMUs application to monitoring & control of power system.	08
IV	**Microgrids and Distributed Energy Resources:** Concept of microgrid, need & application of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid, Plastic & Organic solar cells, thin flim solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.	08
V	**Power Quality Management in Smart Grid:** Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring	08

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid:
4. Technology and Applications", Wiley.
5. Jean Claude Sabonnadiere, NouredineHadjsaid, "Smart Grids", Wiley Blackwell 19.
6. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press.

Reference Books:

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability",Artech House Publishers July 2011.
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
3. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "SubstationAutomation (Power Electronice and Power Systems)", Springer
4. R.C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication.

KOE085: QUALITY MANAGEMENT		
DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.	08
II	Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.	08
III	Control Charts, Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart, Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts	08
IV	Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.	08
V	ISO-9000 and its concept of Quality Management, ISO 9000 series, Taguchi method, JIT in some details.	08

Text Books:

1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, .
2. Greg Bounds, "Beyond Total Quality Management",McGraw Hill
3. Menon, H.G, "TQM in New Product manufacturing",McGraw Hill

KOE086: INDUSTRIAL OPTIMIZATION TECHNIQUES		
DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**I Linear Programming:** Historical development of optimization, engineering application of optimization, formulation of design problems as a mathematical programing problem. Graphical method of solution, Simplex method, Dual Simplex method and its application in engineering. **Transportation and Assignment:** Introduction**,** Mathematical formulations, optimal solution of transportation model. Assignment problems: mathematical formulation, solution of Assignment models (Hungarian method), variation of the Assignment problem, the travelling sales man problem and their application in Engineering.	08
II	**Sequencing and Network Analysis:** Introduction of sequencing, General assumptions, n Jobs through 2 machines, n jobs through 3 machines, *n* jobs through *m* machines, 2 jobs through *m* machines and their applications in Engineering. **Network Analysis: Introduction,** Network logic (Network or arrow diagram), Rules for drawing network diagrams, time analysis, forward and backward computation CPM and PERT, and their applications in Engineering.	08
III	**Theory of Games and Queueing Models:** Introduction, 2 person zero sum games, Maximin and minimax principle, game with saddle point and without saddle point, Principle of dominance, Rectangular games, graphical solution of 2xn or mx2 games. **Queuing model:** Introduction, Application of Queuing model, generalized Poisson queuing model, single server models and multiple channel Queuing modeland their applications in Engineering.	08
IV	**Dynamic Programming and Simulation**: Introduction Formulation of Dynamic Programming Problem, Dynamic Programming Algorithm, Forward recursions, Capital Budgeting Problem, Cargo-loading Problem. Solution of LPP by DPP **Simulation:** Introduction, definition and types of simulation, need for Simulation advantage and disadvantage, application of simulation, simulation procedure, Monte Carlo simulation and their applications in Engineering.	08
V	**Inventory Control and Replacement Models:** Introduction, types of inventories, Inventory cost, Deterministic and probabilistic (nondeterministic) inventory models and their application in engineering. **Replacement models:** Introduction, definition, Replacement of items that deteriorate, Replacement of items that fail suddenly, Equipment Renewal Problem, Individual and Group Replacement policies & their applications in Engineering	08

Text Books:

1. Singiresu S. Rao. “Engineering Optimization” Theory and Practice”. New Age International, New Delhi.
2. R. Panneerselvam. “Operations Research “. Prentice- Hall of India, New Delhi
3. Eliezer Naddor. “Inventory Systems”. John Wiley & Sons, Inc. New York

Reference Books:

1. H.A. Taha: Operations Research – An Introduction, Macmillan Publishing Company, Inc., New York.
2. K. Swarup, P.K. Gupta, M. Mohan: “Operations Research”, Sultan Chand and Sons, New Delhi.
3. P.K. Gupta, D.S. Hira: “Operations Research” – An Introduction, S. Chand & Company Limited, New Delhi.
4. S.S. Rao: “Optimization Theory and Applications”, Wiley Eastern Ltd., New Delhi.
5. J.K. Sharma: “Operations Research: Theory and Applications”, Mac Millan India

KOE 087: VIROLOGY

OBJECTIVE:

The objective of this course is to help the student learn molecular virology by general principles as opposed to describing each virus family. The rules for viral replication that all viruses follow are illustrated and discussed: while pointing out to the specific features of each virus, the course aims to reveal unity in the virus world rather than diversity. Host-pathogen interactions and examples of viral diseases will be discussed, with particular emphasis on the main principles of vaccine and antiviral drug development

DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	General Concepts: Virus history, Diversity, shapes, sizes and components of genomes. Isolation and purification of viruses and components.	08
II	Consequences of virus infection to animals and human. Viral infection: affect on host macromolecules. Viral infection: establishment of the antiviral state. Viruses counter attack mechanisms. Viral diagnostic techniques: Rapid Antigen testing, RTPCR.	08
III	Classification of viruses and nomenclatures. +strand RNA viruses- Picorna viruses. Flavi viruses- West Nile virus and Dengue virus. Corona viruses- SARS pathogens. Small DNA viruses: parvo- and polyoma viruses. Large DNA viruses: Herpes-adeno-, and poxviruses. Miscellaneous viruses.	08
IV	–ve strand RNA viruses Paramyxo viruses. Orthomyxo viruses: Influenza pathogenesis and Bird flu. Rhabdo viruses: Rabies pathogenesis.. dsRNA viruses- Reo viruses. Retroviruses: structure, classification, life cycle; reverse transcription. Retroviruses: HIV, viral pathogenesis and AIDS.	08
V	Antivirals and viral vaccines Viral Vaccines Conventional vaccines- killed and attenuated, modern vaccinesrecombinant proteins, subunits, DNA vaccines, peptides, immunemodulators (cytokines), vaccine delivery and adjuvants, large scale manufacturing- QA/QC issues. Antivirals Interferons, designing and screening of antivirals, mechanism of action, antiviral libraries, antiretrovirals- mechanism of action and drug resistance. Modern approaches of virus control Anti-sense RNA, siRNA, ribozymes.	08

Reference Books:

1. Antiviral Agents, Vaccines and immunotherapies. Stephen K. Tyring. ISBN 9780367393748 CRC
2. Basic Virology – Edward K Wanger. Blackwell Publication
3. Fundamentals of molecular virology – Acheson and Nicholas H,2011
4. Principles of Virology 2nd edition by S.J.Flint, L.W.Enquist, R.M.Krug,V.R. Racaniello, and A.M.Skalka ASM Press
5. Medical Virology 4th edition by David O.White and Frank J. Fenner. Academic Press.

KOE088: NATURAL LANGUAGE PROCESSING		
DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Natural Language Understanding:** The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.	**08**
II	Introduction to semantics and knowledge representation, some applications like machine translation, database interface.	**08**
III	Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top- Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.	**08**
IV	**Grammars for Natural Language:** Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.	**08**
V	**Ambiguity Resolution:** Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.	**08**

Text Books:

1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, "NLP: A Paninian Perspective", Prentice Hall, New Delhi.
2. James Allen, "Natural Language Understanding", Pearson Education.
3. D. Jurafsky, J. H. Martin, "Speech and Language Processing", Pearson Education.
4. L. M. Ivansca, S. C. Shapiro, "Natural Language Processing and Language Representation", AAAI Press, 2000.
5. T. Winograd, Language as a Cognitive Process, Addison-Wesley.

KOE089: HUMAN VALUES IN MADHYASTH DARSHAN		
DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
	Catalogue Description: Madhyasth Darshan is a new emerging philosophy that describes the existential realities along with its implication in behaviour and work at the level of individual as well as society. This philosophy has been propounded by Shri A. Nagraj in seventies. It is to be kept in mind that Darshan means realisation which calls for developing the capacity to see the reality in oneself directly. So, any study of Darshan shall help develop this capacity in the students through proper steps of practices and shall not just provide the information.	08
I	**Module I: Introduction to Madhyasth Darshan and its Basics** Need to study Madhyasth Darshan; introduction, basic formulations of the darshan; the complete expanse of study and the natural outcome of living according to the darshan.	08
II	**Module II: Submergence of Nature in Space** The ever-present existence in the form of nature submerged in space; nature classified into two categories – material and consciousness, and four orders; the form, property, natural characteristic and self-organization of the four orders, General direction and process of evolution in the nature/ existence.	08
III	**Module III: Human Being as an indivisible part of Nature** Human being as an indivisible part of nature; various types (five classes) of human beings; human being in the combination of self and body; purpose of self as realization, prosperity for the body; need of behavior and work for attaining the goals of realization and prosperity	08
IV	**Module IV: Fulfillment of human goal of realization and prosperity** Following natural, social and psychological principles for actualizing the human goal; form of conducive society and order for such practices, study process- achieving realization through self-study and practice while living in such a society (social order).	08
V	**Module V: Human Conduct based on Madhyasth Darshan** Description of such a realized self, continuity of happiness, peace, satisfaction and bliss through realization, conduct of a realized human being. Possibility of finding solutions to present day problems (such as inequality of rich and poor, man and woman etc.) in the light of it.	

Text Books:

1. Nagraj, A., "*Manav Vyavahar Darshan"*, Jeevan Vidya Prakashan, 3rd edition, 2003

References:

1. Nagraj, A., "Vyavaharvadi Samajshastra", Jeevan Vidya Prakashan, 2nd edition, 2009.
2. Nagraj, A., "Avartanasheel Arthashastra", Jeevan Vidya Prakashan, 1st edition, 1998.
3. Class notes on "Human Values in Madhyasth Darshan" available on www.uhv.org.in
4. PPTs for "Human Values in Madhyasth Darshan" available on www.uhv.org.in
5. Video lectures on "Human Values in Madhyasth Darshan" on AKTU Digital Education (https://www.youtube.com/watch?v=l4x26FPFJYs&t=1558s)

OPEN ELECTIVE –IV

KOE-090	**ELECTRIC VEHICLES**
KOE-091	AUTOMATION AND ROBOTICS
KOE-092	COMPUTERIZED PROCESS CONTROL
KOE-093	DATA WAREHOUSING & DATA MINING
KOE-094	DIGITAL AND SOCIAL MEDIA MARKETING
KOE-095	MODELING OF FIELD-EFFECT NANO DEVICES
KOE-096	MODELLING AND SIMULATION OF DYNAMIC SYSTEMS
KOE-097	BIG DATA
KOE-098	**HUMAN VALUES IN BUDDHA AND JAIN DARSHAN
KOE-099	**HUMAN VALUES IN VEDIC DARSANA

** It is mandatory that for these subjects (KOE098 & KOE099) only Trained Faculty (who had done the FDP for these courses) will teach the courses.

KOE090 ELECTRIC VEHICLES		
DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**Introduction of Electric Vehicles:** Concept of Electrified transportation, Past, present status of electric vehicles, Recent developments and trends in electric vehicles, Comparison of EVs and IC Engine vehicles, Understanding electric vehicle components, Basic EV components and architecture, Autonomy and vehicle computing needs.	08
II	**Electric Motor Drives for EV applications:** Concept of EV motors, Classification of EV motors, Comparison of Electric motors for EV applications, Recent EV motors, BLDC and SRM, axial flux motor. Introduction to power electronics converters, DC-DC converter, speed control of dc motor, BLDC motor driving schemes.	08
III	**EV Batteries and Battery Management System:** EV batteries, Lead Acid batteries – Basics, Characteristics, Lithium batteries- Basics, Characteristics, Selection of battery for EVs, Smart battery pack design, Mechanical and reliability aspects of Li Ion packs, UN38 regulation familiarity, Cell balancing in Li Ion, Battery second life and usage in BESS (energy storage systems). BMS - Global price trends, volumetric and gravimetric efficiency trends	08
IV	**Charging system design technology for EV applications:** Charging system design considerations, AC & DC Charging, Charging methods, On-board/Off-board chargers,Vehicle to charger communication system, OCPP familiarity cloud and device side, metrology, billing and authentication types, understand the computing needs in a charging system, Understand internal major block diagrams and subsystems of low and high power chargers. IEC61850 and 61851 familiarities, IEC61000, 60950/51, IEC62196 key highlights.	08
V	**EV Charging Facility Planning:** Identification of EV demand, Impact of EV charging on power grid, Energy generation scheduling, different power sources, centralized charging schemes, Energy storage integration into micro-grid, Overview and applicability of AI for the EV ecosystem, design of V2G aggregator, case studies.	08

Reference:

1. C.C.Chan, K.T.Chau. Modern Electric Vehicle Technology, Oxford University Press, NY 2001
2. M.Ehsani, Y.Gao, S.E.Gay, A.Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design, CRC Press, 2004
3. James Larminie, John Lowry. Electric Vehicle Technology Explained. Wiley 2012
4. NPTEL Course on Electric Vehicles – Part 1 by Dr. Amit Jain, IIT Delhi
5. Tests on Lithium-ion batteries. Available at: https://www.lithium-batterie-service.de/en/un-38.3-test-series
6. Handbook on Battery Energy Storage Systems- ADB, 2018

Addition Practical Hand (Lab works):

a. BLDC motor control experiment
b. E-rickshaw commercial BLDC and driver based live demo
c. Charge discharge characteristics of Li-Ion batteries and cells
d. BMS function SoC, SoH and cell balancing demo
e. PFC demo and waveform capture
f. LLC (DCDC) demo and waveform capture
g. CV, CC operation
h. Tear down analysis of DC fast charger and AC fast charger

KOE091 AUTOMATION AND ROBOTICS		
DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**Automation:** Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.	08
II	**Manufacturing Automation:** Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimode and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations.	08
III	**Robotics:** Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source. Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.	08
IV	**Robot Drives and Power Transmission Systems:** Robot drive mechanisms: Hydraulic/Electric/Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings. Robot end Effectors: Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for rippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.	08
V	**Robot Simulation:** Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming. Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.	08

Text Books:

7. An Introduction to Robot Technology, by Coifet Chirroza, Kogan Page.
8. Robotics for Engineers, by Y. Koren, McGraw Hill.
9. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
10. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
11. Robotics, by J.J. Craig, Addison-Wesley.
12. Industrial Robots, by Groover, McGraw Hill.
13. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.
14. Robots & Manufacturing Automation, by Asfahl, Wiley.

KOE092 COMPUTERIZED PROCESS CONTROL		
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	Basics of Computer-Aided Process Control: Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer–Aided Process Control System Computer Aided Process–control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.	08
II	Industrial communication System: Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System.	08
III	Process Modelling for computerized Process control: Process model, Physical model, Control Model, Process modelling. Modelling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation.	08
IV	Advanced Strategies For Computerised Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	08
V	Examples of Computerized Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant.	08

Text Books:

1. S. K. Singh, “Computer Aided Process control”, PHI.

Reference Books:

1. C. L. Smith, “Digital computer Process Control”, Ident Educational Publishers.
2. C. D. Johnson, “Process Control Instrumentation Technology”, PHI.
3. Krishan Kant, “Computer Based Industrial Control”
4. Pradeep B. Deshpande & Raymond H. Ash, “Element of Computer Process Control with Advance Control Applications”, Instrument Society of America, 1981.
5. C. M. Houpis & G. B. Lamond, “Digital Control System Theory”,McGraw Hill.

KOE093: DATA WAREHOUSING & DATA MINING		
	DETAILED SYLLABUS	**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Data Warehousing**: Overview, Definition, Data Warehousing Components, Building a Data Warehouse, Warehouse Database, Mapping the Data Warehouse to a Multiprocessor Architecture, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept.	08
II	**Data Warehouse Process and Technology:** Warehousing Strategy, Warehouse /management and Support Processes, Warehouse Planning and Implementation, Hardware and Operating Systems for Data Warehousing, Client/Server Computing Model & Data Warehousing. Parallel Processors & Cluster Systems, Distributed DBMS implementations, Warehousing Software, Warehouse Schema Design	08
III	**Data Mining**: Overview, Motivation, Definition & Functionalities, Data Processing, Form of Data Pre-processing, Data Cleaning: Missing Values, Noisy Data, (Binning, Clustering, Regression, Computer and Human inspection), Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Discretization and Concept hierarchy generation, Decision Tree	08
IV	**Classification:** Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms. **Clustering**: Introduction, Similarity and Distance Measures, Hierarchical and Partitional Algorithms. Hierarchical Clustering- CURE and Chameleon. Density Based Methods DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method – Statistical Approach, Association rules: Introduction, Large Item sets, Basic Algorithms, Parallel and Distributed Algorithms, Neural Network approach.	08
V	**Data Visualization and Overall Perspective**: Aggregation, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse. Warehousing applications and Recent Trends: Types of Warehousing Applications, Web Mining, Spatial Mining and Temporal Mining.	08

Suggested Readings:

1. Alex Berson, Stephen J. Smith "Data Warehousing, Data-Mining & OLAP", McGrawHil.
2. Mark Humphries, Michael W. Hawkins, Michelle C. Dy, "Data Warehousing: Architecture and Implementation", Pearson Education..
3. I. Singh, "Data Mining and Warehousing", Khanna Publishing House.
4. Margaret H. Dunham, S. Sridhar,"Data Mining:Introductory and Advanced Topics" Pearson Education.

KOE094: DIGITAL AND SOCIAL MEDIA MARKETING		
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	Introduction to Digital Marketing: The new digital world - trends that are driving shifts from traditional marketing practices to digital marketing practices, the modern digital consumer and new consumer's digital journey. Marketing strategies for the digital world-latest practices.	08
II	Social Media Marketing -Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post, Content Planning and writing. Introduction to Face book, Twitter, Google +, LinkedIn, YouTube, Instagram and Pinterest; their channel advertising and campaigns.	08
III	Acquiring & Engaging Users through Digital Channels: Understanding the relationship between content and branding and its impact on sales, search engine marketing, mobile marketing, video marketing, and social-media marketing. Marketing gamification, Online campaign management; using marketing analytic tools to segment, target and position; overview of search engine optimization (SEO).	08
IV	Designing Organization for Digital Success: Digital transformation, digital leadership principles, online P.R. and reputation management. ROI of digital strategies, how digital marketing is adding value to business, and evaluating cost effectiveness of digital strategies.	08
V	Digital Innovation and Trends: The contemporary digital revolution, digital transformation framework; security and privatization issues with digital marketing Understanding trends in digital marketing – Indian and global context, online communities and co-creation.	08

Text Books:

1. Moutsy Maiti: Internet Mareting, Oxford University Press India
2. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts
4. Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional.
5. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page.
6. Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)

KOE095 MODELING OF FIELD-EFFECT NANO DEVICES		
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	MOSFET scaling, short channel effects - channel engineering - source/drain engineering - high k dielectric - copper interconnects - strain engineering, SOI MOSFET, multigate transistors – single gate – double gate – triple gate – surround gate, quantum effects – volume inversion – mobility – threshold voltage – inter subband scattering, multigate technology – mobility – gate stack.	08
II	MOS Electrostatics – 1D – 2D MOS Electrostatics, MOSFET Current-Voltage Characteristics – CMOS Technology – Ultimate limits, double gate MOS system – gate voltage effect - semiconductor thickness effect – asymmetry effect – oxide thickness effect – electron tunnel current – two dimensional confinement, scattering – mobility.	08
III	Silicon nanowire MOSFETs – Evaluvation of I-V characteristics – The I-V characteristics for nondegenerate carrier statistics – The I-V characteristics for degenerate carrier statistics – Carbon nanotube – Band structure of carbon nanotube – Band structure of graphene – Physical structure of nanotube – Band structure of nanotube – Carbon nanotube FETs – Carbon nanotube MOSFETs – Schottky barrier carbon nanotube FETs – Electronic conduction in molecules – General model for ballistic nano transistors – MOSFETs with 0D, 1D, and 2D channels – Molecular transistors – Single electron charging – Single electron transistors.	08
IV	Radiation effects in SOI MOSFETs, total ionizing dose effects – single-gate SOI – multi-gate devices, single event effect, scaling effects.	08
V	Digital circuits – impact of device performance on digital circuits – leakage performance trade off – multi VT devices and circuits – SRAM design, analog circuit design – transconductance - intrinsic gain – flicker noise – self heating –band gap voltage reference – operational amplifier – comparator designs, mixed signal – successive approximation DAC, RF circuits.	08

Text Books:

1. J P Colinge, "FINFETs and other multi-gate transistors", Springer – Series on integrated circuits and systems, 2008
2. Mark Lundstrom, Jing Guo, "Nanoscale Transistors: Device Physics, Modeling and Simulation", Springer, 2006
3. M S Lundstorm, "Fundamentals of Carrier Transport", 2nd Ed., Cambridge University Press, Cambridge UK, 2000.

KOE096:MODELLING AND SIMULATION OF DYNAMIC SYSTEMS		
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	I**ntroduction to modeling and simulation:** Introduction to modeling, Examples of models, modeling of dynamic system, Introduction to simulation, MATLAB as a simulation tool, Bond graph modeling, causality, generation of system equations.	08
II	**Bond graph modeling of dynamic system:** Methods of drawing bond graph model- Mechanical systems & Electrical systems, some basic system models- Mechanical systems, Thermal systems, hydraulic systems, pneumatic systems and electrical systems.	08
III	**System models of combined systems:** Linearity and non linearity in systems combined rotary and translatory system, electro mechanical system, hydro- mechanical system.	08
IV	**Dynamic Response and System Transfer Function:** Dynamic response of 1^{st} order system and 2^{nd} order system, performance measures for 2^{nd} order system, system transfer function, transfer function of 1^{st} and 2^{nd} order system Block diagram algebra, signal flow diagram, state variable formulation, frequency response and bode plots.	08
V	**Simulation and simulation applications:** Simulation using SIMULINK, examples of simulation problems- simple and the compound pendulum, planner mechanisms, validation and verification of the simulation model, parameter estimation methods, system identifications, introduction to optimization.	08

Text Books:

1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2nd Edition. Academic press 2000.
2. Robert L. Woods, Kent L. Lawrence, “Modeling and simulation of dynamic systems”, Person, 1997.
3. Brown, Forbes T. “Engineering System Dynamics”, New York, NY: CRC, 2001. ISBN: 9780824706166.
4. Pratab.R " Getting started with MATLAB" Oxford university Press 2009.

KOE097: BIG DATA		
	DETAILED SYLLABUS	**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Big Data**: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.	**08**
II	**Hadoop:** History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System. **Map-Reduce:** Map-Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats, Map Reduce features, Real-world Map Reduce	**08**
III	**HDFS (Hadoop Distributed File System):** Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, how does HDFS store, read, and write files, Java interfaces to HDFS, command line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: Compression, serialization, Avro and file-based data structures. Hadoop Environment: Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, security in Hadoop, administering Hadoop, HDFS monitoring & maintenance, Hadoop benchmarks, Hadoop in the cloud	**08**
IV	**Hadoop Eco System and YARN:** Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features – Name Node high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN. **NoSQL** Databases: Introduction to NoSQL MongoDB: Introduction, data types, creating, updating and deleing documents, querying, introduction to indexing, capped collections **Spark**: Installing spark, spark applications, jobs, stages and tasks, Resilient Distributed Databases, anatomy of a Spark job run, Spark on YARN **SCALA:** Introduction, classes and objects, basic types and operators, built-in control structures, functions and closures, inheritance.	**08**
V	**Hadoop Eco System Frameworks**: Applications on Big Data using Pig, Hive and HBase **Pig** : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators, **Hive** - Apache Hive architecture and installation, Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions, sorting and aggregating, Map Reduce scripts, joins & subqueries. **HBase** – Hbase concepts, clients, example, Hbase vs RDBMS, advanced usage, schema design, advance indexing, Zookeeper – how it helps in monitoring a cluster, how to build applications with Zookeeper. IBM Big Data strategy, introduction to Infosphere, BigInsights and Big Sheets, introduction to Big SQL.	**08**

Suggested Readings:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
2. Big-Data Black Book, DT Editorial Services, Wiley.
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers and Techniques", Prentice Hall.

KOE098 HUMAN VALUES IN BAUDDHA AND JAIN DARSHAN

Catalogue Description: Bauddha and Jain Darshan form a part of the philosophy of Indian tradition. This course outlines the basic concepts and principles of these two philosophies and provides scope for further reading of the philosophies, so as to gain clarity about the human being, the existence and human participation i.e. human values expressing itself in human conduct.

It is to be kept in mind that Darshan means realization which calls for developing the capacity to see the reality in oneself directly. So, any study of Darshan shall help develop this capacity in the students through proper steps of practices and shall not just provide the information.

DETAILED SYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Bauddha and Jain Darshan and their Basics** Need to study Bauddha and Jain Darshan; the origin of the these philosophies, their basic principles and scope for further reading.	08
II	**Basic Principles of Bauddha Darshan** law of impermanence (changability); four noble truths; eightfold path; law of cause- action (*pratitya-samutpaad*) Definition of some salient words of Buddha Darshan – *nirvana, dhamma, tri- ratna(Buddha, Dharma and Sangh), pragya, karma, parmi, ashta-kalap, trishna, shad-ayatan, samvedana, vipassana, anitya, maitri, brham-vihaar, tathagata, arahant..*	08
III	**Purpose and Program for a Human Being based on Bauddha Darshan** The purpose and program of a human being living on the basis of it, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition. Purpose-freedom from suffering, *nirvana*; root of suffering- *vikaar – raga, dvesha* and *moha,* Progam – various steps of meditation for attaining knowledge; *shamath and vipassana; sheel- samadhi-pragya; practice of equanimity (samatva),* eightfold path(Ashtang Marg); combination of understanding and practice..	08
IV	**Basic Principles of Jain Darshan** Basic realities – description of nine elements in existence (*jeev, ajeev, bandh, punya, paap, aashrav, samvar, nirjara, moksha*), 6 dravya of lok – *dharma, adhrma, akash, kaal, pudgal, jeev*; tri-lakshan, various types of *pragya*, various stages of realisation; *samyak-gyan, samyak- darshan, samyak-charitra, syadvaad, anekantavaad, naya- nishchaya and vyavahar, karma- phal siddhanta* Definition of some salient words of Jain Darshan *–arhant, jin, tirthankara, panch- parameshthi, atma, pramaan, kaal, pudgal, paramanu, kashay, leshya..*	08
V	**Purpose and Program for a Human Being based on Jain Darshan** The purpose and program of a human being living on the basis of it, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition, possibility of finding solutions to present day problems in the light of it. Purpose (goal) - *moksha*, Program- following *mahavrat, anuvrat, 10 lakshan dharma; samyak darshan-gyan-charitra.* Commonality with Bauddha Darshan	08

T**ext Books:**

1. Chattejee, S.G. and Datta, D.M., "*An Introduction to Indian Philosophy*", University of Calcutta Press, 1960..

Reference Books:

1. "*Dhammapad*", Vipassana Research Institute, 2001.
2. Drukpa, G., "*Musings from the Heart"*, Drukpa Publications Private Ltd, 2018.
3. Jyot, *"Ek cheez milegi Wonderful"*, A Film Directed by Jyot Foundation, 2013.
4. Goenka, S.N., "The Discourse Summaries", Vipassana Research Institute, 1987.
5. Madhavacharya, "*Sarva-darshan Samgraha"*, Chaukhambha Vidya Bhavan, Varanasi, 1984.
6. Varni, J., "*Samansuttam"*, Sarva Seva Sangh Prakashan, Varanasi, 7th Edition, 2010.
7. https://www.youtube.com/watch?v=cz7QHNvNFfA&list=PLPJVlVRVmhc4Z01fD57jbzycm9I6W054x (English)
6. https://www.youtube.com/watch?v=r5bud1ybBDc&list=PLY9hraHvoLQLCkl7Z2DWKMgRAWU77bKFy (Hindi).

KOE099: HUMAN VALUES IN VEDIC DARŚANA		
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Vedic Darśana and Nyāya Darśana (Philosophy of Indian Logic and Reasoning)** Introduction to Vedic literature, need to study Vedic Darśana; its origin and subject matter. Introduction to Nyāya Darśana, 16 padārthas (pramāṇa, prameya, saṃśaya, prayojana, dṛṣṭānta, siddhānta, avayava, tarka, nirṇaya, vāda, jalpa, vitaṇḍā, hetuābhāsa, chala, jāti, nigrahasthāna) paṃcāvayava prakriyā (pratijñā, hetu, udāharaṇa, upanaya, nigamana).	09
II	**Vaiśeṣika Darśana (Philosophy of Matter)** Introduction to Vaiśeṣika Darśana, definition of Dharma, abhyudaya, niḥśreyasa; 6 padārthas (dravya, guṇa, karma, sāmānya, viśeśa, samavāya) – their definition, characteristics and relationship; nitya-anitya; cause-effect relationships; dṛṣṭa-adṛṣṭa karma phala; mindful dāna; śucitā-aśucitā; reasons of rāga-dveśa, avidyā, sukha-duḥkha, etc. and how to get rid of them.	07
III	**Sāṃkhya-Yoga Darśana (Philosophy of Spirituality)** Sāṃkhya Darśana- Puruṣārtha, the nature of Puruṣa and Prakṛti, 24 elements of Prakṛti, bondage and salvation (liberation), the principle of satkāryavāda, triguṇātmaka prakṛti.Yoga Darśana- the steps of Aṣṭāṃga yoga (yama, niyama, āsana, prāṇāyāma, pratyāhāra, dhāraṇā, dhyāna and samādhi) and the challenges in following them, afflictions (kleṣa)- avidyā, asmitā, rāga, dveṣa, abhiniveśa, different types of vṛttis (pramāṇa, viparyaya, vikalpa, nidrā, smṛti), the process of nirodha of vṛttis; maitri, karuṇā, muditā, upekṣā; description of yama, niyama, āsana and praṇayāma; kriyāyoga– tapa, svādhyāya and īśvara-praṇidhāna; different steps of samādhi, different types of saṃyama, vivekakhyāti, prajñā. **Vedanta Darshan** Vedanta Darshan- *Nature* of *Brahma* and *Prakriti*, Methods of *Upasana*; a*dhyasa*and s*anskar*; n*ature* of Atma, description of existence, principle of *karma-phala*, description o *pancha kosha*, different *nature* of *paramatma/brahma, Ishwar, Four qualifications (Sadhan chatushtay)*.	12
IV	**Upaniṣad and Vedanta Darśana (Philosophy of God)** Introduction to Upaniṣads and Vedanta Darśana; Īśopaniṣad – Idea of renouncement, Karma Yoga, balance of Vidyā-Avidyā and Prakṛti-Vikṛti; Tattirīyopaniṣad – Different names of the God and their meaning, parting message of Guru to the graduating student (Śikṣāvallī), Nature of Brahma and Prakṛti, Methods of Upāsanā; Nature of Ātmā, Description of existence, principle of karma-phala, description of paṃca kośa, nature of mukti , process and way to achieve it, antaḥkaraṇa-śuddhi, different characteristics of paramātmā/brahma, Īśvara, Four qualifications (Sādhana-catuṣṭaya)	08
V	***Purpose and Program for a Human Being based on the Vedic Darśana*** *The purpose and program of a human being living on the basis of the Vedic Darśana, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition. Vedic system of living in a society - the idea of vratas and varaṇa (freedom of choice with commitment), Varṇa System, Āśrama System, Paṃca Mahāyajṇa, 16 Saṃskāras, etc.*	06

Refertence Books:

1. Acharya Udayveer Shastri, Sankhya Darshanam (vidyodayaBhashyam), Govindram Hasanand.
2. Acharya Rajveer Shastri, Patanjal Yog Darśana Bhashyam, Arsha Sahitya Prachar Trust.
3. Acharya Udayveer Shastri, Brahma Sutra (Vedanta Darshanam), Govindram Hasanand.
4. Krishna, I. (2010) The SāṃkhyaKarika, BharatiyaVidyaPrakashan, 4th edition
5. Madhavacharya, Sarva-DarshanaSamgrah ChaukhambhaVidyabhavan,Varanasi.
6. Muller, F.M. (1928) The Six Systems of Indian Philosophy, London: Longmans Green and Co. Publication.
7. Maharaj O. () PatanjalYogpradeep, Geeta press Gorakhpur
8. Vachaspati M. Sankhyatatvakaumudi, Motilal Banarasi Das Publication.
9. Shreemad Bhagwat geeta
10. Shankaracharya, VivekChoodamani
11. Rajyoga, Swami Shivananda
12. The Nyāya Sutras of Gotama, Sinha, N. (Ed.). Motilal Banarsidass Publ. (1990).
13. Pandit Madanmohan Vidyasagar. Sanskar Samuchaya, Vijaykumar Govindram Hasanand. 1998
14. Vedic Vision: Ancient Insights Into Modern Life, Satyavrata Siddhantalankar, Vijay Krishn Lakhanpal, 1999
15. Sanskar Chandrika (Hindi), Dayananda Saraswati, and Satyavrata Siddhantalankar. Vijay Krishn Lakhanpal, (1990).
16. THE TAITTIRIYA Upanishad, Achari, Sri Rama Ramanuja. (2013).
17. Vedic religion: The Taittiriya-Upanishad with the commentaries of Sankaracharya Suresvaracharya and Sayana (Vidyarana). Sastri, A. Mahadeva.(2016).
18. Taittiriyopanishad Sankara Bhashya With Hindi Translation Gita Press 1936.
19. Gautama's Nyāyasūtras: With Vātsyāyana-Bhāṣya. Jha, Ganganatha, ed. Oriental Book Agency, 1939.
20. NyayaDarshnam, Acharya Udayveer Shastri, Vijaykumar Govindram Hasanand (2018)
21. VaisheeshikaDarshanam, Acharya Udayveer Shastri, Vijaykumar Govindram Hasanand (2017)
22. Chattejee, S.G. and Datta, D.M. (1960) An Introduction to Indian Philosophy,Calcutta: University of Calcutta Press.
23. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Asthana, G. P. Bagaria (2019 Second Revised Edition), Excel Books, New Delhi [ISBN 978-93-87034-47-1].
24. Class notes on "Human Values in Vedic Darśana" available on www.uhv.org.in
25. PPTs for "Human Values in Vedic Darśana" available on www.uhv.org.in