AC-10-2-12
Item No.4.1

UNIVERSITY OF MUMBAI

Syllabus for the S.Y.B.Sc.
Program: B.Sc.
Course: AERONAUTICS
(MECHANICAL STREAM)

(Credit Based Semester and Grading System with effect from the academic year 2012–2013)

AERONAUTICS (MECHANICAL STREAM) Syllabus
Credit Based and Grading System
To be implemented from the Academic year 2012-2013

SEMESTER III

Course Code	UNIT	TOPICS	Credits	L / Week
USARM301	I	AIRFRAME & SYSTEMS	3	2
	II	LANDING GEAR, WHEEL BRAKES		2
USARM302	I	AIRCRAFT ELECTRICITY & ELECTRONICS	4	3
	II			2
USARM303	I	DIGITAL TECHNIQUES	3	2
	II	INSTRUMENTS		2
USARM304	I	THEORY OF FLIGHT AND FLIGHT CONTROLS	3	4
USARM305	I	AIRCRAFT ENGINE (PISTON)	3	2
	II	AIRCRAFT ENGINE (JET)		2
USARMP301	AIRFRAME & SYSTEMS, LANDING GEAR, WHEEL BRAKES		2	2
	AIRCRAFT ENGINE (PISTON /JET)			3
USARMP302	AIRCRAFT ELECTRICITY & ELECTRONICS		2	2
	DIGITAL TECHNIQUES & INSTRUMENTS			2

SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L / Week
USARM401	I	OXYGEN SYSTEM	3	3
	II	FIRE PROTECTION		2
USARM402	I	AIRCRAFT ELECTRICITY & ELECTRONICS	3	2
	II			3
USARM403	I	RADIO NAVIGATION	3	3
	II	INSTRUMENTS		2
USARM404	I	THEORY OF FLIGHT	3	2
	II	AIRCRAFT FLIGHT CONTROLS		2
USARM405	I	AIRCRAFT ENGINE (PISTON / JET)	3	3
	II			2
USARMP401	OXYGEN SYSTEM & FIRE PROTECTION		3	2
	THEORY OF FLIGHT & AIRCRAFT FLIGHT CONTROLS			1
	AIRCRAFT ENGINE (PISTON / JET)			2
USARMP402	AIRCRAFT ELECTRICITY & ELECTRONICS		2	2
	RADIO NAVIGATION & INSTRUMENTS			2

Course Code	Title	Credits
USARM301	**AIRFRAME & SYSTEMS, LANDING GEAR, WHEEL BRAKES**	**3 Credits (60 lectures)**
Unit I: Airframe & Systems – Loads/ stresses on structural members, load factor, Classification of Damage. Special tools for sheet metal repair, Metal working machines, making straight line bends, Laying out rivets, Installation and driving rivets, Rivet failure, Removal, Dimpling, Counter sinking, Permissible repairs, Window & Windshield repairs, Composite Material repairs, FRP/Honeycomb, Sandwich repairs.		**30 Lectures**
Unit II : Landing Gear, Wheel brakes – Construction of Landing Gear, retractable & non-retractable landing gears, Nose & tail gears, Construction of shock absorbers, Function & Maintenance of shock cords, Spring steel struts, Air Oil Oleo struts, Struts spring steel struts, Anti-skid assemblies, Shimmy dampers, Safety device & indications. Landing gear mechanisms, warning and safety devices, Operations, Landing gear brakes, Power brake systems, inspection after heavy landing and over weight landing.		**30 Lectures**
TEXT BOOKS – 1. Airframe and Power plant Mechanics Airframe Handbook (AC65 – 15A) (Ch – 1, 2, 3, 4, 5 & 9) – SHROFF PUBLISHER AND DISTRIBUTERS Pvt. Ltd.		

Course Code	Title	Credits
USARM302	**AIRCRAFT ELECTRICITY & ELECTRONICS**	**4 Credits (75 lectures)**
Unit I : DC Generators: theory & construction, type of DC generators, characteristics of DC generators, DC voltage regulators basic principle, type of regulators, RC relay, Differential RC relays, starter generators & its controls, maintenance of DC generators & RC relays, generator control unit functions, trouble shooting of generator system.		**40 Lectures**
Unit II : DC Motors – theory & construction, different type of DC motors, Characteristics of different type of DC motors, reversing the direction of rotation of DC motors, speed & torque characteristic of DC motors, Motor starters, inspection & maintenance of DC motors.		**35 Lectures**
TEXT BOOKS – 1. Aircraft Electricity and Electronics by EISMIN (Ch – 10) 2. Examples in Electrical Calculation by ADMIRALTY (BR158) (Ch – 13, 14, 15, 16, 17, 18, 19) 3. Electrical Technology by B.L.THERAJA (Ch – 21, 22, 23, 24, 25, 26)		

Course Code	Title	Credits
USARM303	**DIGITAL TECHNIQUES & INSTRUMENTS**	**3 Credits (60 lectures)**
Unit I : Digital Techniques – Basic Logic Gates – NOT, OR, AND, Universal Gates – NAND, NOR and OR Invert Gates, Positive and Negative Logic, Logic Families, Combinational Logic circuit, Sequential Logic Circuit, Application Of Combinational and Sequential Logic circuits, Troubleshooting Devices ; Number Systems – Binary, Octal, Hexadecimal, Conversions ; Codes – BCD, EBCDIC, ASCII, GRAY		**20 Lectures**
Unit II : Instruments – Altitude alerting system, Mach warning system, Mach / ASI, CADC, altitude module, Air speed module, True Air speed computation, pressure error correction. Gyroscope & property, limitation, errors, gyroscopic instruments, Erection system - mechanical & electrical, Fast erection system, errors due to acceleration & turning. Turn & bank indicator, turn coordinator. Heading indicating instrument, magnetic properties, Aircraft magnetism Deviation co-efficient & compass swinging. Synchronous data transmission system, Measurement of engine speed, Measurement of fuel - fuel quantity gauge, volumetric top off system, fuel flow measurement. Engine vibration monitoring system.		**40 Lectures**
TEXT BOOKS – 1. Digital Principles and Applications by DONALD P. LEACH, ALBERTPAUL MALVINO, GOUTAM SAHA (Ch – 1, 2, 3 & 5) – TATA McGRAW HILL COMPANIES 2. Aircraft Instrument by E.H.J PALLET (Ch – 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 &14) – STERLING BOOK HOUSE		

Course Code	Title	Credits
USARM304	**THEORY OF FLIGHT AND FLIGHT CONTROLS**	**3 Credits (60 lectures)**
Unit I : Performance of aircraft, take-off, climbing, Power curves – Propeller propulsion, horizontal flight, effect of changes of engine power, effect of altitude on power curves, Ceiling, effect of weight on performance, influence of Jet propulsion on performance. Acceleration, loads during turn, angle of bank, Aerobatics, Inverted maneuvers. Stability & control, Lateral, Longitudinal & directional stability, effect of wing shape, position & type on stability, Control of an airplane.		**60 Lectures**
TEXT BOOKS – 1. Mechanics of Flight (11^{th} Edition) by A.C.KARMODE (Ch – 1, 2, 3, 4, 5, 6, 7, 8, 9,10,11&12) – PEARSON EDUCATION Pvt. Ltd.		

Course Code	Title	Credits
USARM305	**AIRCRAFT ENGINE (PISTON / JET)**	**3 Credits (60 lectures)**
Unit I : Aircraft Engine (Piston) – General requirements for power-plant, Internal combustion engines, Cycles, Otto-cycle, Two stroke & four stroke, Classification of engines, Compression ratio, Reciprocating engine construction, Engine operating principles, Power, Calculations of power, Efficiency, Lubrication & Oil, Engine cooling & engine control systems. Fuel metering devices for engines, Fuel system requirements, Basic fuel system, Octane & performance ratings, Carburetor principles, Direct fuel injection system, Carburetor maintenance, Preservation & storage of fuel metering system components.		**25 Lectures**
Unit II : Aircraft Engine (Jet) – Factor determining blade creep Exhaust section cone. Thrust reversers effects, engine efficiency, Magnitude of reverse thrust produced, Engine noise suppressors, Noise patterns & methods of reducing noise level, Corrosivity. Contamination (Water & Dirt) Sampling. Turbine engine principles, Types of reaction engine, Constructional features, Major sub-assemblies, their functions, Cycles of operation, Efficiency, specific fuel consumption, Thrust reverses, noise suppression, Principles of propulsion, thrust distribution, Propulsive efficiency Bypass ratio & engine pressure ratio, Engine air inlet, Vortex destroyer jet engine fuel system, General outline, Diffusers, Compression Ratio, Airflow, Combustion Fuel/Air Ratio, Constructional properties and Turbine blade components for resistance to oxidation and corrosion, Lubricants and fuels Low volatility, Anti-foaming, Specification of turbine fuels, Properties of fuels, Safety requirements during ground handling, Effects of flammability.		**35 Lectures**
TEXT BOOKS – 1. Airframe and Power plant Mechanics Power plant Handbook (EA – AC65 – 12A) (Ch – 1, 2, 3, 5, 6 & 7) - SHROFF PUBLISHER AND DISTRIBUTERS Pvt. Ltd.		

Course Code	Title	Credits
USARMP 301	• **AIRFRAME & SYSTEMS, LANDING GEAR, WHEEL BRAKES** • **AIRCRAFT ENGINE (PISTON / JET)**	**2 Credits (75 lectures)**
Unit I: Airframe & Systems – Familiarization of Fuselage types ; Familiarization of Wing Structure ; Familiarization of Control Surfaces ; Familiarization of different types of Rivets, Bolts, Nuts, Washers ; Single Row Riveting and Double Row Riveting		**10 Lectures**
Unit II: Landing Gear, Wheel brakes – Familiarization of Main Landing Gears and different types of Shock Strut ; Familiarization of Brake System		**20 Lectures**
Unit III: Aircraft Engine (Piston) – Familiarization of Piston engine components : Crankcase, Crankshaft, Camshaft, Bearings, Connecting Rod, Piston, Piston Rings.		**20 Lectures**
UNIT IV: Aircraft Engine (Jet) – Familiarization of Propeller, Parts of Propeller, Types of Propeller, Types of Compressors: Axial, Centrifugal, Types of Combustion Chambers.		**25 Lectures**

Course Code	Title	Credits
USARMP 302	• **AIRCRAFT ELECTRICITY & ELECTRONICS** • **DIGITAL TECHNIQUES & INSTRUMENTS**	**2 Credits (60 lectures)**
Unit I: Identification and purpose of parts of a DC Generator ; Identification of a Series Shunt and Compound Wound Generator ; Dismantling and assembling and other common maintenance practices on a DC Generator – checking of antenna with growler, undercutting of Commutator, checking of carbon brushes ; Identification of different parts of a Carbon pile Voltage Regulator ; Identification of different parts of RC Relay and Differential RC Relay ; Identification of Starter Generator and Normal Generator ; Identification of different parts of Generator Control Unit (GCU)		**20 Lectures**
Unit II: Identification of different parts of a DC Generator and purpose of each by dismantling of a DC Motor ; Practical on reversing the direction of rotation of a DC Motor ; Practical on different type of DC Starters ; Dismantling and identification of different parts of a DC Starter Motor ; Maintenance practice on DC Motor – changing of brushes, undercutting of Commutator segments, etc.		**15 Lectures**
Unit III: Digital Techniques – To study the characteristics of operation of TTL inverters ; Study operation and characteristics of TTL NAND gate ; Study operation and characteristics of TTL NOR gate ; Construct a exclusive OR gate and study its operation ; Study the BJT switching circuit (direct coupled)		**10 Lectures**
Unit IV: Instruments – Disassembly, cleaning, inspection and assembly of Air Speed Indicator ; Disassembly, cleaning, inspection and assembly of Altimeter ; Showing properties of Gyro ; Disassembly, cleaning, inspection and assembly of Directional Gyro		**15 Lectures**

SCHEME OF EXAMINATION

Course Code	Title of the Course	Theory		Practical		Total	Duration	
		Written	Internal	Sem End	Internal		Written	Sem End
USARM 301	Airframe & Systems, Landing Gear, Wheel brakes	60	40	--	--	100	2 Hrs.	--
USARM 302	Aircraft Electricity & Electronics	60	40	--	--	100	2 Hrs.	--
USARM 303	Digital Techniques & Instruments	60	40	--	--	100	2 Hrs.	--
USARM 304	Theory of Flight and Flight controls	60	40	--	--	100	2 Hrs.	--
USARM 305	Aircraft Engine (Piston /Jet)	60	40	--	--	100	2 Hrs.	--
USARM P301	Airframe & Systems, Landing Gear, Wheel brakes	--	--	60	40	100	--	2 Hrs.
	Theory of Flight and Flight controls							
	Aircraft Engine (Piston /Jet)							
USARM P302	Aircraft Electricity & Electronics	--	--	60	40	100	--	2 Hrs.
	Digital Techniques & Instruments							
Total						**700**		

Course Code	Title	Credits
USARM401	**OXYGEN SYSTEM & FIRE PROTECTION**	**3 Credits (75 lectures)**
Unit I: Oxygen System – Oxygen system: Purpose of the system; Safety portable & fixed Oxygen systems; low pressure and high pressure oxygen system & components; Installation and replacement of Oxygen lines. General familiarization with provision of emergency equipment on modern aircraft such as Emergency exits; Emergency Lights; Megaphone; Signaling Flares; FDR & CVR; Fire Extinguishers.		**40 Lectures**
Unit II: Fire Protection – Fire extinction Principles, fire extinguisher mediums & their proper use, Fire warning devices, Thermal switches, Thermocouple system, continuous loop fire warning systems, spot detection, smoke detection, fire zones, Routine maintenance, inspection.		**35 Lectures**
TEXT BOOKS – 1. Airframe and Power plant Mechanics Airframe Handbook (AC65 – 15A) (Ch – 14 & 10) – SHROFF PUBLISHER AND DISTRIBUTERS Pvt. Ltd.		

Course Code	Title	Credits
USARM402	**AIRCRAFT ELECTRICITY & ELECTRONICS**	**3 Credits (75 lectures)**
Unit I : Alternators, Principle of AC generation, construction, Single & Poly phase alternators, DC Alternators, Transistorized voltage regulators, Brushless alternators, Permanent magnet brushless Alternators , Principle of operation of Constant Speed Drive Unit, Integrated Drive Generators ,Synchronizing of Alternators Static and Rotary Inverters ,A C generator system protection, GCU & BPCU.		**35 Lectures**
Unit II : Production of rotating magnetic field in the stator of an AC motor, AC Motor construction, 3-phase & single phase motors, Synchronous motors, Slip in an induction motor, capacitor action of over-exited synchronous motor, split phase capacitor start motors, shaded pole motors, universal motors, hysteresis motors, transformers, transformer on load, regulation of transformers, equivalent circuit of transformers, three phase transformers, auto transformers, transformer rectifier units, three phase transformer rectifier units, use of electrical diagrams, Maintenance of generators, motors & transformers.		**40 Lectures**
TEXT BOOKS – 1. Aircraft Electricity and Electronics by EISMIN (Ch – 9, 10 & 11) – STERLING BOOK HOUSE 2. Examples in Electrical Calculation by ADMIRALTY (BR158) (Ch – 20, 21, 22, 23, 24 & 25) – STANDARD PUBLISHERS DISTRIBUTORS 3. Electrical Technology by B.L.THERAJA (Ch – 32, 33 & 37) – S. CHAND AND COMPANY Ltd.		

Course Code	Title	Credits
USARM403	**RADIO NAVIGATION & INSTRUMENTS**	**3 Credits (75 lectures)**
Unit I : Radio Navigation – Radio Communication; Basic Principles; Receiver & Transmitters; Antenna; Microphone; Power supply; Interphone; HF and VHF systems; Installation of Units on aircraft; Inspection and checks on aircraft. Electronic Navigation equipment; Flux gate system; Automatic Direction finding system; Principles; equipment and Maintenance; visual omni-range and Instruments Landing systems; operating principles; components and functions operation of DME Doppler and Inertial Navigation systems.		**40 Lectures**
Unit II : Instruments – Principles of flight, Servomechanism & automatic control fundamentals, Sensing of attitude changes, Command signal detection, Command Signal Processing, Outer Loop Control, Conversion of command signal to Powered Control, Flight director & integrated flight control system, Automatic landing.		**35 Lectures**
TEXT BOOKS – 1. Aircraft Communications and Navigation Systems by MIKE TOOLEY AND DAVID WYATT (Ch – 1, 2, 3, 4, 5, 8, 11 & 15) – BUTTERWORTH-HEINEMANN 2. Aircraft Radio Systems by JAMES POWELL (Ch – 1, 2, 7 & 10) – STERLING BOOK HOUSE 3. Automatic Flight Controls (4th Edition) by E.H.J PALLET (Ch – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 & 11) – BLACKWELL PUBLISHING		

Course Code	Title	Credits
USARM404	**THEORY OF FLIGHT & AIRCRAFT FLIGHT CONTROLS**	**3 Credits (60 lectures)**
Unit I : Theory of Flight – Gliding & landing: Gliding angle, real & apparent effect of weight. Maneuvers: Acceleration, Pulling out of a dive, loads on turns, spin, side slip, maneuverability, stability & control, Test flight ,take off, climb, steep turn, maximum & minimum speed for level flight, Dutch Roll, Interface of Auto Pilot, components with flight controls.		**30 Lectures**
Unit II : Aircraft Flight controls – Operation of control surfaces, Power Boosted & Power Operated control systems, types of flaps, high speed and low speed ailerons, lockout mechanism, actuating jacks and ball screw devices, pneumatic and hydraulic drives. Boundary layer control using wing fences, Vortex generators, Aerodynamic balancing. Balancing tabs.		**30 Lectures**
TEXT BOOKS – 1. Mechanics of Flight (11th Edition) by A.C.KARMODE (Ch – 6, 8) – PEARSON EDUCATION Ltd.		

Course Code	Title	Credits
USARM405	**AIRCRAFT ENGINE (PISTON / JET)**	**3 Credits (75 lectures)**
Unit I : Piston engine Ignition systems, Battery ignition, Magneto Ignition system, Contact breaker & condensers, distributor assembly, E Gap position, Flux reversal in magneto, types polar inductor, high and low tension magnetos, internal timing and cold plugs gaps testing, ignition harness, analyzer auxiliary ignition units, vibrator and booster coil impulse coupling, LT, HT ignition Systems, ignition switches, components operation and details engine starting system.		**40 Lectures**
Unit II : Lubrication Systems; Basic requirements; Location and function of oil pumps; filters; Coolers; Oil Jets Scavenge systems; vent systems; Fuel control & metering system including starting control; acceleration; over-speed governing, power limiting, temperature limiting; shut down control; fuel control units; limiting devices; fault location and rectification in components of fuel controls systems and control adjustment. Engine Air/Bleed systems; Anti ice Control system, air turbine starters; pressure regulating & shutoff valves.		**35 Lectures**
TEXT BOOKS – 1. Airframe and Power plant Mechanics Power plant Handbook (EA – AC65 – 12A) (Ch – 3, 4, 5 & 6) - SHROFF PUBLISHER AND DISTRIBUTERS Pvt. Ltd.		

Course Code	Title	Credits
USARMP 401	• **OXYGEN SYSTEM & FIRE PROTECTION** • **THEORY OF FLIGHT & AIRCRAFT FLIGHT CONTROLS** • **AIRCRAFT ENGINE (PISTON / JET)**	**3 Credits (80 lectures)**
Unit I: Oxygen System – Draw PIE-CHART to indicate the percentage of oxygen and other gases in the atmosphere ; Show in an aircraft model the different sources of oxygen available on aircraft ; Procedure to charge the oxygen bottle with the use of high pressure regulator ; Locate and find the function of Emergency Lights, Megaphone, Signaling Flares, FDR & CVR, Fire Extinguishers.		**15 Lectures**
Unit II: Fire Protection – Show type and location of fire extinguishers on aircraft ; Make models of different types of fire detecting devices an aircraft - Thermal switches, Thermocouple, Smoke detectors, Continuous lop system.		**15 Lectures**
Unit III: Theory of Flight – Make a flying model of a glider and means to run it on ground and lift it up ; Make remote controls on the model to change the gliding angle, speed and altitude.		**10 Lectures**
UNIT IV: Flight controls – Fabricate different devices to operate the control surfaces viz. hydraulic actuators, ball and screw mechanism, pneumatic actuator ; Prepare an aircraft wing with wing fences, vortex generators & balancing tabs for control surfaces.		**10 Lectures**
UNIT V: Familiarization with different components of piston engine ignition systems ; Familiarization with different internal components of magnetos ; Familiarization with different components of low tension ignition system ; Familiarization of how ignition timing is set ; Familiarization with the use of ignition analyzer ; Familiarization with auxiliary ignition equipments such as booster coils, impulse starter etc ; Familiarization with ignition harness ; Familiarization with spark plugs, cleaning, gap adjustment ; Practical on installation/ connection disconnection of ignition harness to spark plugs .		**15 Lectures**
UNIT VI: Make basic board models showing working of various types of oil pumps viz. Gear type, Vane type, Ge-rotor type ; Disassemble, Clean, Inspect, test and install an oil filter ; Distinguish between cleanable and non – cleanable filter ; Locate and check the function of fuel system -deicing filter, fuel heater, main fuel pump, fuel control unit, fuel flow transmitter, F.C.O.C, P & D valve and Fuel Nozzles ; Prepare an aircraft model showing the anti-icing of various components of aircraft and the source of heat.		**15 Lectures**

Course Code	Title	Credits
USARMP 402	• **AIRCRAFT ELECTRICITY & ELECTRONICS** • **RADIO NAVIGATION & INSTRUMENTS**	**2 Credits (60 lectures)**
Unit I: Practical in single phase and poly phase ; Practical on dismantling of DC alternators and finding the location of the diodes in a DC alternator ; Practical on how a transistorized voltage regulator works ; Practical an identifying the parts of a transistorized voltage regulator ; Practical an identifying the parts and location of a rotary / Static inverters ; Practical on various types of protection circuits of AC generator system such as BPCU of GCU.		**15 Lectures**
Unit II: Practical on construction of A.C. Generator ; Practical explanation of principle on which the slip rings functions ; Practical on dismantling of an A.C. motor ; Identification of parts of A.C. Motor and re assembling the same ; Practical on the purpose of a capacitor in a single phase Induction motor ; Practical on reversing the direction of rotation ; Practical on shaded pole motors ; Practical on the construction of a transformer both single phase and three phase ; Checking the transformer for serviceability such as Input, Output and insulation etc ; Maintenance of A.C. Generators such as checking insulation, output voltage,bearing changing etc.		**15 Lectures**
Unit III: Radio Navigation – Study of operation of Microphone ; Study of full wave & Bridge rectifier power supply operation ; Familiarization of communication system VHF & its components & test ; Familiarization of HF system and its components & tests ; Familiarization of automatic direction finding system component & test ; Familiarization of ILS components & tests.		**15 Lectures**
Unit IV: Instruments – Practice of connecting primary control surfaces to control column through the linkages and their operation ; Operation of primary control surfaces as per Autopilot system.		**15 Lectures**

SCHEME OF EXAMINATION

Course Code	Title of the Course	Theory		Practical		Total	Duration	
		Written	Internal	Sem End	Internal		Written	Sem End
USARM 401	Oxygen System, Fire Protection.	60	40	--	--	100	2 Hrs.	--
USARM 402	Aircraft Electricity & Electronics	60	40	--	--	100	2 Hrs.	--
USARM 403	Radio Navigation & Instruments	60	40	--	--	100	2 Hrs.	--
USARM 404	Theory of Flight, Aircraft Flight Controls	60	40	--	--	100	2 Hrs.	--
USARM 405	Aircraft Engine (Piston /Jet)	60	40	--	--	100	2 Hrs.	--
USARM P41	Oxygen System, Fire Protection. Theory of Flight, Aircraft Flight Controls Aircraft Engine (Piston /Jet)	--	--	60	40	100	--	2 Hrs.
USARM P42	Aircraft Electricity & Electronics Radio Navigation & Instruments	--	--	60	40	100	--	2 Hrs.
TOTAL						**700**		