VIDYA ACADEMY OF SCIENCE AND TECHNOLOGY

TECHNICAL CAMPUS, KILIMANOOR

(A Unit of Vidya International Charitable Trust)

Accredited by NAAC with B++ Grade

7th Semester Mechanical Engineering(2019 Scheme)

QUESTION BANK

CODE MET 401	COURSE NAME: Design of Machine Elements-II	Credit: 4
Q.No	**Module I**	**Marks**
1	Distinguish between standards and codes	2 Marks
2	Explain notch sensitivity factor, q. What is the relationship between fatigue stress concentration factor and q.	2 Marks
3	Explain the procedure to determine the endurance limit of a material. Also plot the SN curve for steel and aluminium.	5 Marks
4	Draw the stress- strain behaviour of the following materials i) Ductile ii) brittle and iii) perfectly elastic-plastic	6 Marks
5	Explain maximum principal stress theory and max shear stress theory of failure	2 Marks
6	What is the fatigue stress concentration factor?	2 Marks
7	Explain the steps involved in the design process.	2 Marks
8	What is factor of safety? What are the factors affecting factor of safety?	4 Marks
9	What are the endurance strength modification factors?	3 Marks
10	Explain the effect of stress concentration on ductile and brittle materials under static and variable loading.	6 Marks
11	Explain impact factor.	2 Marks
12	How will you design a component made of steel subjected to variable load for a finite life?	4 Marks
13	What do you mean by preferred numbers? Explain with the help of an example	5 Marks
14	Define the term notch sensitivity. Establish the relationship between notch sensitivity and fatigue stress concentration factor.	5 Marks
15	Distinguish between ductile and brittle materials with the help of a stress-strain diagram?	5 Marks
16	What are the factors affecting the endurance strength?	3 Marks
17	Explain the procedure for the design of a component for finite life under varying amplitude loading?	4 Marks
18	Draw the engineering stress-strain diagram of mild steel and explain the salient points on it.	5 Marks
19	What is factor of safety? What are the factors to be considered in the selection of factor of safety (FoS)?	3 Marks
20	What is notch sensitivity factor and explaln its significance in the design under dynamic loadlng.	3 Marks
21	State and explain the theories of fallure (a) Rankine theory (b) von Mises theory and (c) Maximum shear stress theory. Plot the region of safety for each theory.	9 Marks
22	Explain Soderberg, Goodman and Gerber's crlteria for design under fatigue loading	6 Marks
23	Explain the BIS system for designation of steels based on its composition?	2 Marks
24	Define stress concentration. Give any three methods to reduce stress concentration caused by a notch on a flat plate.	7 Marks
25	Explain how the strength and stiffness factors of machine elements affect the design.	3 Marks
26	What are the steps in the design process?	5 Marks
27	Explain the following theories of failure: i) St. Venant's theory and ii) Rankine's theory	5 Marks

28	Define endurance limit and factor of safety.	5 Marks
29	The stresses acting at a critical point in a component are σxx=60MPa, σxy=30MPa, σxz=20MPa, σyy=40MPa, σzz=25MPa and σyz=20MPa. The component is made of steel having the following material properties. Ultimate strength in tension, σu=600MPa, yield strength in tension, σy= 400 MPa, yield strength in shear ,τy= 200 MPa and poisson's ratio,μ =0.3. Determine the factor of safety using all the five static failure theories.	13 Marks
30	A smooth cantilever beam of circular cross section made of hot rolled steelis subjected to an axial load which varies from 7 k N in tension to 5 k N in compression. It is also subjected to a transverse load at the free end which varies from +8 k N to – 6 k N.The length of the cantilever is 400 mm. The material properties are σu=500 MPa, σy= 300 MPa. Factor of safety may be taken as 2. Find the diameter of the beam for a reliability of 90 %.	13 Marks
31	A 50 mm diameter steel shaft with a 20 mm transverse hole is simultaneously subjected to a bending stress which varies from + 100 MPa to – 70 MPa. and a torsional stress which varies from + 80 MPa to -50 MPa. Find the factor of safety for infinite life assuming the following properties. Ultimate strength in tension 800MPa, Yield strength 550MPa. Surface correction factor = 0.85, size factor =0.85 and Notch sensitivity factor = 0.9. Use maximum distortion energy theory.	13 Marks
32	A carbon steel rod of circular cross section is subjected to a bending moment which varies from 300 Nm to 500 Nm and an axial load which varies from 6 kN to 9 kN .Determine the diameter of the rod for a factor of safety of 3.Take σu= 600 MPa, σy=400 MPa	11 Marks
33	A cantilever beam of square section supports an electric motor weighing 1000 N at a distance of 400 mm from the fixed end. If the allowable stress of beam material is 100 N/mm2, Determine section of beam.	5 Marks
34	A mild steel shaft is subjected to a 3500 N-m of bending moment at its critical point and transmits a torque of 2500 N-m. The shaft is made of steel having a yield stress of 230 MPa. Estimate the size of the shaft (FOS =2) based on following theories of failure 1. Maximum normal stress theory 2. Maximum shear stress theory 3. Distortion energy theory	10 Marks
35	A steel shaft is subjected to a torque that varies over a range of +/- 40%. Determine the diameter of the shaft if it transmits 14 kW at 225 rpm. The material has a ultimate tensile strength of 600 MPa and yield strength of 400 MPa. FOS =3.	8 Marks
36	A load of 9 kN is applied to the steel rod of 50 mm diameter as shown in Figure. If a torsional moment of 100 N-m is applied on it, Determine the maximum tensile stress and maximum shear stress.	10 Marks
37	A steel shaaft subjected to a torque that varies over a range of +40%. Determine the diameter of the shaft if it transmits 15 kW at 250 rpm. The material has an ultimate strength of 600 MPa and yield strength of 400 MPa. Take FoS 3.	9 Marks
38	A steel column having square cross section of 90 mm side carries a load of 120 kN at an eccentricity of 12 mm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the section.	6 Marks
39	Taking stress concentration into account find the maximum stress induced in a shaft when a tensile load of 15 kN is applied to a stepped shaft of diameters 50 mm and 20 mm with a fillet of radius of 5 mm.	3 Marks

40	A steel shaft is subjected to the following loads: the bending moment varying from -150 Nm to +400 Nm; The twisting moment varying from 70 Nm to 200 Nm and the axial force varying from -50 N to 150 N. Determine the dimension of the shaft using Von Mises Hencky theory. The frequency of variation of the loads is same as the shaft speed. The properties of the material of the shaft are yield strength = 400 MPa, endurance strength = 310 MPa, ultimate strength = 620 MPa. Take Kt = 1.85, Notch sensitivity factor (q) = 0.95, K a= 0.75, K b= 0.85, K c= 0.9 and Factor of Safety (n) = 2.	12 Marks
41	The bending stress in a machine part fluctuates between a tensile stress of 300MPa and compressive stress of 160 MPa. What should be the minimum ultimate tensile strength of this part to carry this fluctuation indefinitely according to (i) Goodman's formula (b) Soderberg relation and (c) Gerber relation? Take the yield point as 60% of ultimate tensile strength and Endurance limit as 50% of ultimate tensile strength and Factor of safety as 2.	12 Marks
42	Determine the normal and shear stresses induced at section AA when a load of 12 kN is applied at the center of the crank pin as shown in Fig. 1.	10 Marks
43	A machine element is subjected to the following stresses: σx = 60 MPa, σy = 45 MPa, τxy = 30 MPa. Find the factor of safety if the yield stress of the material is 353 MPa using the maximum principal stress theory and maximum shear stress theory.	10 Marks
44	Determine the safe load that can be carried by a bar of rectangular cross-section shown in Fig. 2 (all dimensions are in mm) limiting the maximum stress to 130 MPa. Take stress concentration into account.	10 Marks
45	How to ensure alignment of shaft before fixing coupling bolts in a flange couplings?	3 marks
46	What is critical speed of a shaft?	2 marks
47	Differentiate between torsional rigidity and lateral rigidity of shaft.	5 marks
48	Compare the strength and stiffness of a hollow shaft to that of a solid shaft if both are having same outside diameter	5 marks
49	What do you mean by critical speed of a shaft?	5 marks
50	A shaft is supported by two bearings 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of a belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulley is 1800 and μ=0.24. Determine the suitable diameter for a solid shaft .The allowable working stress is 63 MPa in tension and 42 MPa in shear for the material of the shaft. Assume that the torque on one pulley is equal to that on the other pulley.	15 marks
51	Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 rpm. The angle of lap of the belt is 1800 and the coefficient of friction between the belt and pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0. The allowable shear stress in the shaft may be taken as 35 MPa.	15 marks

52	A solid steel shaft of 500 mm long between bearings ‘A’ and ‘C’ and carrying a cast iron pulley at ‘B’ which is at 300 mm from the bearing ‘A’. The pulley is directly coupled to a 5 kW motor running at 750 rpm. The motor is located left side of the bearing ‘A’. The cast iron pulley is of 250 mm in diameter and weighing 100 N and is driving a machine shaft running below it. The belt from pulley to the machine is inclined 60o to the vertical. Determine the appropriate diameter of the shaft, assuming moderate shock conditions, the friction factor between the pulley and the belt as 0.3, factor of safety 4.0.	15 marks
53	A Shaft is supported by two bearings 600mm apart. it carries a pulley of diameter 500 mm; at 250 mm to the right of left bearing and another pulley of diametc 80 mm; at 130 mm to the right of the right bearing. The belt drive in the left pulley is vertically downward while that on the right pulley is horizontal. The permissible shear stress is not to exceed 42 MPa. The maximum tension in the smallerr pulley is not to exceed 5.5 kN. Find the diameter of the shaft. Coefficient of friction is 0.3 and angle of contact is 180°	15 marks
54	Design a uniform solid shaft supported on bearings (say A and B) 800 mm between centres. A 20° spur gear having 600 mm pitch diameter is located at C, 200 mm to the right of the left hand bearing A and a 700 mm diameter pulley is mounted at D, 250 mm to the left of the bearing B. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° wrap angle. The pulley also serves as flywheel and weighs 2 kN. The maximum belt tension is 3.5 kN and the tension ratio is 3:1. Take the yield stress for the material as 380 MPa and factor of safety as 2.	15 marks
55	A transmission shaft (C45) is mounted between two bearings as shown in the Fig. 5. It transmits power from pulley A to pulley B with diameters 200 mm and 300 mm respectively. The belt tensions during power transmission are as given in the figure. The pulleys are keyed to the shaft. Determine the shaft diameter (i) using ASME code assuming steady loads and (ii) on the basis of torsional rigidity if the permissible angle of twist between the pulleys is 0.50. Take G = 80 GPa.	20 marks
56	Design a connecting rod of I cross section for an IC engine running at 1800 rpm and developing a maximum pressure of 3.15 N/ mm2 . The diameter of the piston is 100 mm, mass of the reciprocating parts per cylinder is 2.25 kg, length of the connecting rod is 380 mm, stroke of the piston is 190 mm and compression ratio is 6:1. Take a factor of safety of 6 for the design. The maximum allowable bearing pressure at big end and the small end are respectively 10 N/mm2 and 15 N/mm2 . The density of material of the rod may be taken as 8000 kg/m3 and allowable stress in the bolts as 85 N/mm2 and in the cap as 80 N/mm2 .	16 marks
57	Design a connecting rod of a diesel engine for the following data. Cylinder bore = 85 mm Length of connecting rod = 350 mm Maximum gas pressure = 3 MPa Factor of safety against buckling failure = 5 (l/d) ratio for piston pin bearing = 1.5 (l/d) ratio for crank pin bearing = 1.25 Allowable bearing pressure for piston pin bearing = 13MPa Allowable bearing pressure for crank pin bearing 11 MPa. Length of stroke = 140 mm Mass of reciprocating parts = 1.5 kg Engine speed = 2000 rpm Thickness of bearing bush = 3 mm Material of cap = 40 C8 (S yt = 380 N/mm 2) Material of bolts=Alloy steel (S yt =450N/mm 2) Factor of safety for cap and bolts = 4 and 5 respectively Density of connecting rod = 7800 kg/m 3 .	20 marks

58	Design a connecting rod for an IC engine using the following data, Diameter of the piston= 140 mm, Stroke = 160 mm, Weight of reciprocating parts =3kg, Length of the connecting rod = 400 mm, Maximum speed = 2000 rpm, Maximum explosion pressure = 2.25MPa. Maximum allowable bearing pressure at small end and big end are 15 MPa and 10 MPa respectively. Assume the density of material as 8000 kg/m3 . Assume also the allowable stress in bolt and cap as 60 N/mm2	12 marks
59	Design a flat belt drive for a compressor running at 670 rpm, which is driven by a 25 kW, 1340 rpm motor. Space is available for a centre distance of 3 m. The belt is open type.	14 marks
60	Enumerate the various types of flat belt drives.	3 marks
61	What is the effect of centrifugal tension on power transmission by a belt drive?	3 marks
Q.No	**Module II**	**Marks**
1	What is the principle of operation of a centrifugal clutch? What are its applications?	3 marks
2	Differentiate between self locking and self energizing block brakes.	3 marks
3	What are the advantages and disadvantages of a band brake?	4 marks
4	A multi plate clutch having effective diameters 250 mm and 150 mm has to transmit 60 kW at 1200 rpm. The end thrust is 4.5 kN and coefficient of friction is 0.08. Calculate the number of disks assuming (i) uniform wear condition and (ii) uniform pressure condition.	12 marks
5	Determine the main dimensions of a cone clutch faced with leather to transmit 30 kW at 750 rpm from an electric motor to an air compressor. Assume an over load factor of 1.75. Due to possibility of contamination of lining, a low value of coefficient of friction 0.2 is recommended	12 marks
6	A simple band brake as shown in figure below is to be designed to absorb a power of 32 kW at a rated speed of 850 rpm. Assume $\mu = 0.25$. Determine, (i) The effort required to stop clockwise rotation of the brake drum, (ii) The effort required to stop counter clockwise rotation of the brake drum,(iii) The dimensions of the rectangular cross-section of the brake lever assuming its depth to be twice the width, and (iv) the dimensions of the cross-section of the band assuming its width to be ten times the thickness.	11 marks
7	Determine the main dimensions of a cone clutch faced with leather to transmit 30 kW at 750 rpm from an electric motor to an air compressor. Assume an over load factor of 1.75. Due to possibility of contamination of lining, a low value of coefficient of friction 0.2 is recommended.	12 marks
8	What is the principle of operation of a centrifugal clutch? What are its applications?	3 marks
9	A simple band brake as shown in figure below is to be designed to absorb a power of 32 kW at a rated speed of 850 rpm. Assume $\mu = 0.25$. Determine, (i) The effort required to stop clockwise rotation of the brake drum, (ii) The effort required to stop counter clockwise rotation of the brake drum,(iii) The dimensions of the rectangular cross-section of the brake lever assuming its depth to be twice the width, and (iv) the dimensions of the cross-section of the band assuming its width to be ten times the thickness	11 marks
10	What are the advantages and disadvantages of band brake?	4 marks
11	Determine the main dimensions of a cone clutch faced with leather to transmit 30 kW at 750 rpm from an electric motor to an air compressor. Assume an over load factor of 1.75. Due to possibility of contamination of lining, a low value of coefficient of friction 0.2 is recommended.	12 marks
12	What is the principle of operation of a centrifugal clutch? What are its applications?	3 marks

13	A multi plate disc clutch transmit5kW at 800rpm.The outer radius is limited to 70mm.Assume any suitable material and Design the clutch	10 marks
14	A single dry plate clutch is to be designed to transmit 8 kW at 1000 rpm. a) Find out the clutch dimensions assuming the ratio of the mean radius to the face width as 4.	15 marks
15	A multi plate disc clutch transmit 4kW at 1000rpm.The outer radius is limited to 65mm.Assume any suitable material and design the clutch.	10 marks
16	An automotive type internal expanding shoe is shown in the diagram. The face width of the friction lining is 60mm and the coefficient of fiction is 0.35.the maximum intensity of pressure is limited to 1.2 N/mm2..Assume angle θ=0. Calculate (1) the actuating force 'F' (2) The torque capacity of the brake	15 marks
Q.No	**Module-III**	**Marks**
1	Discuss the significance of bearing modulus in the design of journal bearing?	3 marks
2	With the help of neat sketches illustrate the working principle of hydrodynamic journal bearings.	3 marks
3	Enumerate any two advantages and disadvantages of rolling contact bearing over sliding ontact bearing.	3 marks
4	A bearing is to carry a radial load of 240 kgf and a thrust load of 130 kgf. The load imposes light shock. The desired 90 % life is 10 hrs per day for 5 years at 3000 rpm. (a) Select a deep groove ball bearing. (b) What is the probability of bearing surviving specified life?	12 marks
5	What is L10 and L50 life of ball bearing?	3 marks
6	A journal bearing for a steam turbine is required to support a radial load of 270 kgf. The shaft diameter at the bearing is 60 mm. The speed of rotation is 1800 rpm. Design the bearing. Design should clearly indicate requirement of artificial cooling.	12 marks
7	Discuss the significance of bearing modulus in the design of journal bearing?	3 marks
8	A single row deep groove ball bearing has a dynamic load capacity of 40210 N and operates on the work cycle consists of radial load of 2000 N at 1000 rpm for 25 % of the time, radial load of 5000 N at 1500 rpm for 50 % of time, and radial load of 3000 N at 700 rpm for the remaining 25 % of time. Calculate the expected life of the bearing in hours.	10 marks
9	Define static and dynamic load carrying capacity of ball bearing.	5 marks
10	A 360 0 hydrodynamic journal bearing operates at 1200 rpm and carries a load of 5.5 k N. The journal diameter is 55 mm and length is 55 mm. The bearing is lubricated with SAE 20 oil and the operating temperature of oil is 790C. Assume radial clearance as 0.025 mm and the attitude angle as 600 . Determine: (i) bearing pressure, (ii) Attitude, (iii) minimum film thickness, (iv) heat generated, (v) heat dissipated, if the ambient temperature is 250C, and (vi) amount of artificial cooling if necessary	15 marks
11	A 80 mm diameter full journal bearing support a radial load of 600N. The speed of the shaft = 1200rpm. Design the bearing.	10 marks
12	Design a ball bearing which is required to support a shaft of 70mm with a radial load of 8kN and a thrust load of 5kN. The rated life of the bearing is to be 1000hours, with inner ring rotating at 1000rpm.	15 marks
13	Design a steam turbine journal bearing with journal diameter 100mm and supports a load of 15kN. The operating speed is 1500rpm. Also calculate the amount of artificial cooling required, minimum oil film thickness and rise in temperature.	15 marks

14	An 80mm diameter full journal bearing supports a radial load of 600 kgf. The length of bearing is 80mm.The speed of the shaft is 600 rpm. The oil film thickness radial clearance is 0.170 mm. Design the bearing.	15 marks
15	A single row deep groove ball bearing is subjected to a radial force of 9kN and a thrust force of 3kN.the shaft rotates at 1400rpm.The expected life L 10h of the bearing is 18000h.The minimum acceptable dia of the shaft is 80mm. Design the bearing.	15 marks
16	A 90 mm diameter full journal bearing support a radial load of 700kgf. The length of the bearing= 90 mm.The speed of the shaft = 700rpm.The oil film thickness= 0.04mm.The radial clearance= 0.180 mm. Design the bearing	15 marks
Q.No	**Module-IV**	**Marks**
1	Design a spur gear drive required to transmit 15 kW at 800 rpm of the pinion. The speed ratio is 3.2:1. Use 20° full depth involute system. Check the gear pair for safe endurance strength and surface durability based on the calculation of dynamic load from Buckingham's equation.	15 marks
2	A helical gear speed reducer is to be designed. The rated power of the speed reducer is 75 kW at a pinion speed of 1200 rpm. The speed ratio is 3:1. For medium shock conditions and 24 hr operation, design the gear pair. The teeth are 20o full depth involute in the normal plane and helix angle is 30 o .	15 marks
3	A motor shaft rotating at 1440 rpm has to transmit 15 kW power to a low speed shaft running at 500 rpm. A 200 pressure angle full depth involute system of gear tooth is used. The pinion has 25 teeth. Both gear and pinion are made of cast iron having allowable static strength of 55 MPa. Design a suitable spur gear drive and check the design for dynamic load and wear.	15 marks
4	A helical gear speed reducer is to be designed. The rated power of the speed reducer is 75 kW at a pinion speed of 1200 rpm. The speed ratio is 3:1. For medium shock conditions and 24 hr operation, design the gear pair. The teeth are 20o full depth involute in the normal plane and helix angle is 30 o .	16 marks
5	Design a helical gearing to transmit 60 HP. The pinion runs at 6000 rpm. The speed ratio is 3. Check also the gear pair for safe endurance strength and surface durability based on the estimate of dynamic load from Buckingham's equation.	15 marks
6	A pair of helical gears with 23o helix angle is to transmit 12.5 kW at 1600 rpm of the pinion at a velocity ratio of 4:1. Both gears are to be made of hardened steel, with an allowable stress of 109.87 N/mm2 Use 20° involute system for the gear pair. Design the gear pair and check the design against safety also.	15 marks
7	A pair of 20o full depth involute bevel gears is used to connect two shafts at right angles having a velocity ratio 2.5: 1. The gear is made from cast steel and the pinion is from the forged steel. Pinion transmits 37.5 kW at 750 rpm. Design the gear drive and check the design for dynamic and wear loads.	16 marks
8	The vertical spindle of a drilling machine is to be driven by a pair of right angled bevel gears with 20° involute teeth. The speed reduction is 3:1. The drill requires a power of 15 HP at 500 rpm. A service factor of 1.15 may be taken and select suitable materials for gear and pinion. Design the gear pair and check its safety.	15 marks
9	A motor shaft rotating at 1440 rpm has to transmit 15 kW power to a low speed shaft running at 500 rpm. A 200 pressure angle full depth involute system of gear tooth is used. The pinion has 25 teeth. Both gear and pinion are made of cast iron having allowable static strength of 55 MPa. Design a suitable spur gear drive and check the design for dynamic load and wear.	20 marks
10	State and explain law of gearing with a neat sketch	7 marks
11	Give an account on different modes of failure of gear tooth	6 marks
12	Explain why dynamic factors need to be considered in the design of gears	8 marks

13	A pair of spur gear is required to transmit 18kW power. The input shaft rotates at 600rpm and the output shaft rotates at 160rpm. Design the spur gear.	15 marks
14	Design a helical gearing to transmit 60 HP. The pinion runs at 6000 rpm. The speed ratio is 3. Check also the gear pair for safe endurance strength and surface durability based on the estimate of dynamic load from Buckingham's equation.	20 marks
15	A pair of 20o full depth involute bevel gears is used to connect two shafts at right angles having a velocity ratio 2.5: 1. The gear is made from cast steel and the pinion is from the forged steel. Pinion transmits 37.5 kW at 750 rpm. Design the gear drive and check the design for dynamic and wear loads.	20 marks
16	A motor shaft rotating at 1440 rpm has to transmit 15 kW power to a low speed shaft running at 500 rpm. A 200 pressure angle full depth involute system of gear tooth is used. The pinion has 25 teeth. Both gear and pinion are made of cast iron having allowable static strength of 55 MPa. Design a suitable spur gear drive and check the design for dynamic load and wear.	16 marks
17	A helical gear speed reducer is to be designed. The rated power of the speed reducer is 75 kW at a pinion speed of 1200 rpm. The speed ratio is 3:1. For medium shock conditions and 24 hr operation, design the gear pair. The teeth are 20o full depth involute in the normal plane and helix angle is 30 o .	16 marks
18	Design a helical gearing to transmit 60 HP. The pinion runs at 6000 rpm. The speed ratio is 3. Check also the gear pair for safe endurance strength and surface durability based on the estimate of dynamic load from Buckingham's equation.	20 marks
19	Give an account on different modes of failure of gear tooth.	4 marks
20	Explain why dynamic factors need to be considered in the design of gears.	4 marks
Q.No	**Module V**	**Marks**
1	A pair of 20o full depth involute bevel gears is used to connect two shafts at right angles having a velocity ratio 2.5: 1. The gear is made from cast steel and the pinion is from the forged steel. Pinion transmits 37.5 kW at 750 rpm. Design the gear drive and check the design for dynamic and wear loads.	16 marks
2	Design a worm gear drive to transmit 20 HP from worm at 1440 rpm to the worm wheel that should be rotated at 200 rpm	10 marks
3	Design a worm gear drive to transmit 20 HP from worm at 1440 rpm to the worm wheel that should be rotated at 20+-rpm	10 marks
4	Design a worm gear drive to transmit 20 HP from worm at 1440 rpm to the worm wheel that should be rotated at 40+/-2%rpm.	10 marks
5	The vertical spindle of a drilling machine is to be driven by a pair of right angled bevel gears with 20° involute teeth. The speed reduction is 3:1. The drill requires a power of 15 HP at 500 rpm. A service factor of 1.15 may be taken and select suitable materials for gear and pinion. Design the gear pair and check its safety.	16 marks
6	A pair of 20o full depth involute bevel gears is used to connect two shafts at right angles having a velocity ratio 2.5: 1. The gear is made from cast steel and the pinion is from the forged steel. Pinion transmits 37.5 kW at 750 rpm. Design the gear drive and check the design for dynamic and wear loads.	15 marks
7	A pair of 20o full depth involute bevel gears is used to connect two shafts at right angles having a velocity ratio 2.5: 1. The gear is made from cast steel and the pinion is from the forged steel. Pinion transmits 37.5 kW at 750 rpm. Design the gear drive and check the design for dynamic and wear loads.	16 marks
8	Design a worm gear drive to transmit 20 HP from worm at 1440 rpm to the worm wheel that should be rotated at 40+/-rpm.	

9	A pair of straight bevel gears is required to transmit 14kW at 800rpm from the motor shaft to another shaft at 300rpm.The pinion has 26 teeth. The pressure angle is 20 ◦ .If the shaft axis are at right angles to each other. Design the gear. The gears are capable of withstanding static stress of 65MPa	16 marks
10	A pair of straight bevel gears is required to transmit 16kW at 1000rpm from the motor shaft to another shaft at 500rpm.The pinion has 26 teeth. The pressure angle is 20 ◦ .If the shaft axis are at right angles to each other. Design the gear. The gears are capable of withstanding static stress of 80MPa	15 marks
11	Draw the kinematic arrangement and ray diagram for a six speed gear box having output speed ranging from 400-1400 rpm.	10 marks
12	A pair of bevelgear is required to transmit 20kW power. The input shaft rotates at 700rpm and the output shaft rotates at 170rpm. Design the bevelgear.	10 marks
13	A pair of bevel gear is required to transmit 15kW at 2000rpm. The output shaft is running at 500rpm. The helix angle is 30˚. Design the pair of gears.	10 marks
14	A pair of worm gear is required to transmit 15kW power. The input shaft rotates at 600rpm and the output shaft rotates at 160rpm. Design the gear.	10 marks
15	Design a worm gear drive to transmit 30 HP from worm at 1600 rpm to the worm wheel that should be rotated at 60+/-rpm.	10 marks
16	Design a worm gear drive to transmit 50 HP from worm at 1800 rpm to the worm wheel that should be rotated at 350 rpm	10 marks
17	What are the applications of worm gear?	4 marks
18	Why worm gear arrangement is used for high speed reduction?	4 marks
19	Why worm gear arrangement is used in windshield wipers in automobiles?	4 marks
20	List out any four applications of bevel gears.	4 marks

Course Code:EET435	Course Name Renewable Energy Systems	Credits:3
1	Differentiate between flat plate collectors and solar concentrators.	3
2	Discuss advantages and limitations of conventional energy sources.	3
3	With the help of a block diagram explain the working of a hybrid OTEC.	3
4	List out the advantages and disadvantages of a tidal power plant.	3
5	Discuss the different types of wind turbine rotors used to extract wind power.	3
6	The Danish offshore wind farm has a name plate capacity of 209.3 MW. As of January 2017 it has produced 6416 GWh since its commissioning 7.3 years ago. Determine the capacity factor of above wind farm.	3
7	What are the factors that affect biogas generation	3
8	Discuss the process of biomass to ethanol conversion	3
9	What are the components of micro hydel power plant.	3
10	Enumerate the design and selection of different types of turbines used for small hydro plants	3
	Module 2	
1	With the aid of a neat diagram, explain the working of a central tower collector type solar thermal electric plant Define (i) Open Circuit Voltage (ii) Short circuit Current	14

	(iii) Fill factor and (iv) Efficiency of the solar cell Compare the components and working of a standalone and grid connected PV	
2	How energy resources are classified.	14
3	Compare conventional and non-conventional sources of energy resources	14
4	What are the site selection criteria for OTEC? Draw the block diagram and explain the working of Anderson cycle based OTEC system.	
5	Explain how biofouling affects efficiency of energy conversion and how can it be minimised? Explain the principle of operation of a tidal power plant. How it is classified?	
6	Draw the layout of a double basin tidal power plant and label all the components. Explain the function of each component	
	Module 3	
1	Prove that the maximum wind turbine output can be achieved when and are down-stream and up-stream wind velocity What is pitch control of wind turbine?	
2	Explain. Determine the power output of a wind turbine	

	whose blades are 12m in diameter and when the wind speed is 6m/s, the air density is about 1.2kg/maximum power coefficient of the wind turbine is 0.35.	
3	Explain the parts, their function and working of a wind power plant.	
4	What are the site selection criteria of a wind power plant?	
5	With a neat schematic diagram , explain the biomass gasification based electric power generation system	
6	Explain the how urban waste is converted into useful energy	
7	Compare the construction and performance of floating drum type and fixed dome type biogas plants with the help of neat sketches	
8	Explain the importance of biomass programme in India	
	Module 5	
1	Explain the operation of a phosphoric acid fuel cell with the help of a suitable diagram	14
2	What are the different methods used for the production	14

	and storage of hydrogen	
3	Draw the layout of a mini hydro project and explain its working	14
4	Describe the working and constructional features of PEM fuel cell	14

VIDYA ACADEMY OF SCIENCE AND TECHNOLOGY, TECHNICAL CAMPUS

QUESTION BANK

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MET473	AIR CONDITIONING AND REFRIGERATION	PEC	2	1	0	3

MODULE 1

1. What you mean by natural refrigeration and artificial refrigeration? Give two examples each.
2. With the support of schematic flow diagram and T-S diagram, explain the working of simple bootstrap aircraft refrigeration system
3. A refrigeration system working on Bell-Coleman cycle operates with a pressure ratio of 8 and lower pressure of I bar. The cold chamber exit temperature is 9.loC and expander inlet temperature is 29 °C . [f the expansion and compression follow polytropic process with n: 1.35, determine the COP
4. List the various applications of refrigeration
5. What is the Unit of Refrigeration?
6. Compare the COP of heat pump and a refrigerator with neat sketches
7. Explain aircraft refrigeration system in detail
8. Define COP and Relative COP
1. Sketch the T-s diagram of a bootstrap air refrigerating system.
1. A refrigeration system produces ice at a rate of 30kg/hr at -2°C from water at 25°C.etermine the refrigeration effect and tonnage of the system , find COP if the power input is 1.1KW.
1. A refrigeration system working on Bell-Coleman cycle operates with a pressure ratio of 8 and lower pressure of 1 bar. The cold chamber exit temperature is 9.1°C and expander inlet temperature is 29°C.If the expansion and compression follow polytropic process with n=1.35.Determine COP.
2. An aircraft refrigeration system has to handle a cabin load of 25 tonnes. The atmospheric temperature is 16°C.The atmospheric air is compressed to a pressure of 0.96 bar and temperature of 29°C due to ram action. The air is then further compressed in a compressor to 4.8 bar ,cooled in a heat exchanger to 66°C expanded in a turbine to 1 bar and supplied to cabin. The air leaves the cabin at a temperature of 26°C.The isentropic efficiencies of both compressor and turbine are 0.9.Calculate (a) mass of air circulated /min (b) Cp = 1.005KJ/KgK and $\gamma = 1.4$

MODULE 2

1. What are the methods used for liquefaction of gases
2. List the advantages of Vapour compression refrigeration system
3. What is p-h chart
4. What is subcooling or undercooling
5. What are the effect of sub cooling
6. Explain in detail about multi evaporative systems
7. Explain flash intercooling
8. Explain cascade system
9. Explain different vapor compression cycles
10. A vapor compression refrigerator works between the pressure limits of 60 bar and 25 bar. The working fluid is just dry at the end of compression and there is no under cooling of liquid before the expansion valve. Determine (a)COP (b) Capacity of the refrigerator if the rate off fluid flow is 5kg/min.

Pressure (bar)	Saturation temp (K)	Enthalpy (KJ/Kg)		Entropy (KJ/KgK)	
		Liquid	Vapour	Liquid	Vapour
60	295	151.96	293.29	.554	1.0322
25	261	56.32	322.58	.226	1.24

11. Find the theoretical COP for a CO2 machine working between the temperature range of 25°C and -5°C.The dryness fraction off CO2 gas during suction stroke is 0.6.

Temperature (°C)	Latent heat (KJ/Kg)	Liquid		Vapour	
		Enthalpy KJ/Kg	Entropy KJ/KgK	Enthalpy KJ/Kg	Entropy KJ/KgK
25	117.46	164.77	.5978	282.23	.9918
-5	248.76	72.57	.2862	321.33	1.21

12. Explain the effect of discharge pressure
13. Explain the 3 stage cascade refrigeration system

MODULE 3

1. Explain Vapour absorption systems
2. With the help of a neat sketch explain Steam jet refrigeration.
3. List the applications of steam jet refrigeration system
4. List the relative merits and demerits of steam jet refrigeration system
5. Explain Lithium Bromide water system.

6. Explain Electrolux system
7. Compare Electrolux system with vapour compression system.
8. Explain steam jet refrigeration system and list its merits and demerits
9. Derive the COP of ideal vapour absorption refrigeration system
10. In an aqua ammonia vapour absorption system of 10 TR capacity the vapours leaving the generators are 100 percent pure NH_3 saturated at 40°C.The evaporator,absorber,condenser and generator temperatures are -20°C,30°C,40°C and 70°C.At absorber exit the concentration of ammonia in solution is x=.38,h=22KJ/Kg.At generator exit x=.1 and h=695KJ/Kg. Determine the mass flow rate of ammonia in the evaporator, determine the heat rejection in absorber and condenser, heat added in generator and COP.

MODULE 4

1. Explain the various refrigeration system components
2. Explain the working of compressors and its classification
3. Explain the working of condensers,
4. Explain the working of expansion devices
5. Explain the working of evaporators and how heat is exchanged
6. Explain the working of Cooling towers and how they are classified
7. How refrigerant leakage can be detected and how it can be prevented
8. What do you meant by charging of refrigerant?
9. List the various Refrigerants and their properties,
10. Differentiate CFC, HCFC, HFC, HC refrigerants
11. What are Eco-friendly Refrigerants
12. Explain ODP
13. Explain GWP
14. How various refrigerants are selected for different applications
15. What is called charging of refrigerant? Point out minimum two ways to perform it
16. Explain different types of refrigerants available and their relative merits and demerits
17. Explain the working of Scroll compressor with the help of neat sketch?

MODULE 5

1 Explain dry, wet and dew point temperature
2 Differentiate between humidity, specific humidity, absolute humidity, relative humidity and degree of saturation
3 -What do you meant by sensible heating and cooling
4 Differentiate between humidifying and dehumidifying
5 Explain bypass factor
6 Air conditioning- applications,
7 Comfort air conditioning- factors affecting human comfort.
8 Differentiate between summer air conditioning and winter air conditioning
9 An Auditorium has seating capacity 800 people is to be maintained at 23°C DBTand50% RH. The outdoor conditions are 40°C DBT and 27°C WBT. The various loads in the office are: Solar heat gain 10KW, sensible heat gain per occupant 80W, Latent heat per occupant 70W, Lighting load 5KW, Sensible heating load from other sources 12KW, Infiltration load 0.3m3 /sec. Outdoor air and return air is mixed in the ratio of 1: 6 ,before cooling coil (processing unit) and then supplied to room. The supply temperature cannot be lower than 120C .find capacity of the plant required, mass flow rate of air
10 .An office for seating 30 occupants is to be maintained at 22°C DBTand55% RH. The outdoor conditions are 36°C DBT and 27°C WBT. The various loads In the office are: Solar heat gain 8500W, Sensible heat gain per occupant 83W, Latent heat gain per occupant 100W, Lighting load 2500W,Sensible heat load from other sources 12000W, infiltration load 15 cubic meter/minute .Assuming 40% fresh air and 60% of re-circulated air passing through the evaporator coil and ADP of the coil is 8 0C. Find capacity of the plant and mass flow rate of air
11 What is dew point temperature and represent it in the psychrometric chart?
12 Explain the working of thermostat in a refrigeration system.
13 Air at 32°C and 70% RH is cooled and dehumidified to the following conditions (1) 20°C and 70% RH (2) 22°C and 50% RH.If the flow rate of air is 600l/sec find the heat absorbed in KWW and moisture removed in g/s for the three conditions.
14 With the help off a neat sketch explain the working of year round refrigeration system
15 Describe the important factors to be considered while designing (1) cinema theatres (b) hospitals

MET413 ADVANCED METHODS IN NON DESTRUCTIVE TESTING

Module 1

1	How visual inspection helps in non-destructive testing?	3
2	Explain any three Visual aids used in visual inspection.	3
3	What are the different types of developers? Describe the properties of good liquid penetrant.	6
4	Describe the principle of liquid penetrant inspection.	3
5	Explain various methods of liquid penetrant inspection.	6
6	What is the use of field indicators in MPI?	3
7	With a simple sketch, explain any two magnetisation techniques used in magnetic particle inspection.	8
8	Explain the procedure of magnetic particle inspection of casting.	6
9	What are the applications of eddy current testing?	3
10	With sketches, explain eddy current inspection process.	8

Module 2

1	Describe the method of generating ultrasonic waves.	8
2	Explain the features of ultrasonic guided waves.	3
3	What is Snell's law of critical angle?	3
4	What is laser shearography?	3
5	Describe the features of Electro Magnetic Acoustic Transducer.	6
6	Describe a method of detecting kissing bonds in friction stir welds of aero structures.	6
7	Explain the concept of laser ultrasonics.	8
8	Explain various modes of display in ultrasonic testing.	6
9	Explain the principle of pulse echo method	6
10	Explain the advantages and disadvantages of contact testing	6
11	Explain the advantages and disadvantages of immersion testing	6
12	Describe about Fresnel and Fraunhofer effects	8

Module 3

1	Explain the radiography testing using Cobalt 60 isotopes.	3
2	Describe image quality indicators in Radiography testing.	3
3	Explain the principle of radiation.	3
4	How the quality of a good radiograph is assessed.	3
5	What is radiographic sensitivity?	3
6	What are the safety measures to be followed in radiography testing?	8
7	What is sensitometry? Discuss the importance of characteristics curves.	6
8	What is Real time radiography? Explain its advantages.	8
9	Explain the procedure of film processing in radiography testing.	6
10	Explain the principle of pulse echo method	3

11	Explain the principle of through transmission method	5
12	Explain the principle of through transmission method resonance method	3
13	What are the applications of Laser shearography	4

Module 4

1	Illustrate the procedure of phased array inspection.	4
2	Describe the techniques of Time of flight diffraction.	4
3	Explain the methods of structural health monitoring.	3
4	Explain the use of Synthetic aperture focussing technique.	3
5	What are the properties of X-rays?	3
6	What is neutron radiography?	3
7	Explain the principle of phased array techniques.	6
8	Describe the theory of time of flight diffraction (TOFD).	8
9	Explain the features of Flash radiography for material motion detection.	6
10	What are the applications of thermography testing?	8
11	Explain focal law	3
12	What is the difference between linear, sectorial, C scan	6

Module 5

1	Describe a technique for inspecting and monitoring the behaviour of equipment and materials performing under stress.	6
2	Suggest a suitable inspection method for detecting potential problems in energised electrical components.	8
3	Explain the advantages of digital radiography in medical application compared to conventional x-ray film radiography.	6
4	Describe the applications of Computed Tomography in industry	3
5	Differentiate between digital radiography and computed tomography	3
6	Describe the applications of thermography testing.	4
7	Explain the principle of acoustic emission inspection.	6
8	Explain any four types of leak testing.	8
9	Describe two methods of thermography testing.	6
10	Explain the industrial applications of computed tomography.	8
11	Explain the working principle of thermographic NDE	4
12	Explain about the active and passive methods used in thermographic NDE	8
13	Write a short note on heat sensitive paints	3

MCN 401 Industrial Safety Engineering

Question Bank

Module 1

1. Discuss the Risk Associated with Industrial Work
2. Safety at Work Increase Productivity of Industry: Justify
3. Explain role of Safety Education and training in Industry
4. Discuss the cost of accidents
5. What is personal protective equipment? Explain different PPE used for different purpose and an importance of PPE.
6. Explain the different types of industrial accidents and general steps to be taken for preventing the accidents in any industry. Also explain the procedure for accident reporting.
7. What is condition monitoring? Explain in brief methods for condition monitoring.
8. Explain following
   (1) Total productive maintenance
   (2) 4 E's of Safety

Module 2

1. Role of Industrial Psychology in Prevention of Accident
2. Discuss Measures for Maintenance Performance
3. Role of ESI Act for Industrial Safety: Discuss in brief
4. What are the Major chances of Equipment failure?
5. What is fire triangle? Explain the different classes of fire with symbols and extinguishers used for them. Draw any four symbols for possible fire hazards you have seen.
6. State the types of hazards and explain any three in detail with possible causes and remedial actions.
7. Highlight the characteristics of factory act and explain employee's safety provisions to be made in factory.

8. What is workman's compensation act and explain main features of the same? Also narrate the possible reasons for which compensation may not be given to employee.

Module 3

1. Explain maintenance function costs in
   (1) Chemical industry
   (2) Fertilizer industry.
2. What is the importance of lubrication? Explain various methods of lubrication.
3. How equipment life cycle is useful for deciding maintenance activities? Explain in detail.
4. Explain in detail about codes and regulations for worker's safety and health.
5. Discuss objective of Preventive Maintenance
6. Breakdown maintenance is reactive type maintenance: Discuss
7. Explain the possible steps and measures to be taken by factory management and Government with respect to industrial safety.
8. Define failure with respect to machine and enlist the methods of failure analysis. Also explain FMEA method.

Module 4

1. Explain in detail wear debris analysis.
2. What is total productive maintenance? Explain its main features and benefits of TPM.
3. Define: (i) Reliability (ii) Machine Availability (iii) Equipment Life Cycle (iv)Mean Time Between Failure (v) Maintainability (vi) Mean Time Down (vii) Mean Time to Repair.
4. Explain how sales and marketing directly affect equipment reliability
5. Noise and vibration is major challenge for Industrial Equipment, Explain the major steps to be consider while designing the equipment to minimize Noise and Vibration.
6. Recommend the suitable procedure for safety in inspection and testing

7. Explain hazards about manual material handling.
8. Describe the various factors affecting physiology of human beings on the basis of ergonomic principles.

Module 5

1. Explain the salient features of Indian Boiler Act and Electricity Act
2. Explain occupational diseases prevention.
3. What is the role of communication in safety? Explain how it is to be carried out to be effective
4. Explain the methodology of identifying, organizing and evaluating various Safety educations and training requirements for an industry
5. Explain the chief components of safety budget? What are the proposals that should go into safety budget?
6. Explain in detail the steps involved in safety audit.
7. List out the various safety documents and records sought during a safety audit.
8. What is the constitution and various functions of Safety Committee?
9. Discuss the objectives for safety, health and environment protection of the
10. company.

11. Discuss the objectives for safety, health and environment protection of the
12. company.
13. Discuss the objectives for safety, health and environment protection of the
14. company
15. Discuss the objectives for safety,

16. health and environment protection of the company