GOVERNMENT OF KARNATAKA

Proposed Curricular Framework for Under Graduate

Program in Universities of Karnataka State

In

Physics

Submitted to

Karnataka State Higher Education Council
Government of Karnataka
Bengaluru

Physics

Expert Committee Report
on
Undergraduate Programme

Members of the Committee:

Prof. S.M. Shivaprasad,	Chairperson Director,Karnataka State Higher Education Academy, Dharwad
Dr. M. A. Sridhar	University of Mysore, Mysuru
Dr. S. R. Inamdar ,	Karnatak University, Dharwad.
Dr. Ramakrishna Damle	Bangalore University, Bengaluru.
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Shri Rohini Kumar Hilli,	MSI Degree College, Kalaburgi
Dr. M. Narayana Bhat,	St. Aloysius College, Mangalore.
Shri L. S. Ramesh,	Karnataka State Higher Education Council

BOS Members as invitees

Dr. M.N. Kalasad,	Davangere University. Davangere
Prof. Narayan,	Mangalore University, Mangalore
Dr. L.R. Naik,	Karnatak University, Dharwad

Detailed Syllabus for Semester I & II

Course Content Semester – I

Course Title: Mechanics and Properties of Matter	Course Credits:4
Total Contact Hours: 60	Duration of ESA: 2 hours
Formative Assessment Marks:40	Summative Assessment Marks:60
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course, the student should be able to:

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

1. will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)
2. will learn about accuracy of measurement and sources of errors, importance of significant figures.
3. will know how g can be determined experimentally and derive satisfaction.
4. will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters.
5. will come to know how various elastic moduli can be determined.
6. will measure surface tension and viscosity and appreciate the methods adopted.
7. will get hands on experience of different equipment.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**
1. will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)	**x**	**x**				
2. will learn about accuracy of measurement and sources of errors, importance of significant figures.	**x**	**x**				
3. will know how g can be determined experimentally and derive satisfaction.	**x**					
4. will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters.	**x**					
5. will come to know how various elastic moduli can be determined.	**x**					
6. will measure surface tension and viscosity and appreciate the methods adopted.	**x**					
7. will get hands on experience of different equipment.	**x**					

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Content		Hrs
Unit - 1		
Chapter No. 1	**Topics** to be covered/taught/learnt: **Units and measurements:** System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae. Minimum deviation, errors.	
	Text Book : Units/sections to be Referred:	
Chapter No. 2	Topics to be Covered **Momentum and Energy**: Work and energy, Conservation of momentum (linear). Conservation of energy with examples. Motion of rockets.	
	Text Book : Units/sections to be Referred:	
Chapter No. 3	Topics to be Covered **Special Theory of Relativity:** Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	
	Text Book : Units/sections to be Referred:	
Topics for self study(If any)		
	Suggested Activities	
Activity No. 1	1. Activity: i). Students can measure diameters of small balls of different size and estimate their volumes. ii). Students can measure lengths of nails of different size. iii). Students can measure volume of a liquid iv). Students can measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Ask them to mention the precession of the measurement. v). students can estimate standard deviations wherever possible.	
	Reference : Weblink/Youtube/Book	
Activity No. 2	Activity: Students can try and understand conservation of energy in every day examples. For example: i) What happens in solar conservation panels ii) Pushing an object on the table it moves iii) Moving car hits a parked car causes parked car to move. In these cases, energy is conserved. How? Understand and verify if possible.	
	Reference : Weblink/Youtube/Book	

Unit - 2		
Chapter No. 4.	**Laws of Motion:** Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass.	
	Text Book : Units/sections to be Referred:	
Chapter No. 5.	Topics to be covered Topics to be covered **Dynamics of Rigid bodies**: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. moment of inertia: M I of a rectangular Lamina and solid cylinders. Flywheel, Theory of compound pendulum and determination of g.	
	Text Book : Units/sections to be Referred:	
Chapter No. 6.	Topics to be covered **Gravitation:** Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's laws (statements). Satellite in a circular orbit.	
	Text Book : Units/sections to be Referred:	
Topics for self study(If any)	**Chapter 7**: Geosynchronous orbits. Basic idea of global positioning system (GPS).	
	Suggested Activities	
Activity No. 3	Activity: Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m. Students by referring to websites, can construct and perform simple experiments to verify that MI α mr^2.	
	Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn	
Activity No. 4	Activity: Prepare suitable charts and give seminar talks in the class.	
	Reference : Weblink/Youtube/Book	

Unit - 3		
Chapter No. 8	Topics to be covered **Elasticity:** Hooke's law - Stress-strain diagram, elastic moduli-relation between elastic constants, Poisson's Ratio-expression for Poisson's ratio in terms of elastic constants. Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder. Torsional pendulum-Determination of rigidity modulus and moment of inertia - q, η and σ by Searle's method	
	Text Book : Units/sections to be Referred:	
Topics for self study(If any)		
	Suggested Activities	
Activity No. 5	Activity: Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material.	
	Reference : Weblink/Youtube/Book	
Activity No.6	Activity: Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	
	Reference : Weblink/Youtube/Book	

Unit - 4		
Chapter No. 9	Topics to be covered **Surface tension:** Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact.	
	Text Book : Units/sections to be Referred:	
Chapter No. 11	Topics to be covered: **Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method. Problems	
	Text Book : Units/sections to be Referred:	
Topics for self study(If any)	Capillarity determination of surface tension by drop weight method.	
	Suggested Activities	
Activity No.7	Activity: 1. Measure surface tension of water and other common liquids and compare and learn i) Why water has high ST? think of reasons. ii) Check whether ST is a function of temperature? You can do it by heating the water to different temperatures and measure ST. iii) Plot ST versus T and learn how it behaves. Mix some quantity of kerosene or any oil to water and measure ST. Check whether ST for the mixture is more or less than pure water. Think of reasons.	
	Reference : Weblink/Youtube/Book	
Activity No. 8	Activity: 2. Collect a set of different liquids and measure their viscosity. i) Find out whether sticky or non sticky liquids are most viscous. Think of reasons. ii) Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non-sticky liquid concentration. iii) Do the above experiment by mixing sticky liquid to the non sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid. Think why anyone should know viscosity of the liquid.	
	Reference : Weblink/Youtube/Book	

Text Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Mechanics by, New Eition	D. S. Mathur	S.Chand & Co.	2000
2	Mechancis and Relativity by 3rd Edition,	Vidwan Singh Soni,	PHI Learning Pvt. Ltd.	
3	Mechanics Berkeley Physics Course, Vol.1:	Charles Kittel, *et.al*.	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal & Subramanyam.		

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics. 9th Edn,	Resnick, Halliday & Walter,	Wiley	2010
2	Physics	Halliday and Resnick,		

List of Experiments to be performed in the Laboratory

1.	Determination of g using bar pendulum (L versus T and L versus LT^2 graphs)
2.	Determination of moment of inertia of a Fly Wheel.
3.	Determination of rigidity modulus using torsional pendulum
4.	Verification of parallel and perpendicular axis theorems.
5.	Determine the Young's Modulus of a wire by bar bending method
6.	Determination of elastic constants of a wire by Searle's method
7.	Young's modulus by Koenig's method
8.	Modulus of rigidity (twisting)
9.	Viscosity by Stake's method
10.	Radius of capillary tube by mercury pellet method
11.	Hook's law verification
12.	Surface tension by drop weight method
13.	Critical pressure for stream line flow

Reference Book for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B.Saraf	Vikas Publications	2013
2	A lab manual of Physics for undergraduate classes, 1st Edition,		Vikas Publications.	
3	BSc Practical Physics Revised Edition	CL Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd.	**2002**

Formative Assessment	
Assessment Occasion	**Marks**
End of Unit-1 (Activity)	10
End of Unit-2 (Test)	20
End of Unit-3 (Activity)	10
Total	40

Course Content

Semester – II

Course Title: Electricity and Magnetism	Course Credits: 4
Total Contact Hours: 60	Duration of ESA: 2 hours
Formative Assessment Marks:40	Summative Assessment Marks:60
Model Syllabus Authors:	

Course Outcomes (COs):

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

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

1. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.
2. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
3. Apply Gauss's law of electrostatics to solve a variety of problems.
4. Describe the magnetic field produced by magnetic dipoles and electric currents.
5. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
6. Describe how magnetism is produced and list examples where its effects are observed.
7. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.
8. Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**
i. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.	**x**	**x**				
ii. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.	**x**					
iii. Apply Gauss's law of electrostatics to solve a variety of problems.	**x**	**x**			**x**	

iv.	Describe the magnetic field produced by magnetic dipoles and electric currents.	**x**					
v.	Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.	**x**					
vi.	Describe how magnetism is produced and list examples where its effects are observed.	**x**				**x**	**x**
vii.	Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.	**x**	**x**			**x**	**x**
viii.	Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.	**x**	**x**			**x**	**x**

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Content		Hrs
Unit - 1		
Chapter No. 1	**Topics**to be covered/taught/learnt: Electric charge and field Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy)	
	Text Book : Units/sections to be Referred:	
Chapter No. 2	Topics to be Covered Gauss's law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii)an infinite flat sheet of charge).	
	Text Book : Units/sections to be Referred:	
Chapter No. 3	Topics to be Covered Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole.	
	Text Book : Units/sections to be Referred:	
Topics for self study(If any)		
	Suggested Activities	
Activity No. 1	Activity: 1. Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries. 2. A small project report on production of electricity as a source of energy: Different methods	
	Reference : Weblink/Youtube/Book	
Activity No. 2	Activity: 1. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire.	

	2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
	Reference : Weblink/Youtube/Book	
Unit - 2		
Chapter No. 4.	Topics to be covered Conductors in electrostatic field Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Guass's law.	
	Text Book : Units/sections to be Referred:	
Chapter No. 5.	Topics to be covered Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination. force on a moving charge.	
	Text Book : Units/sections to be Referred:	
Topics for self study(If any)	*Currents and voltage in combination of R, L and C circuits*	
	Suggested Activities	
Activity No. 3	Activity: 1. Learn about electrical appliances which work with AC and DC electricity 2. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic)	
	Reference : Weblink/Youtube/Book	
Activity No. 4	Activity: 1. Learn about power transmission: 3-phase electricity, voltage and phase 2. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? 3. Prepare a small project report on street lighting and types of electrical bulbs.	
	Reference : Weblink/Youtube/Book	
Unit - 3		

Chapter No.6	Topics to be covered Magnetism Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect. Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field.	
	Text Book : Units/sections to be Referred:	
Chapter No. 7	Topics to be covered Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits.	
	Text Book : Units/sections to be Referred:	
Topics for self study(If any)	Hall Effect	
	Suggested Activities	
Activity No. 5	Activity: 1. Prepare a small project report on street lighting and types of electrical bulbs. 2. Learn the measurement of electric current using tangent galvanometer.	
	Reference : Weblink/Youtube/Book	
Activity No.6	Activity: Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
	Reference : Weblink/Youtube/Book	
Unit - 4		
Chapter No. 8	Topics to be covered Electromagnetic waves Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.	
	Text Book : Units/sections to be Referred:	
Chapter No. 9	Topics to be covered: Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves.	

	Text Book : Units/sections to be Referred:	
Chapter No. 12	Topics to be covered:	
	Text Book : Units/sections to be Referred:	
Topics for self study(If any)	*B-H curves and its characteristics* *Ferrites*	
	Suggested Activities	
Activity No.7	Activity: 1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. 2. Learn the principle of working of a Gauss meter to measure magnetic field	
	Reference : Weblink/Youtube/Book	
Activity No. 8	Activity: 1. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years.	
	Reference : Weblink/Youtube/Book	

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics-Part-II,	David Halliday and Robert Resnick	Wiley Eastern Limited	2001
2	Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition	Edward M Purcell	Tata Mc Graw-Hill Publishing Company Ltd, New Delhi	2008

List of Experiments to be performed in the Laboratory

1.	Experiments on tracing of electric and magnetic flux lines for standard configuration
2.	Variation of electrical conductivity with temperature in (i) Metals (ii) Semiconductors
3.	Experiments using Ballistic galvanometer – (i) Determination of components of earth's magnetic field (ii) Determination of capacitance of a condenser (iii) Determination of high resistance by leakage
4.	Experiments on AC circuits (i) Charging and discharging of a capacitor(energy dissipated during charging and time constant measurements (ii) Series and parallel resonance circuits (LCR circuits) (iii) Impedance of series RC circuits- determination of frequency of AC (iv) Determination of self inductance of a coil

Formative Assessment	
Assessment Occasion	**Marks**
End of Unit-1 (Activity)	10
End of Unit-2 (Test)	20
End of Unit-3 (Activity)	10
Total	40

Some Examples of Activity Based Pedagogy:

Conducting activity based teaching-leaning experience for students empower students with several graduate attributes by addressing several Outcomes at different levels of the Cognitive Blooms Taxanomy of Learning: like Clarity of Concept, ability to apply knowledge, evaluate and analyse the results, while they are also learn through the Affective and Psycho-motor domains of Learning through self-learning, group dynamics and team work, communication and presentation skills, ethics, life-long learning, etc. These experiments must be ones that do not involve sophisticated instrumentation and should be able to be performed outside laboratories.

Example 1: Elastic Properties of Solids:

The most important concept of studying elastic properties of solids is the Hooke's Law, which defines the stress-strain relationship.

Class 1: Defining problems, forming groups and giving instructions:

- The students should be made into forced groups of 6 to 8 members, depending on the class strength, consisting of diverse kinds of students in cognition, cultural, sex, behaviour, etc.

- Different materials of varying elastic properties should be given to each group, and should be asked to plot a graph of stress-strain of these materials in 8-10 days.

- Give clear instructions and clarify doubts, but not giving the procedure for the experiments. Students should discuss among themselves and consult books and internet to identify the procedure to obtain the Stress-strain graph. They should use only house-hold items or other commonly available tools to perform all the experiments.

Class 2: Presentation and discussion by students (max 8-10 mins each)

- Each group will be asked to make a presentation of 2 power point slides, where the first one explains the process they went through to arrive at the results and the second one shows their measured graph and an ideal text book plots. This slide should also contain two or three explanations of why both the plots differ.
- The student who will make the presentation on behalf of the group will be randomly selected just before the presentations. This will ensure that all group members will be mutually train each other for the presentation.
- The teacher should give equal marks to each member of a group depending on the methods adopted and clarity of concepts and results obtained and ability to analyse.

The following Program Outcomes will be attained by the students in such an activity based learning:

P.O. 1 : Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

P.O. 3 : Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

P.O. 5 : Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
P.O. 6 : Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Example 2: Periodic and Non-Periodic Motions

Most important aspect of understanding this topic is to distinguish them with the amplitude versus distance and amplitude versus time plots.

Class 1: Defining problems and giving instructions

- Each student will be asked to list as many observations as possible, under the two types of motion as they observe in the external world (home, market, college, etc) in 8-10 days.
- The student will be asked to identify any one motion in each of the lists and plot graphs of amplitude versus distance and amplitude versus time for each of them in the 8-10 days.

Class 2: Peer evaluation by students and defending self

- Each student is asked to submit the lists of periodic and non-periodic motions observed in everyday life.
- Each student is also asked to submit the amplitude versus distance and amplitude versus time of one periodic motion and one non-periodic motion of his/her choice among his/her list.
- The submissions are randomly distributed among other students. Teacher now discusses the two types of motions in the lists of students and shows how the graphs will ideally look like.
- Now students are asked to evaluate and mark the submissions of other students they have with them and then the marked papers are returned to the respective students.
- Each student should be given an opportunity to question the marks he has got and each student who has given the marks should be able to defend his choice or marks.
- While observing the lists, marks obtained and the plots made, the teacher can assign marks to each student.

The following Program Outcomes will be attained by the students in such an activity based learning:

P.O. 1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
P.O. 4. Ethics: Apply the professional ethics and norms in respective discipline.
P.O. 6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Recommendations:

- Since studying Physics (choosing Physics as Discipline A) well inevitably involves having sufficient knowledge of Mathematics and Chemistry, the student should be able to choose these subjects either as Discipline B or as an Open Elective.

- Since the list of Open Electives that will be offered by the Physics departments being applied in nature and will be useful for Physics graduates, they should also be accessible for the students to choose (if their content is not covered in the syllabus of Physics as Discipline A).

- Some Open Electives should be multi-disciplinary and should be designed by 2 to 3 separate faculty (eg. Nanoscience and Nanotechnology)

- The SECs should be treated as 'Non-credit compulsory Courses', due the nature of the courses and to reduce the Credit load on students.

- Research should start in the VII semester itself, since it is difficult to do a meaningful project in only the 8th semester. This is especially important an opportunity for students to directly go for a Ph D program after the 4 year program.

- The suggests 70:30 ratio for summative and formative assessments, the syllabus for the core discipline must be proportionately reduced and the 30% internal assessment can be made for the following:
    - One 10% mid-semester test
    - Two 10% each Activity based tasks

- The Question Paper patterns should be left to the prerogative of the respective University to design as per their convenience.